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Water and energy consumptions of dishwashers and washing machines:

An analysis of efficiencies to determine the possible need and options for a water efficiency label for wet white goods

Prepared for Defra
September 2008

Waterwise is an independent, not-for-profit, nongovernmental organisation focused on decreasing water consumption in the UK, and on building the evidence base for large-scale water efficiency. In England, we sit on the Environment Minister's Water Saving Group alongside the water industry and regulators. We also convene the Saving Water in Scotland network.

Our aim is to reverse the upward trend in how much water we all use at home and at work by 2010. We are developing a framework supported by a robust social, economic, and environmental evidence base to demonstrate the benefits of water efficiency.

To achieve our aims we work with water companies, governments, manufacturers, retailers, non-governmental organisations, regulators, academics, agricultural groups, businesses, domestic consumers, the media and all other stakeholders.

We conduct our own research and also undertake work as consultants.

Authorship

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Disclaimer

Effort has been made to ensure the accuracy of the content of this report, as well as the reliability of the analyses presented. Waterwise accept no liability for any actions taken on the basis of the contents of this report. Opinions expressed herein are not necessarily those of Waterwise.

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Executive Summary

The statistical analyses conducted as part of this study have revealed that,

- across the entire production stocks of dishwashers and washing machines, as energy rating increases it can be expected that water efficiency will increase as well;
- between energy ratings, there are significant differences in mean water use, with A-rated machines generally more water efficient than B-rated models; however, it must also be noted that some less energy efficient models do use less water than some more energy efficient models, even when adjusted for capacity;
- within a single energy rating, there exists a wide spread in water use among both dishwashers and washing machines; for example, for A-rated dishwashers with 12 place settings (the most common capacity) the water consumption varies between 8 and 19 litres per cycle;
- among those models rated best on energy, there are still several that perform less than production stock mean water efficiency; and,
- capacity and energy use do not alone or together completely explain the variation in water consumption: other variables also affect water consumption, which may include technological design, cycle programming, and trade-offs between less hot water / lower temperatures / more rinsing water.

Analyses show that energy efficiency ratings are *not* a suitable proxy for water efficiency information because of the variation in water consumption between and within energy ratings. These findings support a further detailed look at options for addressing the water consumption of washing machines and dishwashers, some of which are briefly examined in this report:

- extension of the BMA's Water Efficient Product Label;
- expansion of Energy Saving Recommended;
- development of the Waterwise Marque;
- promotion of the EU Flower Ecolabel;
- adjustments to the EU Energy Label, such as normalising consumption and or adding a water efficiency rating; and,
- introducing a new UK or EU voluntary or mandatory label.

It is recommended that a more detailed assessment of costs and benefits for these options is carried out.

Based on the findings from the statistical analyses and the brief examination of options, it is also recommended that the water consumption of dishwashers and washing machines be addressed, both in terms of technical efficiency and operational efficiency, to encourage good (not necessarily best) practice.

It is further recommended that a rinse performance requirement be introduced alongside any efforts to increase water efficiency so that acceptable performance of washing machines and dishwashers is maintained.

In addition, it is suggested that washer-dryers be examined in more detail once sufficient data on water consumption is available. Because these appliances use water in the drying

phase (as part of the condensation process) as well as in the washing phase, washer-dryers use significantly more water than separated washers and dryers. Therefore, there may be considerable scope to encourage greater water efficiency amongst these appliances.

Contents

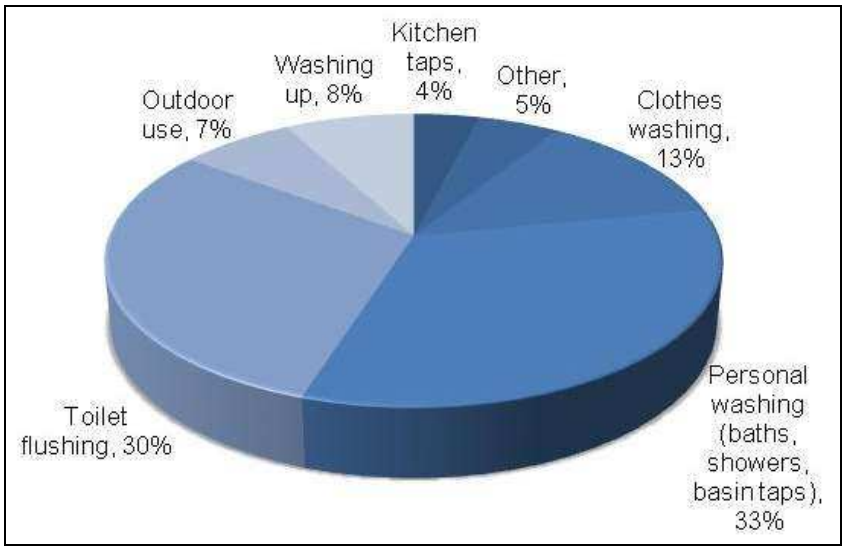
1. Background

At the UK[1] and EU[2] levels, concerns have recently been expressed over the future availability of freshwater. Despite the floods of 2007, the droughts of 2005 and 2006 are still remembered. The sustainability of some current water abstractions remain a real concern, particularly in light of predicted demographic, behavioural and climate changes.

While household water demand is currently around 150 litres per person per day in the UK, the Environment Agency predict that total household demand will increase by 12 percent over the next twenty-five years. Demand from agriculture and industry has shown an overall decrease; however, the growth in domestic demand has resulted in a net increase of water demand. Therefore, the past few years have seen an increased support for a twin-track approach in which water demand management is taken as seriously as the development of supply side measures.

Management of household demand has long been targeted at toilet flushing. Modern cisterns are now much smaller than they were ten years ago, and 4-litre single flush models can be purchased. Therefore, the slice attributed to toilets has been shrinking as a proportion of the total water demand pie. Other uses, however, have not decreased as significantly, with some uses actually increasing in volume, such as personal washing. The majority of an individual's water demand is still attributed to toilet flushing and personal washing, but clothes washing and washing up are also significant uses, together accounting for about 20 percent of household water use (figure 1).

FIGURE 1. Typical household consumption.[3]

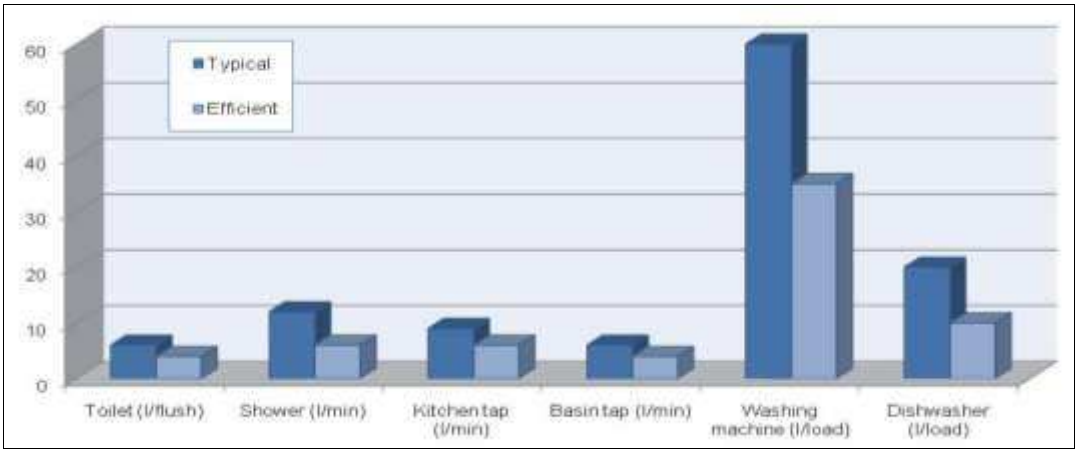


[1] "Areas of water stress: final classification", Environment Agency (2007): http://www.environment-agency.gov.uk.
[2] "Addressing the challenge of water scarcity and droughts in the European Union". European Commission Communication to the European Parliament and the Council (July 2007): http://ec.europa.eu/environment/water/quantity/scarcity_en.htm.
[3] Waterwise (2006): http://www.waterwise.org.uk/reducing_water_wastage_in_the_uk/house_and_garden/save_water_at_home.html.

2. Research questions and structure of report

It is generally accepted that individual demand can be reduced by utilising modern technology and encouraging behavioural changes. Waterwise estimate that water consumption in the home can be reduced by about one-third through retrofit and simple behavioural adjustments. The typical components of domestic demand that are found in homes often differ significantly from the consumption of best available components (figure 2).

FIGURE 2. Water consumption of typical versus water efficient products.[4]



Toilets have been targeted for a long while through retrofit programmes, the distribution of cistern displacement devices and the development of legislation; personal washing is beginning to be addressed through the promotion of water efficient showerheads and shower timers. In contrast, washing machines and dishwashers have received much less attention.

Therefore, this report will look at the water consumption of washing machines and dishwashers. Washer-driers are briefly addressed (section 5), but since Waterwise do not have access to a complete database of these appliances, an in-depth analysis was not undertaken.

This report first examines whether there is a need to address the water consumptions of washing machines and dishwashers, with particular examination of the relationship between energy efficiency and water efficiency. The report then considers options for addressing the water consumption of these appliances, focusing particularly on labelling.

The role of and successes/failures of labels in influencing consumer behaviour are not examined, as an extensive collection of literature exists on this topic, which is beyond the scope of this report.

The EU Energy Label is dealt with superficially. Praises and critiques of this label, particularly of test standards, have not been examined in-depth. Please refer to the work of the Market Transformation Programme for more information.[5]

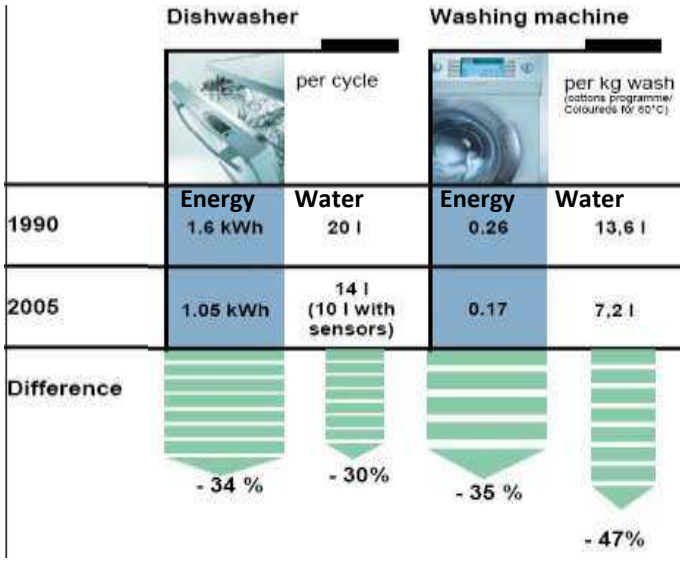
[4] Waterwise (2007).

Details of the databases used for analyses are presented in Appendix 2.

3. Present situation and trends

The water consumption of washing machines and dishwashers has decreased in recent years (figure 3). Dishwashers manufactured in 2005 used 30 percent less water than those made in 1990. The water consumption of front-loading washing machines has been reduced by 76 percent since 1970, from 30 litres per kilogram in 1970 to 13.6 l/kg in 1990 to 7.2 l/kg today.

FIGURE 3. Trends in energy and water consumption of Bosch und Siemens Hausgeräte appliances.[6]



The water and energy consumptions of washing machines and dishwashers were already decreasing before the introduction of the EU Energy Label; however, it is generally accepted that the EU Energy Label contributed to a steeper trendline toward greater energy efficiency. As energy use was driven down so, too, was water use - this relationship is explored in section 4.

3.1 Washing machines

Over 2,200,000 washing machines are sold in the UK every year. Sales are expected to increase along with the projected increase in the number of households. While penetration of washing machines has remained steady at about 80 percent of households, this percentage may decrease slightly as more people may move toward washer-driers (section

[5] See, for example, "BNW08 Energy and performance test methodologies for domestic washing machines and washer dryers" at http://www.mtprog.com/spm/download/document/id/585.
[6] Otto, Ruminy and Mrotzek, "Assessment of the environmental impact of household appliances", Appliance Magazine (April 2006): http://www.appliancemagazine.com.

5), which currently account for 15 percent of households.[7] On average, a clothes washing machine is replaced once every 12 years.[8]

The Waterwise database contains over 260 washing machine models that were available on the UK market in 2007, representative of over 25 brands (appendix 2.1). Wash capacities vary from 3 to 10 kilograms, with the most common loads being 5-6 kg.

Mean water consumption for 6 kg machines was 50.20 l/cycle (*SD*=4.93), with a mean water efficiency index[9] of 8.37 l/cycle/kg (*SD*=0.82).

Mean water consumption overall was 54.08 l/cycle (*SD*=8.28) with a mean water efficiency index of 8.44 l/cycle/kg (*SD*=1.15). Median water consumption was 53.00 l/cycle, and the median water efficiency index was 8.43 l/cycle/kg. Figures 4 and 5 illustrate the distributions of water consumption and efficiency in the 2007 Waterwise database.

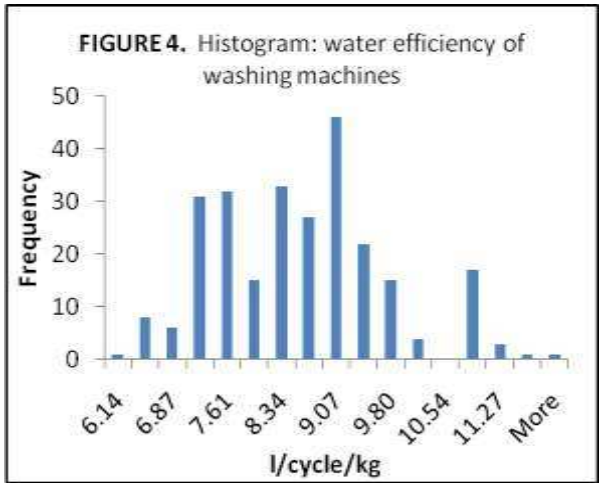


FIGURE 4. Histogram: water efficiency of washing machines

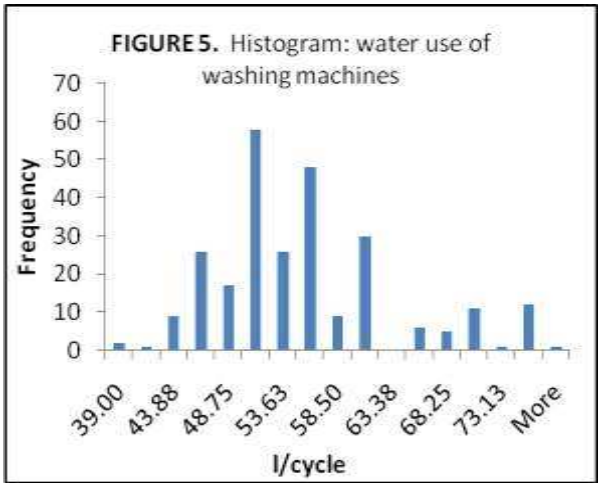


FIGURE 5. Histogram: water use of washing machines

The real water and energy impacts of washing machines are heavily dependent on users' behaviours (section 6).

3.2 Dishwashers

Around 600,000 dishwashers are sold in the UK every year; sales are expected to remain stable over the next few years. Only about 28 percent of UK households own a dishwasher, and penetration is not expected to increase significantly anytime soon. The penetration of dishwashers in the UK is well below that of other European nations; for example, 60 percent of households in Germany own a dishwasher. Reasons often cited for low penetration in the UK include the lack of space in homes, perceptions of high purchase and running costs,

[7] "BNW05: Assumptions underlying the energy projections for domestic washing machines", Market Transformation Programme (2008): http://www.mtprog.com.
[8] *Ibid*. Other sources indicate 9 years.
[9] The water efficiency index was obtained by dividing total water consumption per cycle by wash capacity, to obtain litres consumed per kilogram (or place setting) washed.

and the view amongst householders that they do not have enough dishes to wash to justify the purchase.[10] The typical lifespan of a dishwasher is approximately 16 years.[11]

The Waterwise database contains over 260 models of dishwashing machines that were available on the UK market in 2007, representative of about 30 brands. Wash capacities vary from 6 to 15 place settings (PS), with the most commonly occurring capacity being 12 PS.

Mean water consumption for 12 PS machines was 14.62 l/cycle (*SD*=2.28), with a mean water efficiency index of 1.22 l/cycle/PS (*SD*=0.18).

Overall, mean water consumption was 14.10 l/cycle (*SD*=2.11), with a mean water efficiency index of 1.22 l/cycle/PS (*SD*=0.21). Overall median water consumption was 14.00 l/cycle, and the median water efficiency index was 1.22 l/cycle/PS. Figures 8 and 9 illustrate the distributions of water consumption and water efficiency in the 2007 Waterwise database.

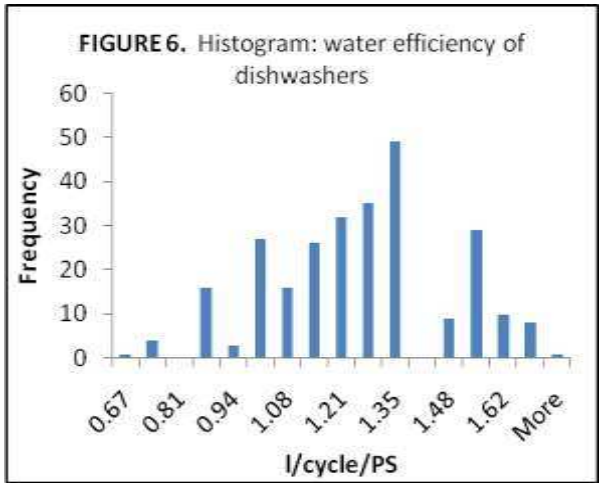


FIGURE 6. Histogram: water efficiency of dishwashers

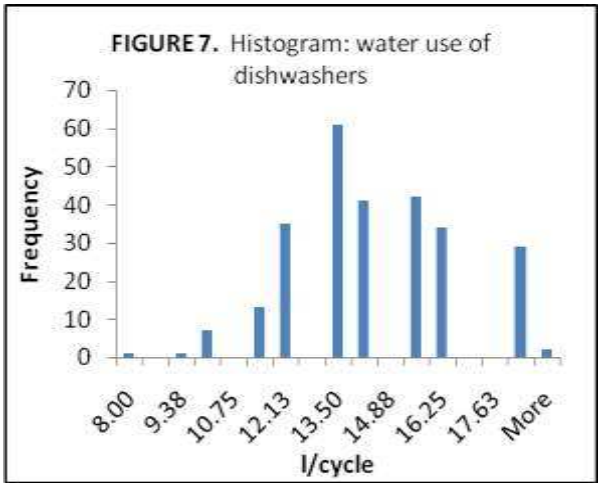


FIGURE 7. Histogram: water use of dishwashers

In general, the use of a dishwasher may be more water efficient than washing up by hand.[12] In practice, however, the water and energy impacts of washing up are heavily dependent on the individual users' behaviour. Section 6 further explores behaviour.

4. Water consumption and relationship to energy consumption

The statistical analyses conducted as part of this study have revealed that,

- across the entire production stocks of dishwashers and washing machines, as energy rating increases it can be expected that water efficiency will increase as well;
- between energy ratings, there are significant differences in mean water use, with A-rated machines generally more water efficient than B-rated models; however, it

[10] "BNW07: Assumptions underlying the energy projections for dishwashers", Market Transformation Programme (2008): http://www.mtprog.com.
[11] *Ibid*. Other sources cite 6 years.
[12] "BNW16: A comparison of manual washing-up with a domestic dishwasher", Market Transformation Programme (2008): http://www.mtprog.com.

must also be noted that some less energy efficient models do use less water than some more energy efficient models, even when adjusted for capacity;

- within a single energy rating, there exists a wide spread in water use among both dishwashers and washing machines; for example, for A-rated dishwashers with 12 place settings (the most common capacity) the water consumption varies between 8 and 19 litres per cycle;
- among those models rated best on energy, there are still several that perform less than production stock mean water efficiency; and,
- capacity and energy use do not alone or together completely explain the variation in water consumption: other variables also affect water consumption, which may include technological design, cycle programming, and trade-offs between less hot water / lower temperatures / more rinsing water.

The following sections detail findings for washing machines and dishwashers.

Note that the mandatory EU Energy Label only recognises A to G ratings. The A+ and A++ ratings used by some manufacturers have been created through a voluntary industry agreement and though they may be used in promotional materials they are not displayed on the EU Energy Label. Refer to section 7.2.2.2. for more information.

The statistical analyses used in this report take A+ and A++ manufacturer claims to be valid, in order to differentiate washing machines beyond the A level, with which the market is currently saturated.

4.1 Washing machines

Analysis of the 2007 Waterwise database of washing machines revealed that 43 percent of the variance in water use is explained by the variance in capacity (figure 8). It was also found that 46 percent of the variance in water use is explained by the variance in energy use (figure 9). These findings are both expected since larger volumes of clothing would require more water to clean effectively, and about 80 percent of a machine's energy consumption is attributed to the hot water wash phase.[13] Thus, water use is expected to increase as capacity increases, but is expected to decrease as energy use decreases.

[13] *Op cit*. 6.

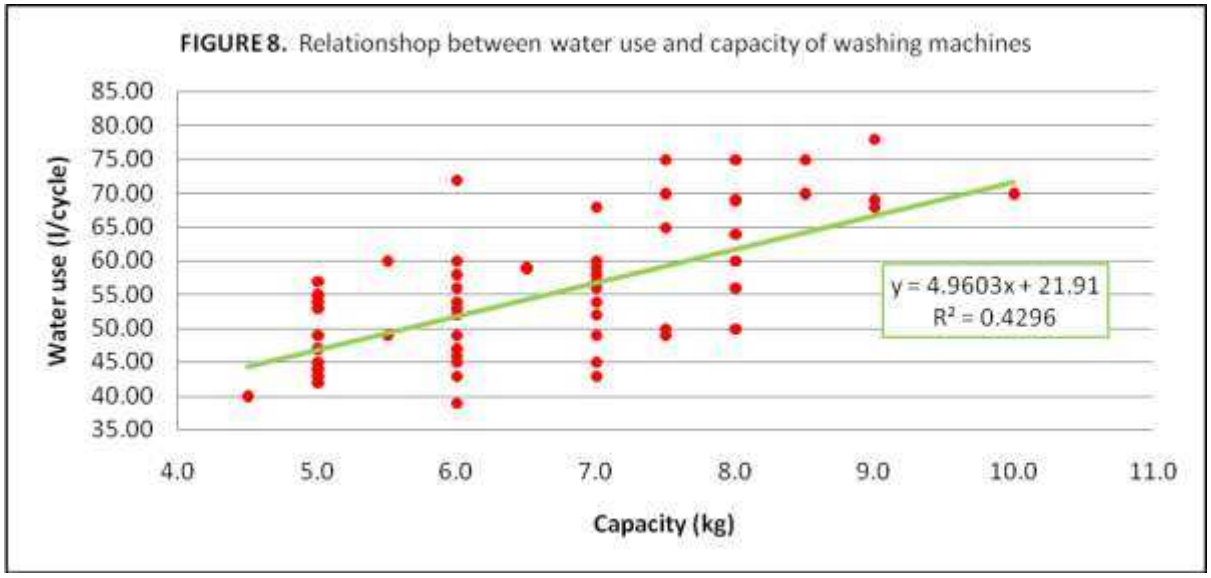


FIGURE 8. Relationshop between water use and capacity of washing machines

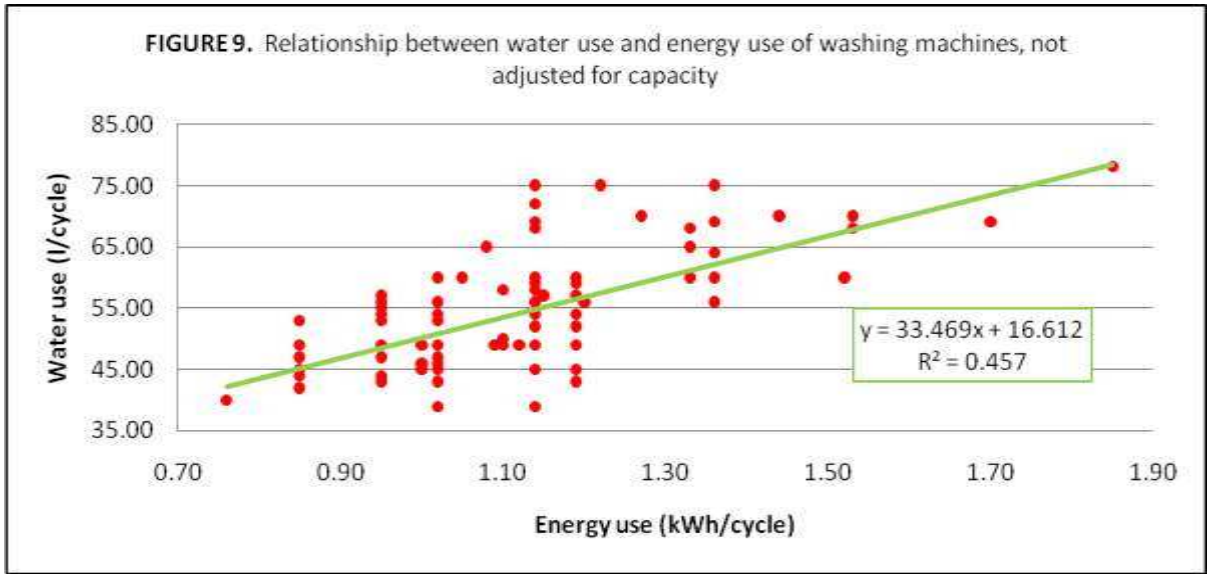


FIGURE 9. Relationship between water use and energy use of washing machines, not adjusted for capacity

When adjusted for capacity, 26 percent of the variation in water use is attributed to the variation in energy use (figure 10), suggesting that one or more other variables influence the water and energy efficiencies of washing machines. These may include technology, design, and programme duration; the precise source(s) of the unexplained variation was not examined.

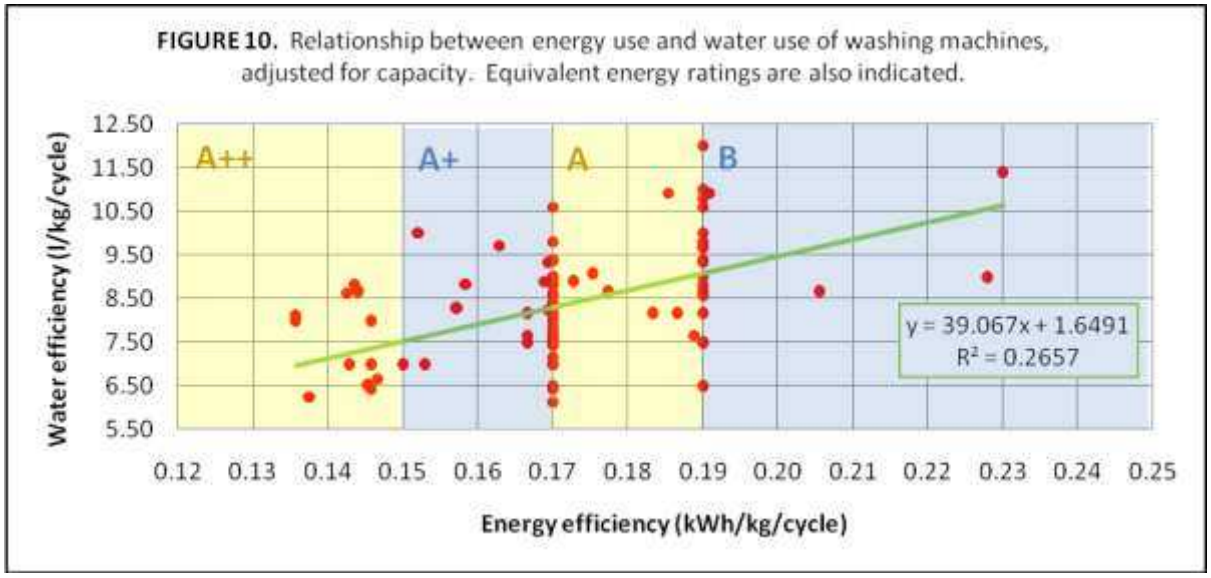


FIGURE 10. Relationship between energy use and water use of washing machines, adjusted for capacity. Equivalent energy ratings are also indicated.

A comparison of the relationship between water use and energy use amongst models with a capacity of 6 kg also revealed a wide spread in water consumption (figure 11). ANOVA ($F(3, 92) = 9.18$, $p < 0.01$) and Tukey's post hocs analyses revealed that the water use of those 6 kg machines with an energy consumption of 1.14 kWh/cycle (52.86 l, *SD* = 5.25) was significantly different from that of 6 kg machines that consume 1.02 kWh/cycle (48.16 l, *SD* = 3.73). Because the number of models in other energy consumption groups was low, comparisons were not possible. Water use varied even amongst those models of the same specific energy consumption.

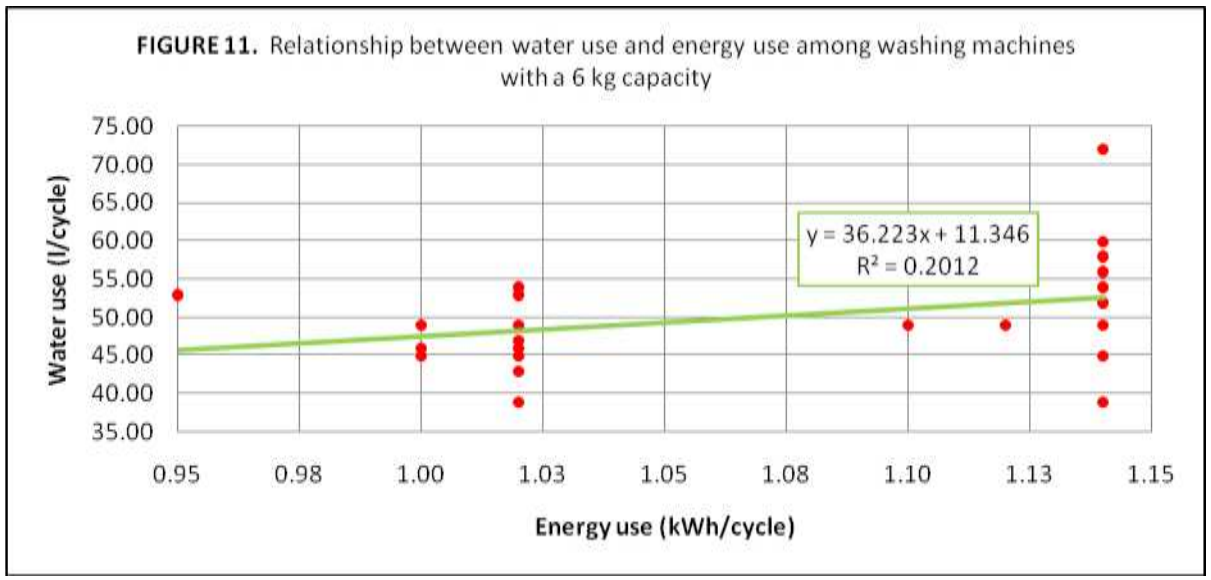


FIGURE 11. Relationship between water use and energy use among washing machines with a 6 kg capacity

It was found that as washing machines achieve better overall energy ratings, the overall water efficiency of the machines is also likely to improve.

There was a significant effect of energy rating on water efficiency (l/cycle/kg); $F(3, 258) = 20.39$, $p < 0.01$. Specifically, using Tukey's post hocs, the water use of A++ models (7.52 l/cycle/kg, *SD* = 0.16) was significantly ($p < 0.01$) lower than that of A+ (9.19, *SD* = 0.91), A (9.13, *SD* = 1.08) and B (9.69, *SD* = 1.49) models. The A+ models consumed significantly less

water than A models. B rated models, on the other hand, did not differ significantly from A or A+ rated models, but did differ from the A++ models. This discrepancy can be attributed to the low sample number (*n*=3) of B rated machines in the 2007 Waterwise database. Results of the analyses follow:

Descriptives - Water Use (l/kg/cycle)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
B	3	9.6900	1.49007	.86029	5.9885	13.3915	8.67	11.40
A	94	9.1281	1.08459	.11187	8.9059	9.3502	6.50	12.00
A+	126	8.1870	.90797	.08089	8.0269	8.3471	6.14	10.60
A++	39	7.5177	1.01315	.16223	7.1893	7.8461	6.25	10.00
Total	262	8.4422	1.15193	.07117	8.3021	8.5823	6.14	12.00

Test of Homogeneity of Variances - Water Use (l/kg/cycle)

Levene Statistic	df1	df2	Sig.
1.321	3	258	.268

ANOVA - Water Use (l/kg/cycle)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	90.433	3	30.144	30.392	.000
Within Groups	255.898	258	.992		
Total	346.331	261			

Post Hoc Tests - Multiple Comparisons - Dependent Variable: Water Use (l/kg/cycle) - Tukey HSD

(I) Equivalent Energy Rating	(J) Equivalent Energy Rating	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
B	**A**	.56191	.58410	.771	-.9485	2.0723
	A+	1.50302	.58180	.050	-.0014	3.0075
	A++	2.17231(*)	.59670	.002	.6293	3.7153
A	**B**	-.56191	.58410	.771	-2.0723	.9485
	A+	.94110(*)	.13573	.000	.5901	1.2921
	A++	1.61039(*)	.18969	.000	1.1199	2.1009
A+	**B**	-1.50302	.58180	.050	-3.0075	.0014
	A	-.94110(*)	.13573	.000	-1.2921	-.5901
	A++	.66929(*)	.18249	.002	.1974	1.1412
A++	**B**	-2.17231(*)	.59670	.002	-3.7153	-.6293
	A	-1.61039(*)	.18969	.000	-2.1009	-1.1199
	A+	-.66929(*)	.18249	.002	-1.1412	-.1974

* The mean difference is significant at the .05 level.

Homogeneous Subsets - Water Use (k/l/cycle) - Tukey HSD

Equivalent Energy Rating	N	Subset for alpha = .05		
		1	2	3
A++	39	7.5177		
A+	126	8.1870	8.1870	
A	94		9.1281	9.1281

B	3			9.6900
Sig.		.411	.133	.565

Means for groups in homogeneous subsets are displayed.
a Uses Harmonic Mean Sample Size = 10.595.
b The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

There is an unusual clustering of machines at the boundaries of energy ratings (figure 10). This clustering may demonstrate the influential role that the EU Energy Labelling scheme has had on machine design, encouraging manufacturers to design in order to meet the next better energy rating. Given the high tolerance that is allowed by test standards for the EU Energy Label, the clustering may also be indicative of a need to tighten testing standards and enforcement. [14,15]

It is also important to note the wide spread in water efficiency amongst models of the same energy efficiency (figure 10). This spread cannot be explained by differences in capacity or in energy use alone; other variables must also be influencing water consumption.

One of the simplest ways to reduce energy use is to alter the hot water wash phase, which accounts for the majority of a machine's energy consumption, either by reducing the amount of hot water used or by reducing the temperature of the hot water. Both these options may result in an increase in overall net water use, as more water may be needed in the pre-wash or rinsing phases. These trade-offs may explain some of the variation in water use among models with the same capacity and energy use. Other likely variables affecting water use may be technological design and cycle programming.

Testing of five Energy Saving Recommended washing machines revealed that two models used more water on the 40°C cycle than on the 60°C cycle, and that the other three models used about the same amount of water regardless of cycle temperature.[16]

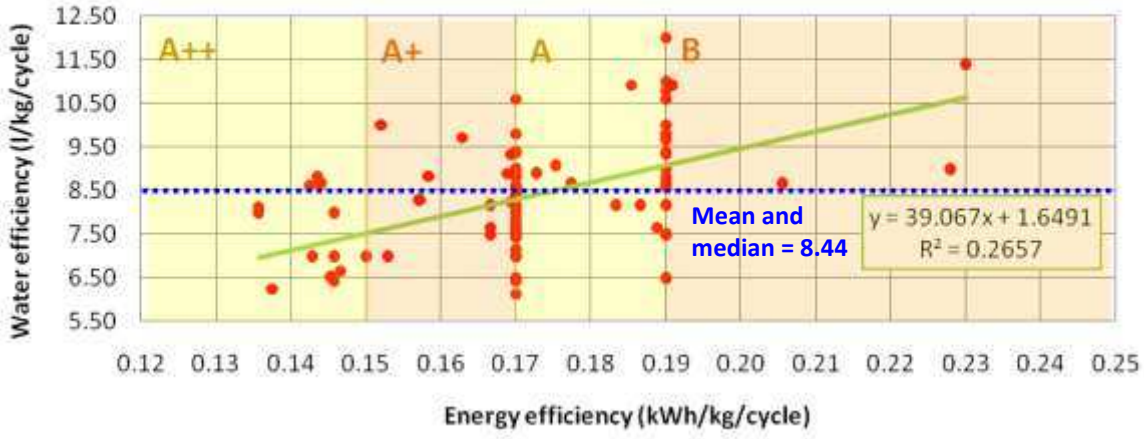
Several variables influence the consumption of washing machines. Since energy use is of more interest to manufacturers because of the mandatory EU Energy Label, the effects of these options on water use may not necessarily factor into the production of a washing machine: the wide spread in water use amongst washing machines of the same capacity and specific energy consumption demonstrates this unintentional effect. Some manufacturers may be increasing cold water use in order to make up for the decrease in hot water use, thus meeting energy efficiency requirements at the expense of water efficiency.

Furthermore, the analyses of washing machines reveal that the most energy efficient models are not always the best in terms of water efficiency. Organisations providing advice to consumers wishing to buy a water efficient washing machine often advise that an energy efficient model will likely be water efficient. This is true: an A++ or A+ model chosen at random is likely to be better than an A- or B-rated model; however, even amongst the A++

[14] There is a 15 percent tolerance allowed on measured energy consumption, or 10 percent as an average of three re-tests if measured consumption is greater than stated value plus 15 percent.
[15] "A review of the range of activity throughout Member States related to compliance with the EU Energy Label regulations in those countries", ANEC (2007): http://www.anec.org/attachments/ANEC-R&T-2006-ENV-008%20(final).pdf.
[16] Market Transformation Programme, personal communication (2007).

and A+ models there are several that are well below the mean water efficiency of the washing machine production stock (figure 12). There is a good chance that an A+ or A++ energy rated machine may not be water efficient, assuming 'water efficient' is defined as better than production stock mean - representative of best practice.

FIGURE 12. Figure 10 with production stock mean indicated. Those models that are on a rating boundary receive the higher rating.



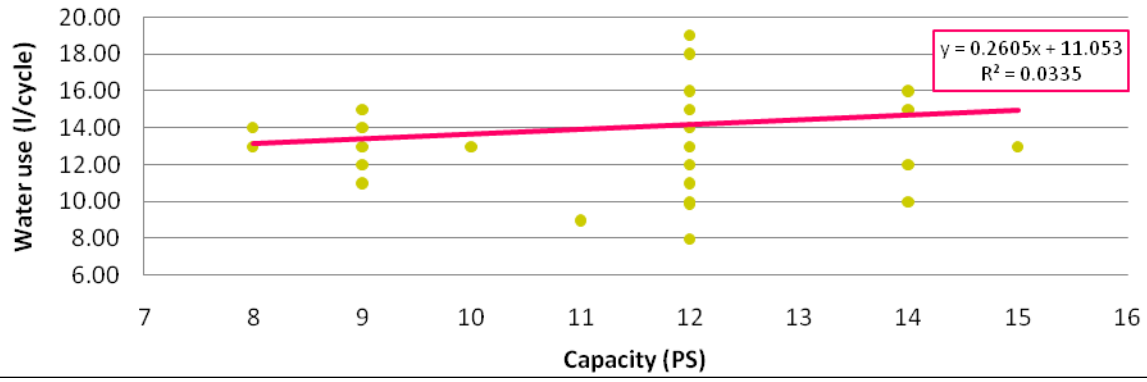
In general, as the energy rating of a model increases so, too, will its water efficiency; however, as the above analyses have shown, there is still a wide range in water consumption - even amongst those models with the same capacity and specific energy consumption. Therefore, there is scope to encourage greater water efficiency among washing machines. This is particularly the case for the production market as a whole, since water use varies significantly across energy ratings and capacities.

The need to address the water use of washing machines is discussed further in section 6.

4.2 Dishwashers

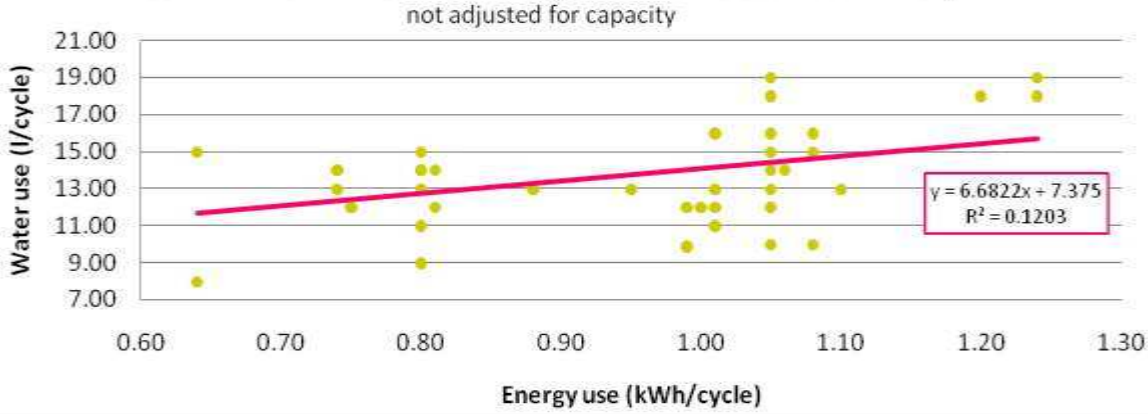
It was expected that analyses of the 2007 Waterwise database of dishwashers would result in similar findings to the washing machines; however, this was not the case. It was found that the relationship between the capacity (PS) and the water use (l/cycle) of dishwashers was very weak. Only about 3 percent of the variation in water use could be attributed to the variation in capacity (figure 13).

FIGURE 13. Relationship between water use and capacity of dishwashers



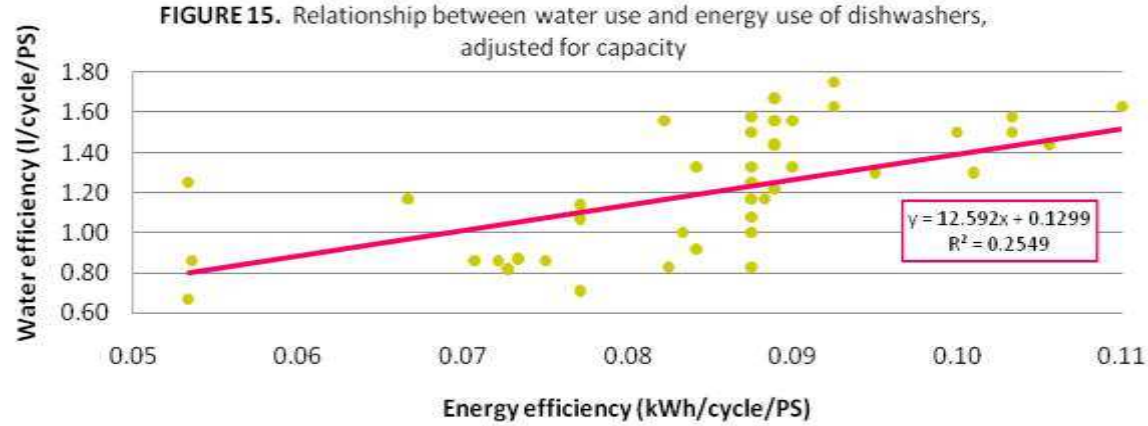
There was a stronger relationship between the water use and the energy use of dishwashers (figure 14). About 12 percent of the variation in water use could be attributed to the variation in energy use.

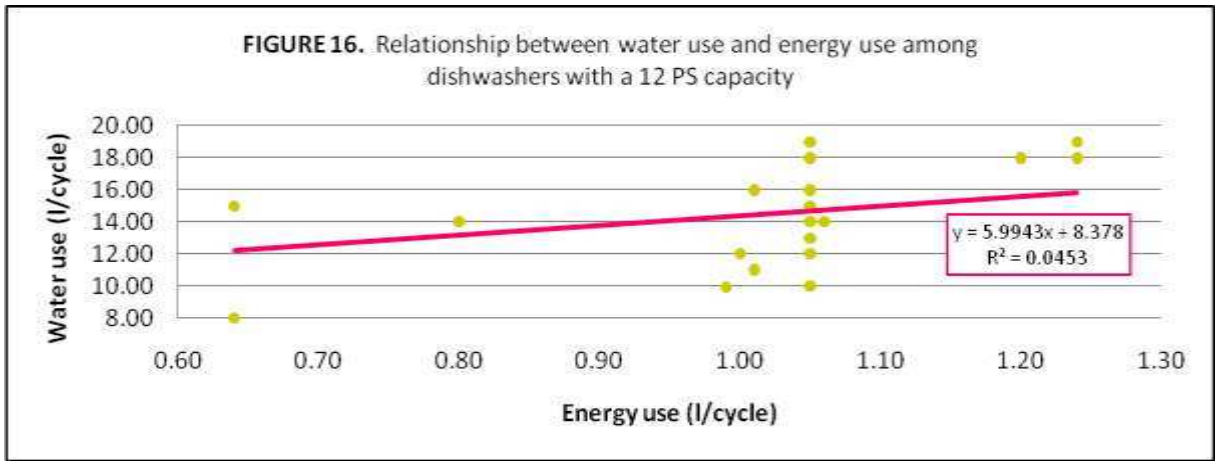
FIGURE 14. Relationship between energy use and water use of dishwashers, not adjusted for capacity



When adjusted for capacity, about 25 percent of the variation in water use was explained by the variation in energy use (figure 15); but, when the water use and the energy use of 12 PS models was examined, is was found that there was a much weaker relationship between the two variables: only about 5 percent of the variation in the water use of 12 PS machines could be explained by the variation in energy use (figure 16).

FIGURE 15. Relationship between water use and energy use of dishwashers, adjusted for capacity

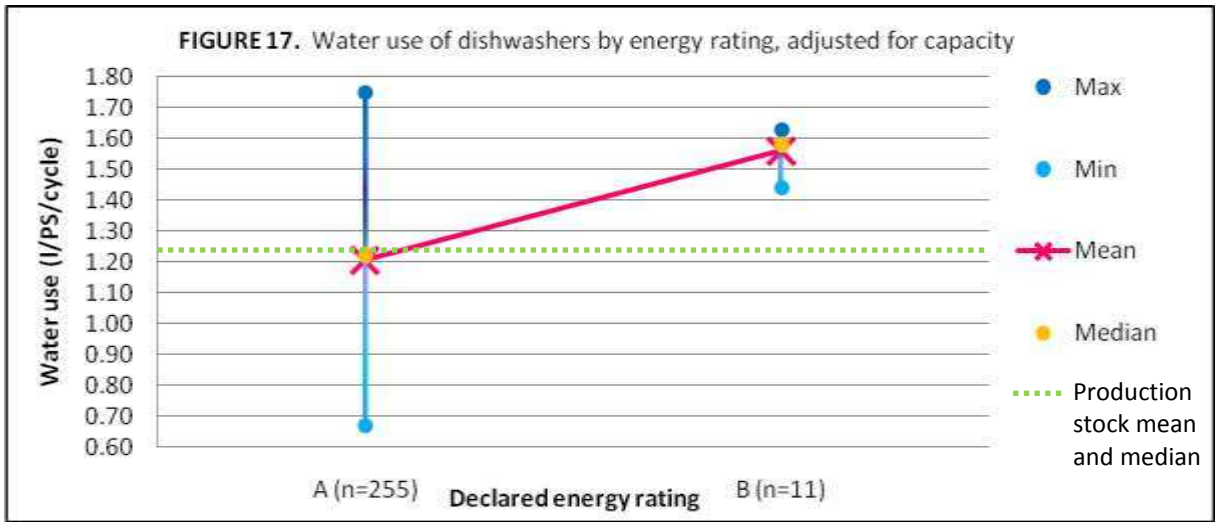




All this points to the finding that, like washing machines, one or more variables other than capacity and energy use have a strong influence over the water use of dishwashers. These may include technological design and cycle programming, as well as trade-offs between water use, energy efficiency, and wash performance. The relationship of these variables to water use was not explored in this study.

There is a wide spread in water use among the A-rated models (figure 17), partly because there is also a wide spread in energy. The vast majority (96 percent) of the dishwashers in the 2007 Waterwise database are rated A for energy. Whereas a Voluntary Industry Commitment for washing machines has led to the marketing of models rated A+ and A++, which are not official EU Energy Ratings, there has been no similar commitment for dishwashers.

Therefore, there is a wide spread of energy uses among A-rated models, leaving scope for energy and water improvements. A t-test showed that the water efficiency (l/cycle/PS) of A-rated machines was significantly better overall than that of B-rated machines ($t(18) = -13.88$, $p < 0.01$). It is likely that this spread may tighten further if the EU Energy Label is revised to include better than A ratings.



In order to explore whether or not a tightened energy scale would result in a tightening of water efficiency, an A+ (currently nonexistent) category was created (table 1).

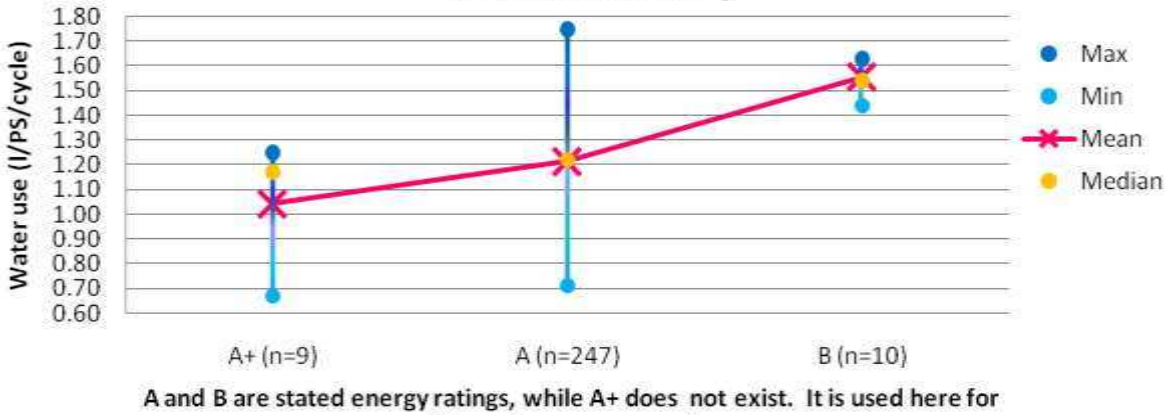
TABLE 1. EU Energy Efficiency Ratings for dishwashers.

Energy Rating	A+[2]	A	B	C	D	E	F	G
Energy Efficiency Index[1]	< 0.58	< 0.64	0.64 < 0.76	0.76 < 0.88	0.88 < 1.00	1.00 < 1.12	1.12 < 1.24	≥ 1.24

[1] The energy efficiency index (Ei) is calculated as Ei = C / Cr, where C is the energy consumption of the test dishwasher and Cr is the reference energy consumption calculated using Cr = 1.35 + (0.025 * S) for machines with ≥ 10 PS or Cr = 0.45 + (0.09 * S) for machines with ≤ 9 PS, where S is the capacity of the dishwasher in place settings (PS). [2] A+ is not an official EU Energy Label rating, and has only been used in this study theoretically. Neither the rating nor the corresponding index value is meant to suggest what is appropriate for the future label revision.

It was found that the water use of the (nonexistent) A+ category would be significantly lower than that of the A category (figure 18).

FIGURE 18. Water use of dishwashers by energy rating (A+ is not an actual rating)



A and B are stated energy ratings, while A+ does not exist. It is used here for illustrative purposes only.

There was a significant effect of energy rating on water use (l/cycle/PS); $F(2, 263) = 17.37$, $p < 0.01$. Specifically, using Tukey's post hocs, the water use of the A+ models (1.04 l/cycle/PS, $SD = 0.24$) was significantly ($p < 0.01$) lower than that of A models (1.21, $SD = 0.20$) and of the B models (1.6, $SD = 0.07$); however, it must also be noted that the sample sizes of A+ and B are low in comparison to the A category. Results of the analyses follow:

Descriptives - Water use (l/PS/cycle)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
A+ (not existent)	9	1.0422	.23541	.07847	.8613	1.2232	.67	1.25
A	247	1.2139	.20337	.01294	1.1884	1.2394	.71	1.75
B	10	1.5540	.07336	.02320	1.5015	1.6065	1.44	1.63
Total	266	1.2209	.21346	.01309	1.1951	1.2466	.67	1.75

Test of Homogeneity of Variances - Water use (l/PS/cycle)

Levene Statistic	df1	df2	Sig.
4.456	2	263	.012

ANOVA - Water use (l/PS/cycle)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.409	2	.705	17.372	.000
Within Groups	10.666	263	.041		
Total	12.075	265			

Post Hoc Tests - Multiple Comparisons - Dependent Variable: Water use (l/PS/cycle) - Tukey HSD

(I) Energy Rating	(J) Energy Rating	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A+ (not existent)	**A**	-.17166(*)	.06834	.034	-.3327	-.0106
	B	-.51178(*)	.09253	.000	-.7299	-.2937
A	**A+ (not existent)**	.17166(*)	.06834	.034	.0106	.3327
	B	-.34011(*)	.06496	.000	-.4932	-.1870
B	**A+ (not existent)**	.51178(*)	.09253	.000	.2937	.7299
	A	.34011(*)	.06496	.000	.1870	.4932

* The mean difference is significant at the .05 level.

Homogeneous Subsets - Water use (l/PS/cycle) - Tukey HSD

Energy Rating	N	Subset for alpha = .05	
		1	2
A+ (not existent)	9	1.0422	
A	247	1.2139	
B	10		1.5540
Sig.		.065	1.000

Means for groups in homogeneous subsets are displayed. a Uses Harmonic Mean Sample Size = 13.943. b The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

In general, as the energy rating of a dishwasher improves, so, too, will its water efficiency; however, there is still a wide variation in water use within and between energy ratings, even when adjusted for capacity. If better than A ratings are introduced, it is likely that water efficiency will also improve, but, as with washing machines, energy efficiency is not an entirely suitable proxy for water efficiency.

Advice-giving bodies often advise consumers looking for water efficient dishwashers to use energy efficiency ratings as proxies. While there exists an overall statistically relevant correlation between water and energy consumption in dishwashers, the variance in this relationship is sufficiently large for energy efficiency categories to not be a reliable indicator of water efficiency. From the perspective of a customer, figure 17 may be interpreted to indicate that there is no guarantee that an A-rated machine will operate with greater water efficiency than a B-rated machine, even if it is generally true that A-rated models are more water efficient than B-rated models The introduction of an A+ rating could remove the overlap with B-rated machines, but it would still not guarantee that an A+ energy rated dishwasher would be more water efficient than a A-rated one.

5. A note on washer-driers

Currently, about 15 percent of households own combination washer-driers; however, penetration may increase as single occupancy households and confined living spaces make washer-driers more practical than separate washers and driers. Although it is also plausible that penetration and sales will remain stable since many Britons have come to accept air drying their clothing.

In general, washer-driers use similar amounts of water in the washing phase as washing machines; however, they also use significant amounts of water in the drying phase, as most operate through a process of condensation that removes humidity but consumes water. Incomplete information gathered by Waterwise in 2006 showed that many models used between 65 and 170 litres of water to wash and dry, with most using over 90 litres.

The overall consumption of washer-driers and the wide spread in consumption suggest that there is a need to address the water consumption of these appliances; however, since the 2006 Waterwise database of washer-driers was not fully populated, washer-driers have been excluded from this study.[17]

6. Discussion of the possible need

Findings suggest that there is a need to address the water consumptions of dishwashers and washing machines, and possibly of washer-driers. While it can be expected that water efficiency will increase overall as energy ratings tighten, there remain large spreads in water use even among models of the same capacity and specific energy consumption. Several of the best-for-energy models are below production stock mean for water efficiency, and some energy inefficient models are better on water than some of the most energy efficient models. This discrepancy makes it imprudent to recommend to consumers that A/A+/A++ models are water efficient. Energy efficiency ratings should not be used as proxy for water efficiency information.

Analyses also indicate that water consumption is influenced by variables other than capacity and energy use, which is why there exist variations in water use amongst machines of the same capacity and the same specific energy consumption. The precise source(s) of the variation was not determined in this study, but it is hypothesised that the remainder of the variation in water use is attributed to technological improvements and cycle programming, as well as to the chosen approaches to reducing energy use, with resulting energy-water-performance trade-offs.

The ECOWET study that has been carried out under the Eco-design Directive has evaluated the present technical and market conditions of wet white goods in the EU.[18] The study has

[17] Waterwise were unable to complete the database or to update it because of a lack of organisational resources; the lack of manufacturer information on water use during the wash phase and during the dry phase also prevented the completion of the 2006 database.

[18] Official website of the preparatory studies for eco-design of EuP products, lot 14, domestic washing machines and dishwashers: http://www.ecowet-domestic.org.

identified several technological improvements that could be made to reduce water consumption in wet white goods even further (table 2).

TABLE 2. Available technological improvements for washing machines and dishwashers that, if applied, would reduce water consumption.[19]

Option	Average rate of application to market (%)	Unit production		Savings of water[1]		Cycle time (+/- min)	Increase in consumer price €
		Cost €	Price €	l/cycle	%		
Technological options list for 12 PS dishwashers							
Alternating spraying of water	40	7	9.1	3	0.1974	+20	27.3
Avoidance or reduction of the cold pre-rinse / pre-wash	60	0	0	3	0.1974	-5	0
Partly draining and refilling of water	20	1	1.3	2	0.1316	---	3.9
DC brushless motor	5	20	26	0.5	0.0329	---	78
Electronic sensors for load soiling (50 percent soiled)	40	5	6.5	1	0.0658	-10	19.5
Electronic sensors for load weight (50 percent mass)	20	4	5.2	1.5	0.0987	-10	15.6
Technological options list for 5 kg washing machines							
Optimised mechanical action	20	0.4	0.5	2	0.0394	---	1.5
Analogue water sensor	5	1.5	1.5-3	5.07	10	---	6
Rinsing phase optimisation	20	3.8	5	7.5	0.1479	-15	15
Increased load capacity in the same machine	30	0.8	0.1	3	0.0592	+15	0.3
Weight sensors (load control)	2	5.8	7.5	4.5	.0888	0	22.5
Sophisticated electronic controls (fuzzy logic)	50	9.6	12.5	1	.0216	0	37.5
LCD with actual load display	0.5-1	7.7	10	4.5	0.0888	0	30

1 None of these savings in water would result in an increase in electricity use

[19] Presutto, *et al*. 2007. Preparatory studies for eco-design requirements of EuPs (Tender TREN/D1/40-2205). LOT 14: Domestic dishwashers and washing machines. Part II: Improvement potential. Task 6: Technical analysis, revision three, task final report. http://www.ecowet-domestic.org.

The study also identified several technologies that could reduce or eliminate the need for water in the future[20]:

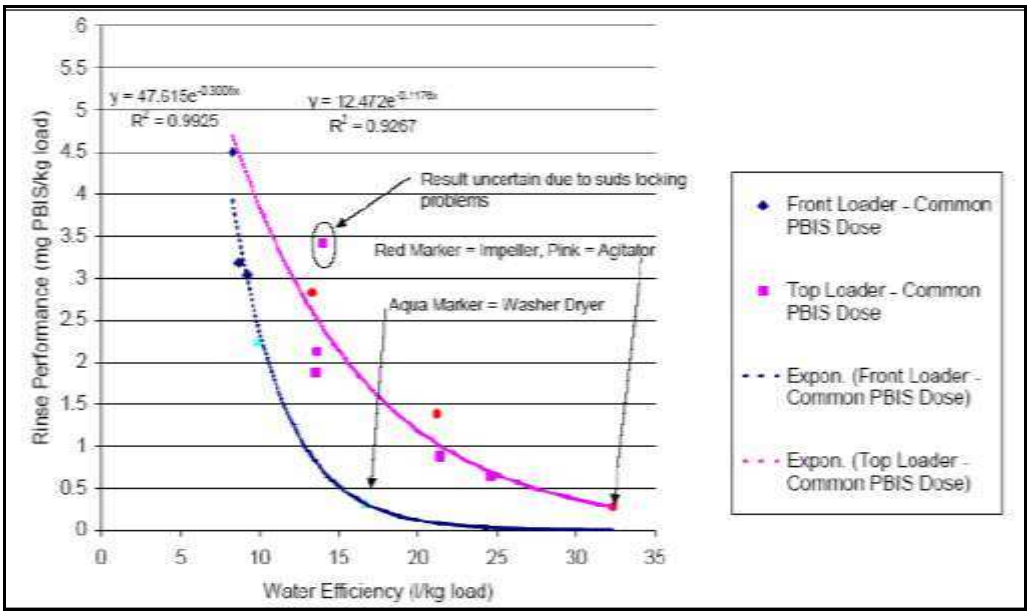
- Washing laundry without water (e.g. pressurised air and negative ions[21]);
- Washing dishes without water (e.g. carbon dioxide in a closed-loop system[22]); and,
- Washing laundry with significantly less water (e.g. ozone and recycled water[23], steam[24], plastic chips[25], ultrasound[26]).

However, the study also concluded that greater water efficiency should not be addressed via a label unless a deterioration in wash and/or rinse performance was prevented, for example by introducing a rinse requirement.[27] The study pointed to Australia where a mandatory water efficiency label was only introduced after rinse requirements were set for washing machines. A study done in Australia prior to the introduction of the rinse requirement showed that an increase in water efficiency would result in a decrease in rinse performance (figure 19). It must be noted, though, that the study was based on a sample of eight top-loading and five front-loading machines, and that there was some significant variation in rinse performance between different models of the same water efficiency.

This decrease in rinse performance due to an increase in water efficiency may not necessarily apply to the UK. As the ECOWET study notes, most models on the market have an 'extra rinse' option, but it remains to be determined as to whether this feature has been developed due to actual need (e.g. highly sensitive skins) or simply to further differentiate products. In general, it seems as though consumers are generally satisfied with machine performance in the EU, and no major problems have been raised.

[20] *Ibid*.
[21] Electrolux Airwash System: http://www.electrolux.com/node49.aspx?Assid=10865&FolderID=20806&Page=1.
[22] "Washing dishes without water", Appliance (February 2005): http://www.appliancemagazine.com/new_products.php?article=6254&zone=204&first=1.
[23] Sanyo AQUA: http://www.sanyo.com/news/2007/03/27-2en.html.
[24] LG Steam Direct Drive: http://uk.lge.com/products/category/list/homeappliances_washingmachine_steamdirectdrivewashingmachine.jhtml.
[25] "Spin dry: the washing machine that needs just one cup of water", Mail Online (09 June 2008): http://www.dailymail.co.uk/sciencetech/article-1025043/Spin-dry-The-washing-machine-needs-just-cup-water.html.
[26] "Ultrasound turns clothes 'ultraclean'", Design News Online (25 March 2002): http://www.designnews.com/article/CA200975.html.
[27] Presutto, *et al*. 2008. Preparatory studies for eco-design requirements of EuPs (Tender TREN/D1/40-2205). LOT 14: Domestic dishwashers and washing machines. Part II: Improvement potential. Task 7: scenario, policy, impact and sensitivity analysis, revision three, final task report for consultation. http://www.ecowet-domestic.org.

FIGURE 19. Rinse performance versus water efficiency for a sample of washing machines on the Australian market in 2004.



The study recommended that for washing machines a maximum water consumption per cycle be set at ≤ 6.5*kg + 32.4. ECOWET analysis revealed that this requirement would eliminate about 5 percent of the models in CECED's 2005 database, most of which would be C rated for energy.

For dishwashers, the ECOWET study pointed out that these appliances consume much less water per cycle than washing machines, with a range among 12 PS models of only 9 to 20 litres. Therefore, since a further increase in efficiency might affect wash performance, the study recommended that the effective benefits of a water efficiency label be weighed carefully with the potential negative impact on consumers.

It must be noted that the ECOWET study was heavily focussed on the potential for improvements in energy efficiency; water use efficiency was given hardly any attention in comparison. Furthermore, the study applied to the EU market as a whole and so findings may not be pertinent to the situation within a single Member State. For example, the ECOWET recommended water use cut-off point for washing machines, when applied to the Waterwise database of models on the UK market in 2007, eliminates only one model. This requirement at the EU level would have little influence on the water consumption attributed to washing machines in the UK, where figures range from 39 to 78 l/cycle.

Given the physical necessities of washing, it is unlikely at present that the water consumption of wet white goods, particularly of dishwashers, could be reduced dramatically.[28,29] There is scope, however, to encourage present best technology - that is, to tighten the spreads in water use among and between energy ratings, and among machines of the same capacity and energy use. Given that this could be done relatively easily via

[28] Significant savings may be made with washer-driers, but these appliances were beyond the scope of this study.
[29] *Op. cit.* 3.

existing routes (section 7), the small savings achieved by encouraging more water efficient wet white goods could well be cost effective and worth the small effort.

For example, for washing machines, if those who bought below the mean were to buy at or above, a savings of 36,749 million litres would be made over the lifespan of all the models purchased in a year. [30]

For dishwashers, if those who bought below the mean were to buy at or above, a savings of 3,728 million litres would be made over the lifespan of all the models purchased in a year. [31] Not as large a savings as for washing machines, but significant nevertheless given changing demographics, behaviours and climate, and the relatively low penetration of dishwashers. This figure becomes more significant if the penetration of dishwashers increases.

The savings that can be made by encouraging more water efficient wet white goods become even more significant if user behaviours are taken into account. An examination of how people use their washing machines and dishwashers was beyond the scope of this study, but mention of behaviour must be made as it can impact significantly on the total water use (and potential savings) attributed to wet white goods.

Several behaviours affect how much water is used for clothes washing and washing up: [32]

- Washing without a full load: evidence suggests that most consumers do not wash with maximum loads, either because they think the machines is full or because they are unwilling to wait until they have enough items to fill it;
- Using (or not) the half load function: two half loads use more water than one full load, but it is better to use this function than the standard setting if a consumer would have done the partial load anyway;
- Pre-washing and extra rinsing: while this may be essential for those with sensitive skin, most consumers could avoid these settings since modern models are often highly effective on just the standard cycle; and,
- Pre-rinsing: studies have indicated that about 30 percent of households manually rinse dishes before placing them in a dishwasher, often under a running tap.

The frequency of use of wet white goods also seems to be increasing.[33] In addition, users tend to use too much detergent, thus necessitating that machines use more water in the

[30] The mean water consumption of washing machines in the 2007 Waterwise database was 54.08 l/cycle. It is assumed that 200 cycles are run per year per machine, which is assumed by the EU Energy Label. The mean consumption of models below the overall mean is 63.16 l/cycle; for those at or above it is 49.24 l/cycle. 2,200,000 models are sold annually, and the MTP states that the typical lifespan of a model is 12 years. This example is meant as an illustration only and has not been weighted with market purchasing data.

[31] The mean water consumption of dishwashers in the 2007 Waterwise database was 14.10 l/cycle. It is assumed that 220 cycles are run per year per machine, which is assumed by the EU Energy Label. The mean consumption of models below the overall mean is 12.68 l/cycle; for those at or above it is 16.21 l/cycle. 600,000 models are sold annually and the MTP estimates that each model has a lifespan of 16 years. This example is meant as an illustration only and is not weighted with market purchasing data.

[32] Staminger, *et al*. 2007. Preparatory studies for eco-design requirements of EuPs (Tender TREN/D1/40-2205). LOT 14: Domestic dishwashers and washing machines. Part I: Present situation. Task 3: consumer behaviour, revision one, final task report. http://www.ecowet-domestic.org.

[33] Waterwise analysis of water company data, and information from WRc and other sources.

rinse phase(s).[34] There are some models that claim to be 'intelligent' enough to monitor the washing process so that water (and energy) use are kept to a minimum according to detergent use, but these models typically only add water instead of being able to decrease water use - i.e. they prevent the addition of water but still use a base volume. Some models also display information on whether or not capacity has been reached, and how much detergent should be used.

Given that behaviours have a strong influence on the total water use of wet white goods, it is important that these appliances become as technically water efficient as possible. Arguably, technology is much easier to alter than behaviours and so by tackling the technical efficiency first some water may be saved while behaviour is then addressed.

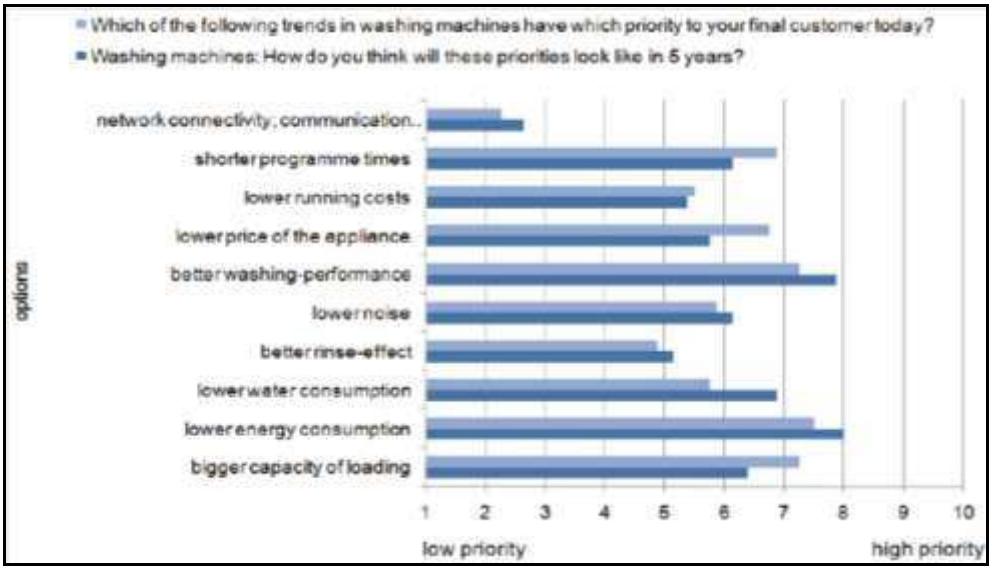
Any increase in the penetration of water efficient appliances and in 'water wise' behaviours will require awareness-raising as well as the provision of easy-to-understand information. While behavioural messages can be communicated to users via existing routes (e.g. the 'Act on CO_2' campaign), water efficiency information about washing machines and dishwashers is harder to come by: the current EU Energy Label does list water consumption, but not in a format conducive for comparison because it is neither adjusted for capacity nor indicative of relative efficiency.

Easy-to-understand information about the water efficiency of a model in comparison to other models is unlikely to be provided in the form and on the scale required without some degree of government intervention. Though some retailers have begun to provide water consumption information in product brochures, this information is often of the same calibre as the information on the EU Energy Label, requiring consumers to actively work out relative efficiency. There is currently no agreed definition of what a 'water efficient' appliance actually is, meaning that different manufacturers use different definitions, thus potentially creating an unlevel playing field.

A survey of European wet white goods manufacturers carried out as part of the ECOWET study found that manufacturers do not rank water consumption high up on their priority list in terms of product development. When asked what they thought their priorities would look like in five years time, however, water consumption moved up to third place, just under better washing performance and lower energy consumption (figure 20). Similar results were seen for dishwashers.

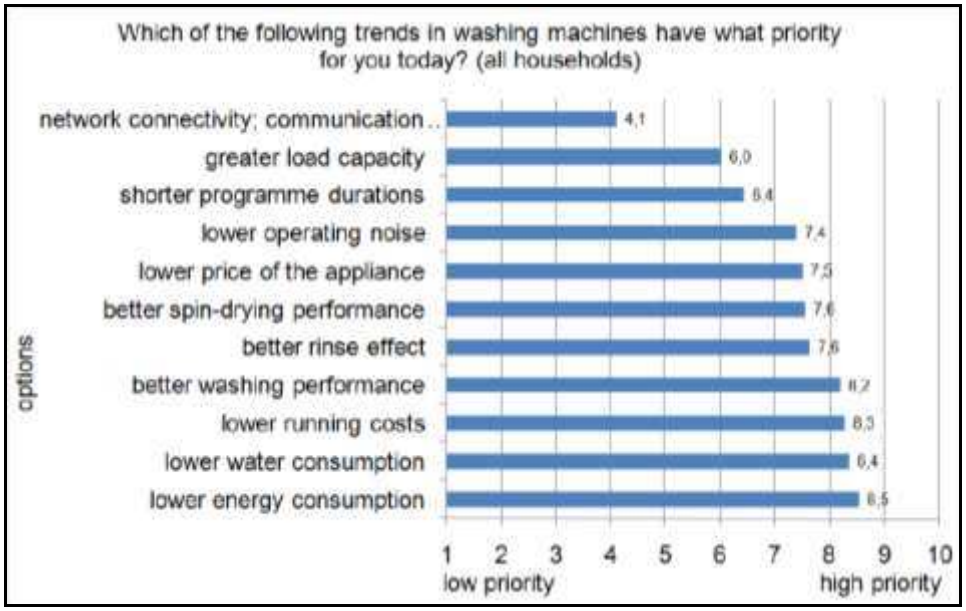
[34] *Op. cit*. 3.

FIGURE 20. Manufacturers' prioritisation of washing machine characteristics.[35]



When 2,497 households across Europe were surveyed, lower water consumption featured second just under lower energy consumption (figure 21), though the prioritisation of water varied widely between countries (table 3). In the UK, better washing performance, lower running costs, and lower energy consumption all came before lower water consumption. Findings were similar for dishwashers.

FIGURE 21. EU-wide consumers' prioritisation of washing machine characteristics.[36]



[35] Faberi *et al*. 2007. Preparatory studies for eco-design requirements of EuPs (Tender TREN/D1/40-2205). LOT 14: Domestic dishwashers and washing machines. Part I: Present situation. Task 2: Economic and market analysis, revision one, final draft. http://www.ecowet-domestic.org.
[36] *Ibid*.

TABLE 3. Variation in priorities for washing machines between EU countries.[37]

Washing machine: Ranking appliance options/features (average)											
countries	UK	DE	IT	FR	ES	SW	PL	HU	FI	CZ	total
greater load capacity	6,5	6,1	6,8	6,5	6,8	5,1	5,3	6,5	5,2	5,4	6,0
lower energy consumption	8,0	9,1	8,2	8,9	8,3	7,8	9,0	8,9	8,4	8,7	8,5
lower water consumption	7,9	9,1	8,0	8,8	8,3	7,1	8,8	8,8	8,1	8,5	8,4
better rinse effect	7,2	8,0	7,6	7,9	7,8	7,0	8,1	8,0	7,6	7,2	7,6
lower operating noise	7,0	7,2	7,8	7,8	7,9	7,1	7,4	7,4	7,2	7,3	7,4
better washing performance	8,1	8,4	8,1	8,5	8,4	7,5	8,6	8,7	7,9	7,8	8,2
better spin-drying performance	7,7	7,8	7,2	8,1	7,9	7,1	7,9	8,3	7,5	6,1	7,6
lower price of the appliance	7,6	8,1	7,2	7,7	8,2	6,6	7,9	7,9	7,0	6,8	7,5
lower running costs	8,1	8,8	7,8	8,5	8,2	7,8	8,7	8,6	8,1	8,2	8,3
shorter programme durations	6,7	6,6	6,6	6,4	6,9	6,1	6,4	6,7	6,3	5,6	6,4
network connectivity; communication between household appliances	3,6	3,4	4,9	3,9	4,6	3,4	4,4	4,4	3,9	4,4	4,1

It is no surprise that washing performance is most important to users in the UK. What is interesting to compare is that water consumption is more important in other countries (e.g. second most important in France), usually on par with energy consumption and just a bit more important than running costs. This demotion of water consumption in the UK may be a result of the low levels of water metering and the relatively low price of water. Aside from wash performance, running costs are the most important characteristic for Britons. As metering penetration and water prices increase, it will be interesting to see if consumers begin to take more notice of the water consumption of their appliances.

Similarly, as levels of awareness over water supply issues rise, consumers may begin to take more notice of the water consumption of their appliances. A slow rise in awareness has already been seen by Waterwise, who published appliance water efficiency rankings in 2006 and 2007, which received attention from many consumers and organisations.

7. Discussion of some of the options

When examining options both direct and indirect benefits must be taken into consideration. The direct benefits of an option are the actual water savings achieved. While direct benefit is easy to understand, it is not as easy to calculate because assumptions have to be made about possible market impacts and influences over consumer purchases and behaviours. A possible direct benefit of a label could be a reduction in water use of 3,278 million litres of water each year in the UK, but only if a label were to be successful in influencing shoppers so that all purchased washing machines and dishwashers were at or above the mean water consumption for all production stock (section 6). This benefit is underpinned by the assumptions that half of current purchases are below mean and that all these could be influenced so that all purchases were made at or above mean.

[37] Ibid.

In contrast to direct benefits, indirect benefits are not attributed directly to the option but instead arise peripherally to it. Indirect benefits are much more difficult to quantify and are often even difficult to identify. For example, labels may have influence over government programmes (e.g. helping procurement schemes along and also guiding minimum standards), manufacturer and retailers initiatives (e.g. fostering competition and providing a new marketing tool), the actions of house builders and specifiers (e.g. helping identify products that fulfil requirements of the Code for Sustainable Homes), and the activities of utilities (e.g. serving as an easy identifier of products that may qualify for rebate/subsidy schemes).

While direct benefits are savings made due to an action if assumptions that were made prove accurate, indirect benefits are positive effects that an action has on other initiatives that then lead to water savings and/or other social, economic or environmental benefits. For example, an indirect benefit of the EU Flower Ecolabel is that Defra have used the Flower's criteria to devise public procurement specifications, thus fulfilling the Flower's aims without actually using the Flower.

No single option presented below is likely to achieve maximum water efficiency amongst wet white goods if pursued in isolation. Therefore, it is suggested that any action(s) taken be incorporated into a wider strategy aimed at increasing technical efficiency along with operational efficiency, i.e. 'water wise' behaviours.

It is also important to prevent the possible deterioration in wash and/or rinse performances while greater water efficiency is encouraged. A rating for wash performance already exists, but there is no rinse requirement for washing machines or for dishwashers. Therefore, it is recommended that a rinse performance requirement be set prior to the initiation of any water efficiency drive. Though it is unlikely that manufacturers would design in such a way as to displease purchasers, a rinse requirement would make certain that water efficient models perform as well as inefficient models - thus ensuring that consumers associate water efficient appliances with excellent performance.

Options for encouraging greater water efficiency amongst wet white goods are presented briefly below with a particular focus on labelling. The aim here is to address technical efficiency, not behaviour - though the two are not necessarily independent since addressing technical efficiency may also promote behavioural change. A full cost/benefit analysis for each option was beyond the scope of this study.

7.1 Business as usual

If the status quo is maintained, it is likely that some improvement in the water efficiency performance of washing machines and of dishwashers would occur as a result of a tightening in the EU Energy Label ratings. Gains from this transition would, however, tail off as the amount of water saved from reducing energy use would eventually reach a ceiling. It is also likely that new technologies would eventually come onto the mass market, such as

washing machines that use recycled water, but policies to encourage this advancement could make this transition period much shorter.

There would be no costs associated with continuing business as usual, but there would be opportunity costs since the savings that could be achieved would not be realised. Thus, no additional benefits would be gained through maintaining the status quo.

7.2 Labelling

For a consumer wishing to purchase a wet white good that is water efficient, the purchasing decision may be quite difficult. Most manufacturers and retailers do not provide information about water consumption, though this situation is slowly changing as water consumption becomes a distinguishing feature among models that are otherwise all rated A for energy, A for wash/clean and A for spin/dry. For example, a leading retailer has began including water consumption information in their in-store washing machine and dishwasher catalogues, and a major manufacturer regularly includes water efficiency information in marketing their products.[38]

For those consumers looking for a water efficient model, the EU Energy Label is of some use as it does list water consumption in l/cycle. This figure, however, is not adjusted for capacity and it is not indicative of relative water efficiency. For those consumers not interested in water, the EU Energy Label does little to foster interest. There are several options to improve this situation, either via existing labels or other means.

Labels are usually introduced in order to influence consumer purchases, at the very least to provide information, and to transform the market. The EU Energy Label seems to have fulfilled both these aims in relation to energy efficiency. Its success has been attributed to the following:[39]

- It is mandatory, which prevents free-riders and encourages fair play among manufacturers and importers;
- It is simple and easy-to-understand for consumers in that it clearly shows how energy efficient a model is relative to its peers, which also encourages appliance designers and manufacturers to produce more energy efficient equipment;
- It fosters competition amongst manufacturers and retailers, and supports them in marketing their efficient products by creating another variable on which models can be distinguished; and,
- It facilitates the development of national, regional, and/or local government actions to incentivise consumers to purchase efficient products, e.g. it enables cash rebate schemes for A-rated products as well as VAT reduction schemes and subsidy programmes.

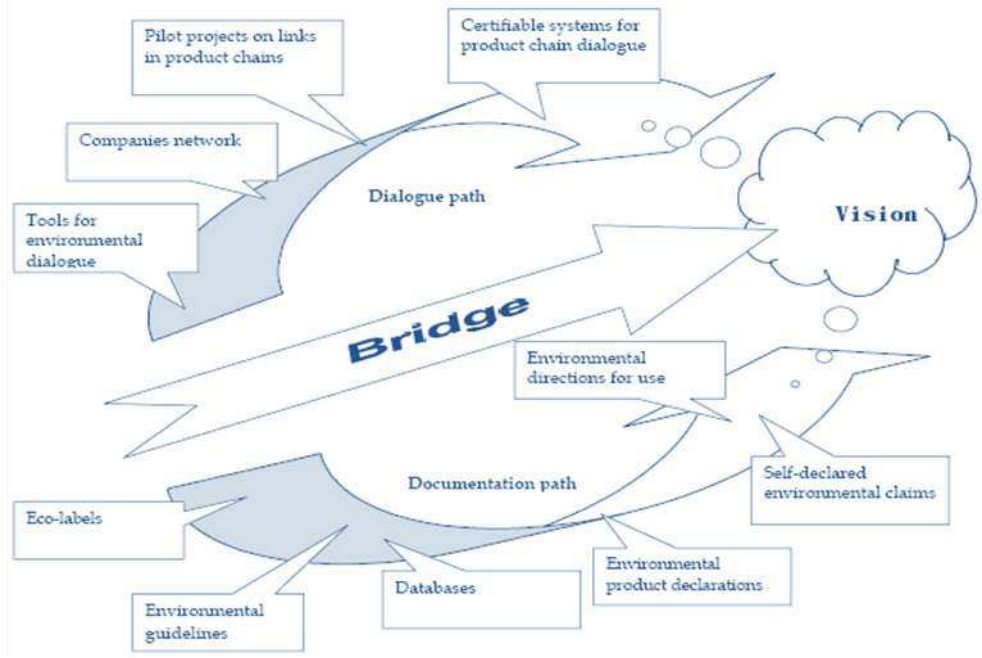
[38] See, for example, http://www.boschappliances.co.uk/boschuk2007/en/products/category-bosch-Dishwashers-cat-2.htm.

[39] Directorate General for Energy and Transport, "Consultation document on the revision of the Energy Labelling Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances", European Commission (2008): http://ec.europa.eu/energy/demand/legislation/domestic_en.htm.

Though the EU Energy Label has had an impact on the take-up of energy efficient products, thus resulting in the direct benefit of energy savings, care must be taken so as not to attribute market transformation entirely to labelling. A range of instruments at local, regional, national and European levels have also played a role in promoting take-up, including public and private procurements schemes, cash rebate programmes, subsidies, etc. Many of these have been linked to the Label, thus resulting in more indirect benefits of the labelling scheme. There is also a positive feedback loop between the Label and consumer awareness, whereby high levels of energy awareness lead to greater impact of the label while the label itself has had an important educational effect as well.[40]

With the exceptions of the EU Energy Label and the Nordic Swan, there has been and continues to be a lack of adequate data on the effectiveness of environmental labelling.[41] The successes of labelling schemes are particularly difficult to ascertain because these schemes never exist in isolation from other initiatives that aim to realise similar goals. Therefore, all that can really be concluded is that the effect of a label is limited and uncertain unless a complete programme is introduced alongside the label, which incorporates actions aimed at influencing product manufacturers and consumers in a multi-dimensional way (figure 22).

FIGURE 22. "Two ways and one bridge: economical and informational barriers for the distribution of cleaner products".[42]



[40] *Op. cit*. 24.

[41] "The trade and environmental effects of eco-labels: assessment and response", UNEP (2005): http://www.unep.ch/etb/publications/Ecolabelpap141005f.pdf; Rubik and Frankl, "The future of eco-labelling: making environmental product information systems effective", Greenleaf Publishing, UK (2005).

[42] Valor and Tinge, 1999, "Two ways and one bridge: economical and informational barriers for the distribution of cleaner products", in: Allison and Carter, 2000, "Study of different types of environmental labelling (ISO Type II and III labels): proposal for an environmental labelling strategy", DG Environment, European Commission: http://ec.europa.eu/environment/ecolabel/pdf/studies/erm.pdf.

Consideration must also be given to trade-offs that may occur as a result of a single-issue approach. In advancing an energy efficiency label, it is possible that water efficiency may decrease at some point as manufacturers lower temperatures to reduce energy use but then may increase water use in order to achieve adequate wash performance. Similarly, a water efficiency label could lead to deterioration in wash and/or rinse performance. A 'resources' label or minimum standards could prevent the first situation, whereas a rinse requirement could prevent the latter situation.

Scale and extent must also be considered when looking at labelling options, in terms of EU versus national action and also coverage of wet white goods versus water-using products. The latter issue of extent will not be addressed here as it is beyond the scope of the study, but consideration must be given as to whether it may be better to address the water efficiency of wet white goods via a label that covers all water-using products. As for scale, there are several reasons for/against action at the European level (table 4).

TABLE 4. Some possible benefits and drawbacks of action at the EU or UK level.

	Benefits	Drawbacks
EU level	• *Fair competition and avoidance of free riders*: common standards ensure a well functioning internal market in which manufacturers can compete on an even playing field; • *Efficiency*: a common approach is more efficient since manufacturers have one requirement to fulfil as opposed to several between various Member States; • *Reinforcing*: since products cross boundaries and so do consumers, one approach could arguable have more impact as it would have a greater span.	Drawbacks concerning actions at both the EU and UK level originate from single-market issues across Member States. • *Single-market issues*: introducing EU-wide regulations would require efficiency standards that are acceptable to all Member States and may therefore be somewhat diluted in respect to the UK. For example, the EU-wide ECOWET study suggests a minimum standard for water consumption that would not have any influence on the UK market; • *Inefficient for manufacturers*: since products are manufactured for more than one nation, manufacturers may incur additional difficulties in responding to unilateral UK actions.
UK level	• *Specific to UK*: actions could be targeted to address the specific situation in the UK, e.g. by refining action to aid other complementary initiatives; • *Stronger action*: tighter requirements could be set in the UK that could otherwise be rejected at the EU level.	

The final decision over scale would also influence whether chosen action(s) would be voluntary, mandatory, or both. Mandatory action would most likely only happen at the EU level, but such action would not prevent voluntary approaches from emerging in the UK. Though it is unlikely that mandatory action would arise at the UK level, even without EU action there is scope for a UK voluntary approach.

7.2.1 Extension of existing UK labels

There are three voluntary schemes in the UK that do or could apply to washing machines and dishwashers: the Bathroom Manufacturers Association Water Efficient Product Label (BMA Label), the Energy Saving Recommended Label (ESR), and the Waterwise Marque. Any or all of these schemes could be used to manage the demand for water attributed to wet white goods.

7.2.1.1 The BMA label

In April 2007, the BMA launched a voluntary Water Efficient Product Label, which aims to help both trade organisations and consumers easily identify water efficient products. The scheme currently covers WC suites, independent flushing cisterns, taps and combination tap assemblies, shower controls and baths. The official website holds all information regarding qualification criteria and a database of registered products with photographs.[43]

The Scheme has not been around long enough to judge its effectiveness, but seems to be doing well since over 300 products have been registered and since it is supported by industry.

Though the scheme applies only to bathroom products, there is scope to extend it to other water using products such as washing machines and dishwashers. The BMA have expressed that "all stakeholders need to come together to make water efficiency work, in a combined, joined-up effort, with the Water Efficient Product Labelling Scheme being a vital piece of that jigsaw".[44]

Some advantages of extending this label are that,

- the scheme is already widely recognised among manufacturers, government, NGOs, and other stakeholder groups;
- the framework for operation is already established;
- the scheme is essentially cost neutral since manufacturer/importer application fees cover operative costs; and, that
- it would benefit from economies of scale since consumers would see the label not only on wet white goods but also on water-using bathroom products, thus reinforcing the label's message.

Some disadvantages of extending this label are that,

- it is not recognised by most consumers;

[43] http://water-efficiencylabel.org.uk

[44] "Retailers key to water efficiency, says Defra ", press release, BMA (19 March 2008): http://www.bathroom-association.org/news.asp?ID=162.

- it is a voluntary scheme and so arguably of less effect than a mandatory scheme; and, that
- it does not appear on inefficient products, which means that consumers must know to look for it when purchasing a product.

Many of these disadvantages could be overcome by a multi-stakeholder initiative to promote the label to consumers and by a collaborative effort to improve the requirements of the voluntary scheme so that it does have a significant impact despite being voluntary, for example by integrating the label into public procurement schemes and offering cash rebates to consumers for purchasing labelled products.

7.2.1.2 Energy Saving Recommended

ESR, previously known as Energy Efficiency Recommended, is a voluntary product labelling scheme for domestic energy saving products that was launched in 2000. The scheme is funded by Defra and managed by the Energy Saving Trust (EST). [45]

The label is awarded to washing machines that are AAA rated, and to dishwashers that are AAA rated and also meet the EU Flower Ecolabel requirement for water consumption. There is no water consumption requirement for washing machines. Requirements are reviewed on an annual basis, and the purpose of the label is to highlight best practice, i.e. to reward the top 20 percent of the market. The EU Energy Label is used as a benchmark.

There are currently 181 dishwashers and 89 washing machines labelled ESR.[46] According to the EST, recognition of the label by the general public is about 22 percent, but efforts are underway to increase recognition to 50 percent.[47] Monthly face-to-face surveys (recognition aided) of 2,000 consumers are carried out, as well as annual telephone surveys (recognition unaided) of 5,000 consumers. A telephone survey of 5,000 people conducted in 2004/5 revealed that of those who had bought an appliance (33 percent of the sample), 43 percent had looked for the ESR label, 65 percent had bought an ESR labelled appliance, and 10 percent would not have bought the selected appliance had it not been ESR labelled.

There is scope to strengthen the water element of the label, particularly since the vast majority of UK dishwashers already meet the EU Flower Ecolabel's water requirements and to introduce a water requirement for washing machines. In theory, there is also scope to rebrand the label as 'Resource Efficiency Recommended' or as 'Energy and Water Saving Recommended'.

Some advantages of strengthening the water element of this label are that,

[45] Official website at http://www.energysavingtrust.org.uk/energy_saving_products.
[46] As of 20 June 2008, www.est.org.uk.
[47] Lock and Hindson, "Energy Saving Recommended: key principles for a successful product labelling scheme", MTP (2006): http://mail.mtprog.com/CD_Layout/Day_3_23.06.06/1115-1300/ID154_Lock_final.pdf; and personal communication.

- the scheme is already widely recognised among manufacturers, government, NGOs, and other stakeholder groups;
- the scheme is relatively well recognised by the general public;
- the framework for operation is already established; and, that
- the benefits of greater water efficiency may be achieved by appealing to the greater proportion of people who care more about energy efficiency.

Some disadvantages of strengthening the water element of this label are that,

- it would not lead to any rise in levels of water awareness, unless rebranded;
- the scheme will introduce additional costs in comparison to business as usual. Additional criteria for water efficiency will require an initial investment in defining testing standards (should they not be provided by the revised EU Label) and additional operational costs in reviewing additional appliance performance indicators and periodically updating performance standards;
- there is limited label recognition and coverage as it is a voluntary schemeand will only be applicable to the top 20 percent of water efficient machines. Consumers must therefore know to look for it when purchasing a product and the product must have elected to have it.

Some of these disadvantages could be overcome if the label was rebranded, and if more stakeholders were brought on board to promote the label; however, it is unlikely that the scheme could become cost neutral since introducing application fees would be difficult and since significant funds are necessary in order to enforce compliance, prevent false marketing, and ensure the label represents the top 20 percent of the market on an annual basis.

7.2.1.3 Waterwise Marque

Waterwise introduced the Marque in autumn 2006. The scheme is a voluntary award-style programme that grants the Marque label to products that save water and/or promote water saving. There are no performance requirements associated with the label; instead, it is subjectively awarded by an independent judging panel that rate applications based on water saving, availability, design and overall performance. The Marque is awarded annually, and currently two dishwashers have won the label.

Some advantages of expanding the Marque are that,

- it is specific to water;
- the framework for operation is already established;
- the scheme is cost neutral;
- it is subjective and takes into consideration availability, design and overall performance.

Some disadvantages of expanding the Marque are that,

- the scheme is not widely recognised by stakeholders;
- the scheme is not widely recognised by the general public;
- it will suffer from the same issues of coverage and recognition as the EST label (see above)

Some of these disadvantages could be overcome if more resources were available to expand the scheme, particularly to conduct a consumer outreach programme and to undertake an awareness raising campaign among manufacturers/importers.

7.2.2 Extension or alteration of existing EU labels

At the EU level, there are two policy instruments that address the labelling of washing machines and dishwashers:

- *EU Flower Ecolabel*: European Parliament and Council Regulation (EC) 1980/2000 on a revised Community-wide ecolabel award that promotes products that have the potential to reduce negative environmental impacts; and,
- *EU Energy Label*: Council Directive 92/75/EEC provides a framework for the compulsory provision of information on energy use and other resource uses of household appliances via labelling.

There is also an Ecodesign Directive that could influence water consumption. Ecodesign in discussed in section 7.2.3.

7.2.2.1 EU Flower Ecolabel

The EU Flower Ecolabel was introduced in 1992 via Council Regulation (EEC) No 880/92 and was revised by Regulation (EC) No 1980/2000 of the European Parliament and of the Council in 2000. Ecolabel criteria for dishwashers and washing machines were introduced in 1998. Along with meeting several lifecycle requirements, the water consumption of dishwashers (l/cycle) must be ≤ (0.625*PS) + 9.25. For washing machines, consumption must be ≤ 12 l/kg.

Application of these formulae to the Waterwise databases revealed that 235 of the 266 dishwashers (88 percent) available in the UK in the first half of 2007 met the Ecolabel requirement for water, and all but one of the 262 washing machines (nearly 100 percent). Despite meeting the water consumption requirement, no UK washing machines or dishwashers currently carry the Ecolabel.

The low penetration of the Ecolabel seems to be widespread to the entire EU: only a very small number of washing machines and dishwashers have ever been labelled, and in recent years no models at all have applied. It has been suggested that manufacturers are not applying for the label because of the complexity and costs associated with application,

which do not weigh favourably against what few market benefits the Flower may have (particularly since the EU Energy Label is seen as more influential).[48]

The scheme costs the EU an estimated €3.4 million annually.[49] Though much criticism has been levied on the scheme, studies have shown that is has been a cost-effective programme that has delivered ecosavings at the EU level.

A study be AEAT in 2004 calculated that the label could deliver CO_2 savings at a cost of less than €1 per tonne *if* 5 percent penetration of the market were achieved. [50] Furthermore, though the direct benefits to the environment in terms of resource savings and pollution prevention have been small, the indirect benefits, i.e. its wider influence on initiatives such as procurement policies, could be described as significant. It has been suggested that the indirect benefits of the label are the means through which to achieve the direct benefits.

The Regulation underpinning the Flower is currently under review following publication in 2005 of the EVER study.[51] This study revealed the lack of consumer recognition and manufacturer knowledge of the Flower, and highlighted this awareness gap as the most significant barrier preventing the success of the Flower. One of the recommendations the study made was that the Commission stop considering the Flower as simply a communication tool targeted at consumers, and start considering it as part of a wider strategy to reduce the environmental impacts of products by delivering appropriate information to all stakeholders.

Noting that communication was essential to the success of the Flower, the study also recommended that the Commission set aside an additional €3 million per year specifically for marketing, and that an additional €3 million per year be raised from Member States. It was also recommended that aside from the existing obligation to conduct national promotional campaigns, Member States should also be obligated to spend at least 20 percent of the annual fees received from Flower holders on promotions.

Some advantages of increasing support and use of the Flower are that,

- it considers the entire life-cycle;
- the framework for operation is already established;
- funding is already in place; and that,
- it is already recognised by Member States, NGOs, and other groups.

[48] Presutto. 2007. Preparatory studies for eco-design requirements of EuPs (Tender TREN/D1/40-2205). LOT 14: Domestic dishwashers and washing machines. Part I: Present situation. Task 1: Definitions, revision three, draft final report. http://www.ecowet-domestic.org.

[49] AEAT, "The direct and indirect benefits of the European Ecolabel – final report", DG Environment, European Commission (2004): http://ec.europa.eu/environment/ecolabel/pdf/market_study/benefitsfinalreport_1104.pdf. Estimate based on assumptions that seven full-time staff on a wage of €100k per year each manage the progamme a the EU level, that €200k of research is done each year, and that each of the twenty-five member states have the equivalent of one full-time person dealing with ecolabel issues at a cost of €100k per year.

[50] *Ibid*.

[51] "EVER: Evaluation of EMAS and Eco-label for their revision", European Commission (2005): http://ec.europa.eu/environment/ecolabel/revision_en.htm.

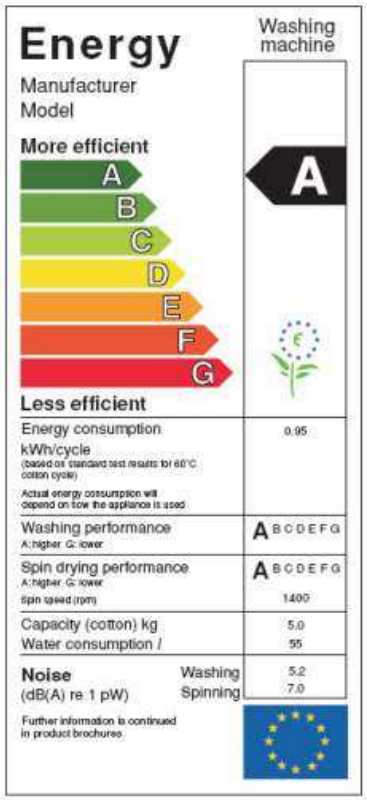
Some disadvantages of the Flower are that,

- the scheme is not cost neutral;
- it is burdened by bureaucracy;
- it is not seen by manufacturers of wet white goods as useful or worth the application effort;
- the existing water requirements are weak;
- the scheme is not widely recognised by the general public in the UK;
- it is a voluntary scheme and so arguably of less effect than a mandatory one; and, that
- it does not appear on inefficient products, which means that consumers must know to look for it when purchasing a product.

The disadvantages associated with this label are many in comparison to the other options presented herein. Some of these disadvantages could be overcome if a multi-stakeholder initiative was undertaken to promote the label to consumers and to convince manufacturers of the label's value. It is unlikely that the application burden and associated bureaucracy could be addressed since the label takes a whole life-cycle approach.

7.2.2.2 EU Energy Label

The EU Energy Labelling scheme was introduced for washing machines in 1995 and for dishwashers in 1999, both under implementing measures to the Energy Labelling Framework Directive 92/75/EEC of 1992.[52] The scheme currently includes A-G ratings for energy efficiency, wash performance and effective drying/spinning. Manufacturers are also required to display water consumption information in l/cycle at the bottom of the label. The scheme is now under complete review with an eye on possibly revising all its elements.



The EU Energy Label has been recognised as a primary driver of energy efficiency improvements in wet white goods, though it has not been alone responsible for the market transformation toward energy efficient products.[53] By 2005, A rated appliances had largely taken over the market. Therefore, in order to distinguish models further, the European Committee of Domestic Equipment Manufacturers (CECED) announced three voluntary industry commitments.

[52] Directives 97/17/EC and 99/9/EC established the scheme for washing machines. Dishwashers were included under Directive 95/12/EC, which was amended in 1996 by Commission Directive 96/89/EC.

[53] "IBNW23: Innovation briefing note on domestic laundry washing products and services", Market Transformation Programme (2007): http://www.mtprog.com.

In 1999, CECED agreed a Unilateral Industry Commitment for the reduction of the energy consumption of dishwashers, which expired in 2004 after achieving its aims.[54] This voluntary commitment included the phasing out by the end of 2000 of all F and G rated dishwashers, as well as E rated models of greater than 10 PS. The agreement also committed the industry to phasing out by the end of 2003 all E rated models and all D rated models of more than 10 PS.

CECED also agreed to two voluntary commitments on washing machines.[55] The first was introduced in 1997 in which manufacturers agreed to stop producing and importing after 1997 any models that were E, F and G rated, excluding those less than 3 kg with E rating and vertical axes models. It was also agreed that manufacturers would stop importing and producing D and E rated models after 1999, excluding D rated models of ≤ 3 kg or those with spin speeds of less than 600 rpm.

This first commitment expired in 2001 after successfully meeting its aims, and was followed immediately thereafter with a second commitment. The second commitment, which expires in 2008, includes the complete phasing out of D rated models by the end of 2003, excluding those without heater and vertical axes, as well as the introduction of an A+ rating that could raise public awareness and distinguish better than A rated models. The A+ rating is not an official EU Energy Label rating, and so is not reported on the Label; instead, it is used in promotional materials by manufacturers and retailers.

Some retailers have since begun to distinguish better than A+ models with an A++ rating. A++ is not an official EU Energy Label rating, nor is it included in any industry commitments.

CECED have recently announced that they will no longer renew or make any more voluntary industry commitments because "patchy government enforcement of the EU's energy labelling scheme […] has undermined industry's ability to go to the next phase of voluntary measures". [56] Instead, CECED are calling for legislation that would be applicable to and enforceable on all market players.

Under the current EU Energy Label scheme, it is mandatory for manufacturers to test the water consumption of dishwashers and washing machines, and to report results on the EU Energy Label; however, there are several problems with this requirement:

- Consumption is not adjusted for capacity;
- Volumes for consumption do not indicate relative efficiency; and,
- The present formatting is of low visibility.

[54] "Voluntary commitment on reducing energy consumption of household dishwashers", CECED (1999): http://www.ceced.eu/ICECED/easnet.dll/GetDoc?APPL=1&DAT_IM=031160.

[55] "Voluntary commitment on reducing energy consumption of domestic washing machines", CECED (1997): http://www.ceced.eu/ICECED/easnet.dll/GetDoc?APPL=1&DAT_IM=031154; and, "Second voluntary commitment on reducing energy consumption of domestic washing machines", CECED (2002): http://www.ceced.eu/ICECED/easnet.dll/GetDoc?APPL=1&DAT_IM=031151.

[56] "Top executives discontinue voluntary energy efficiency agreements for large appliances", press release, CECED (21 March 2007): http://www.ceced.org.

For those consumers wishing to purchase a model with a specific capacity, water consumption in l/cycle is an appropriate measure for comparing like with like. But for those consumers who do not have a preference for a specific capacity (e.g. care little about the difference between 5 kg and 6 kg), consumption that is not adjusted for capacity makes comparisons difficult, in effect leading to the comparison between like with unlike. In these cases, consumption as l/cycle/kg (or PS) would be more helpful.

No matter what units are chosen for water consumption, figures will not be indicative of relative efficiency. Consumer must still actively compare several models before coming to some understanding of a model's relative water efficiency. The great benefit of the Energy Label is that the A-G scale eliminates this need for comparison so that consumers can quickly and easily identify an energy efficient model, without having to divide kWh/cycle by capacity and then actively comparing that figure with other models' figures.

Some would argue that the information necessary to encourage greater water efficiency is already incorporated onto the present label and thus no further action needs to be taken. For those consumers interested in water efficiency, the necessary information is already on the label; for those not interested, changes in the presentation of water information would not influence their purchases.

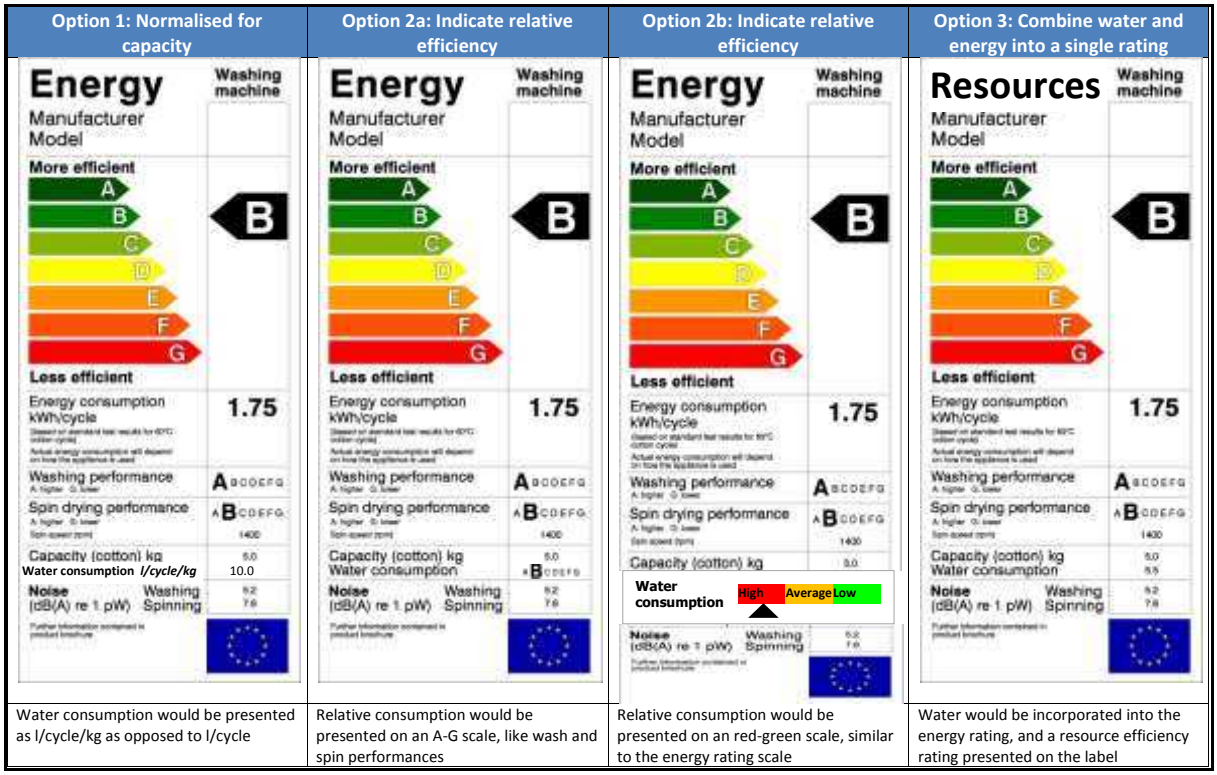
The disadvantage of low visibility is important because it prevents the label from being used as a tool to raise awareness of water efficiency. The argument that water efficiency information is not useful for consumers who do not care about water is moot: labelling programmes can have an awareness raising effect and as metering penetration increases along with water prices, the running costs attributed to water use may well change many peoples' minds about water in the UK. For many other customers in the EU, the water efficiency of appliances is an important factor to consider.[57] For consumers that are *not* concerned, the present label does little to foster interest. For consumers that *are* interested, the present format of the label does not provide information in the most easy-to-understand format.

There are several approaches that may be taken to strengthen the water aspect of the Energy Label (figure 23):

1. Normalise consumption for capacity, i.e. present consumption as l/cycle/kg or l/cycle/PS;
2. Indicate relative efficiency on the label either by,
    a. an A-G scale such as that used for wash and dry/spin performances, or
    b. by a coloured scale similar to that of the energy scale;
3. Combine the energy rating with a water rating, i.e. create an algorithm that would result in a single rating for water and energy; or,
4. Make no changes to the label and instead undertake an awareness raising campaign that would encourage consumers to look at the water information already on the label.

[57] Op. cit. 37.

FIGURE 23. Options for revising the water aspect of the EU Energy Label.



Article 2 of the Energy Labelling Directive already allows for the provision of information related to essential resources other than energy, including water. In order to implement options 1, 2a or 2b, the implementing directives for washing machines and dishwashers would have to be amended to specify the form in which water consumption information should be presented.

Option 3 would likely have to be implemented by amending the EU Energy Labelling Framework Directive and its implementing directives, or by repealing the Directive altogether and instead pursuing a new label through the Ecodesign Directive, which is discussed in the next section. Option 3 would also require a significant amount of work in order to develop an appropriate algorithm and ratings scale.

One disadvantage of pursuing option 3 could be that confusion is created amongst consumers, particularly since products that use energy but no water could still have the old Energy Label. This could be avoided, however, if the old label is completely replaced by a 'resources' label that would be underpinned only by energy if no water is used by the product. 'Resources' may also be confusing since consumers may ask what resources. To overcome this barrier, the label could instead be called 'water and energy'.

Options 1-4 would all require a consumer awareness-raising campaign, though option 3 would likely require a significant effort beyond that of a standard campaign since the label would be in effect a new one. Since campaigns are likely to be undertaken upon revision of the current label, the costs associated with campaigning would not necessarily be more than expected if any of options 1-4 are pursued.

Options 1 would require the least amount of effort, since implementing measures would have to be only slightly amended. One disadvantage of option 1 is that it may encourage manufacturers to overstate capacity in order to reduce the l/cycle/kg value.

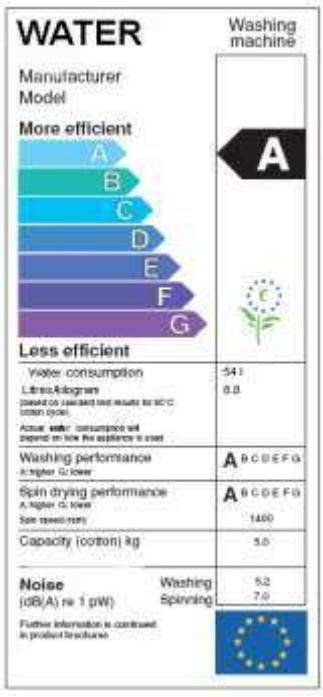
Option 4 would potentially be more cost effective, as messaging concerning water efficiency may be integrated into awareness campaigns already planned for revision of the label. The disadvantage of this option is that it does not address the original problems of normalisation and relative efficiency, still requiring consumers to go one step further to work out water efficiency on their own.

Options 2a and 2b would require more effort in that a definition of 'water efficient' would have to be developed as well as an appropriate scale for water efficiency ratings.

A scaled indicator of water efficiency for washing machines was considered in the ECOWET study, but the conclusion drawn was that "including water efficiency in washing machines shall not proceed on a scaled labelling form as the chances of rinsing performance not being included may be high. Instead, maximum water consumption per cycle will be proposed".[58]

Few stakeholders have yet sided for or against the idea of integrating water a bit more into the EU Energy Label. One stakeholder that has made their position clear is CECED, who believe that strengthening the water element of the EU Energy Label is "extending the environmental relevance of the label" and they suggest instead that focus remain on energy efficiency and energy during use.[59]

The European Commission has shown support for the possibility of expanding existing EU schemes, writing that one way forward in fostering a water saving culture in Europe is to "explore the possibility of expanding existing EU labelling schemes whenever appropriate in order to promote water efficient devices and water-friendly products".[60]



7.2.3 New UK or EU voluntary or mandatory label

Another approach to addressing the water consumption of wet white goods would be to introduce a new label either at the EU or UK level, possibly modelled on the EU Energy Label.

Advantages of introducing a new label would be that,

[58] *Op. cit*. 24.

[59] "Submission to the European Commission Consultation Document on the revision of the Energy Labelling Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances", CECED (2008): http://ec.europa.eu/energy/demand/legislation/domestic_en.htm.

[60] "Addressing the challenge of water scarcity and droughts in the European Union", communication from the Commission to the European Parliament and Council (18 June 2007): http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0414:FIN:EN:PDF.

- it would be water specific;
- it could be mandatory, which would arguably be more effective than a voluntary scheme; and that
- it would be extendable to other water-using products.

Disadvantages of the new label would be that,

- initial implementation would require significant resources;
- annual funding would have to be obtained;
- some Member States may oppose its introduction because water is not viewed as a priority;
- it may not complement an energy label, but rather conflict - for instance, a product may be rated highly according to energy and not water; and that
- consumers may be confused by the new label, some equating greater efficiency with less water with worse performance.

Introducing a new mandatory label at the EU level could be difficult, given that different Member States prioritise water efficiency differently. The introduction of a voluntary EU water label could be easier, but given that the Flower and the EU Energy Label already exist, a new scheme may only serve to confuse consumers and prevent manufacturers from participating.

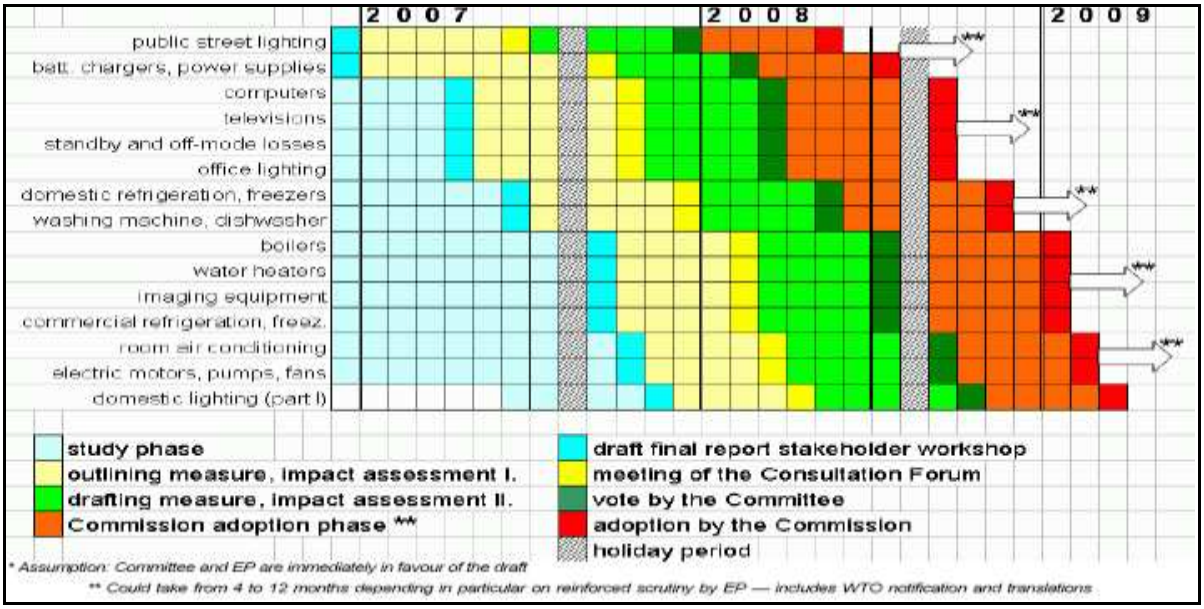
There is some scope to introduce a mandatory water label in the UK, though it would be difficult given European single-market rules. Much greater possibility exists for introducing a voluntary water label, but since three such schemes already exist in the UK (BMA Label, ESR and Marque) efforts may be better directed at improving one or more of these labels.

Another option quite different from those already presented would be to utilise the Ecodesign Directive in order to promote greater water efficiency amongst wet white goods. In 2005, Directive 2005/32/EC of the European Parliament and of the Council established a framework for setting ecodesign requirements for energy-using products, which would have to be met by all products sold in the EU. The purpose of this Directive was to improve energy efficiency and to ensure the free movement of products.

The recently concluded ECOWET study that was required under ecodesign regulations will be used to inform the development of ecodesign implementation directives for domestic dishwashers and washing machines. The Commission, in consultation with stakeholders, will introduce implementing measures that specify ecodesign requirements and that may also require the provision of additional information by manufacturers to consumers.

For dishwashers and washing machines, outlining measures were to be introduced late in 2007 (figure 24); however, the study phase has only just completed with publication of a final report. It is expected therefore that the process has been delayed by several months.

FIGURE 24. Planning for the adoption of ecodesign implementing measures.[61]



It would be possible to merge Ecodesign and Labelling into one programme:

- Ecodesign could be amended to require the provision of information by manufacturers and retailers to consumers, which could then be done via the existing EU Energy Label, which under Article 6 of the Labelling Directive allows for the provision of other information pursuant to other Community legislation; or,
- Ecodesign could be amended to require manufacturers and retailers to provide information via a new labelling scheme.

The present incarnation of the Ecodesign Directive does not call for the provision of information to consumers. Once implementation measures are introduced, products sold in the EU that fall under that measure must carry the CE label to show that they conform to minimum standards. Those products that have received a Flower Ecolabel will generally be considered to meet Ecodesign requirements.[62]

The main differences between Labelling and Ecodesign are that labelling is confined to household products and assigns duties to manufacturers and to retailers. Ecodesign covers all energy using products and assigns duties only to manufacturers. The Labelling Directive calls for implementing directives, whereas Ecodesign allows for implementing measures to be either decisions or regulations. This is of benefit to Member States since it reduces legislative burden, and also to manufacturers who do not then have to wait for all Member States to adopt legislation. In order to use regulations to implement Energy Labelling, the Framework Directive would have to be amended.

While it is important to maintain simplicity in the marketplace by avoiding the introduction of confusing labels and by preventing a proliferation of multiple labels, it is also important to

[61] "Impact assessment study on a possible extension, tightening or simplification of the framework directive 92/75 EEC on energy labelling of household appliances", Europe Economics and Fraunhofer-ISI with BSR Sustainability and FfE (2007): http://ec.europa.eu/energy/demand/legislation/domestic_en.htm.
[62] *Ibid*.

provide consumers with the information they need in order to make informed purchases. It is also important, arguably, to raise consumer awareness of issues that will become more pressing in the future. Therefore, there is a fine balance between providing consumer information and transforming the market.

Water requirements introduced under Ecodesign would help move the market toward greater water efficiency, but would do little to raise awareness of water issues and so would do little to change consumer behaviours in respect to the 'water wise' use of appliances. Alternatively, a label could raise consumer awareness as well as transform the market.

Neither Ecodesign requirements nor a water efficiency label will ensure maximum water efficiency amongst wet white goods, for two main reasons:

- The prioritisation of water efficiency varies between Member States, and so requirements set at an EU level may not have as strong an effect as if they were set by and for the UK market; and,
- Consumer behaviours have a significant influence over the operational water efficiency of wet white goods.

For these reasons, the best approach to encourage greater water efficiency may be to utilise several tools as part of a comprehensive package, which would include one or more of the options outlined in the next section.

7.3 Other options

There are several other tools that when combined together can improve the technical and operational water efficiencies of washing machines and dishwashers:

- Public procurement;
- Private procurement;
- Consumer incentives such as cash rebates, VAT reductions, subsidies, etc;
- Mandatory minimum standards;
- Voluntary industry agreements/initiatives;
- Voluntary retailer agreements/initiatives;
- Communications campaigns; and,
- Accessible databases.

A label does not exist in isolation, and initiatives such as public procurement programmes are not always influential on their own, particularly in relation to wet white goods for which user behaviours heavily influence operational water efficiency. The most effective strategy would set a clear goal and then roll out a comprehensive programme.[63]

[63] Boardman, "Achieving energy efficiency through product policy: the UK experience", Environmental Science and Policy 7 (2004): 169.

Appendix 1. Water consumption of components of domestic demand

Note that Waterwise are currently revising this table.

Component	Typical Consumption	Range of Consumption
Bath	80 l per event	50 – 350 l per event
Brushing teeth		
While tap running	6 l per min	2 – 20 l per min
Using a cup	1 l per event	0.5 – 2 l per event
Car washing		
Drive-in, conventional	150 l per event	80 – 300 l per event
Drive-in, reuses water	30 l per event	10 – 50 l per event
Drive-in, pressurized spray	50 l per event	45 – 55 l per event
DIY, hosepipe with trigger gun/nozzle	300 l per event	150 – 400 l per event
DIY, bucket	35 l per event	10 – 70 l per event
Waterless spray	0 l per event	0 – 2 l per event
Cooking (excluding food prep & washing up)	5 l per day	2 – 10 l per day
Dishwashing machines		
Manufactured before 2000	25 l per load	15 – 50 l per load
Manufactured post-2000		
Normal setting	14 l per load	7 – 19 l per load
Eco setting	10 l per load	8 – 12 l per load
Drinking	2 l per day	1 – 4 l per day
Food prep		
Under a running tap	9 l per min	6 – 25 l per min
Using a bowl, tap off	8 l per event	5 – 10 l per event
Plugged sink	16 l per event	8 – 32 l per event
Hosepipe		
With trigger gun/nozzle	600 l per hr	400 – 800 l per hr
Without	1000 l per hr	600 – 1200 l per hr
Pressure washer	400 l per hr	330 – 600 l per hr
Shaving		
While tap running	6 l per min	2 – 20 l per min
Using a cup	1 l per event	0.5 – 2 l per event
Plugged basin	6 l per event	4 – 15 l per event
Shower		
Electric (kettle-on-the-wall)	6 l per min	3 – 9 l per min
Mixer		
Gravity fed	9 l per min	4 – 14 l per min
Mains fed	15 l per min	12 – 25 l per min
Aerated or water efficient	8 l per min	6 – 8 l per min
Power shower	15 l per min	13 – 16 l per min
Super sized showerhead	25 l per min	20 – 35 l per min
Multiple showerheads	45 l per min	30+ l per min
Sprinkler	1000 l per hr	600 – 1200 l per hr
Tap, dripping	15 l per day	5 – 75 l per day
Tap, running		
Kitchen	9 l per min	6 – 25 l per min
Basin	6 l per min	2 – 20 l per min
Toilet		
Manufactured before 1991	10 l per flush	9 – 14 l per flush
Manufactured 1991-2001	8 l per flush	7.5 – 9 l per flush
Manufactured post-2001	5 l per flush	3 – 6.5 l per flush
Washer-drier	32 l per kg washed and dried	18 – 54 l per kg washed and dried
Washing hands and/or face		
While tap running	6 l per min	2 – 20 l per min
Plugged basin	6 l per event	4 – 15 l per event
Washing machine		
Manufactured before 2000	80 l per load	50 – 110 l per load
Manufactured post-2000		
Normal setting	50 l per load	40 – 75 l per load
Eco setting	35 l per load	30 – 40 l per load
Washing up		
Under running tap	9 l per min	6 – 25 l per min
Using a bowl, tap off	8 l per event	5 – 10 l per event
Plugged sink	16 l per event	8 – 32 l per event
Waste disposal unit (used with running water)	9 l per min	6 – 25 l per min

Appendix 2. 2007 Waterwise databases

The information contained in the 2007 Waterwise databases of washing machines and dishwashers was collected from the websites and publications of manufacturers (e.g. product catalogues and user manuals), and/or from their customer service representatives.

The information reported by manufacturers is in accordance with the EU Energy Labelling Directive, and has been verified by testing according to the test standards that underpin the Labelling Directive.

Though Waterwise have made every effort to ensure the accuracy of the information presented in these databases, we accept no responsibility for the content or for any decisions made based on the content.

Where information seemed inaccurate, e.g. if the manufacturer's declared energy rating was higher than the Waterwise rating obtained after applying the EU Energy Rating formula to the declared kWh/cycle, the model was removed from the database.

Many of the machines listed in the databases may be listed more than once, e.g. models that vary in colour have usually been listed separately and models that vary in spin speed but are otherwise operated by the same engine have also been listed separately. In general, where the manufacturer has indicated a different model number, we have listed the model separately. In some cases, however, we have listed machines that come in more than one colour only once (i.e. instead of listing WMA1365B and WMA1365W separately, we have listed WMA1365B/W once).

Though these discrepancies may bias the databases somewhat, there was no other approach available to us at the time. Manufacturers were not able to provide information about which of their models were actually the same skeletal model, and many machines are also identical except for the brand name under which they are sold. Since the databases were intended to be used by consumers as a decision-making tool, the tables were populated under the assumption that a different model number would mean a different model to the purchaser.

Furthermore, no information was available for the water use of different programmes on a model. Waterwise recognise that the information presented on the EU Energy Label is not necessarily indicative of the operational efficiency of washing machines and of dishwashers, as operational efficiency will be influenced by load size, choice of programme, detergent dosage, etc. The information available to Waterwise represents the best attainable at present.

Furthermore, Waterwise recognise that A+ and A++ categories have no legal standing. These were use in this study, however, for comparative assessment since A no longer breaks up the market.

The full 2007 Waterwise database of washing machines includes models that are freestanding, semi-integrated, and integrated. These have all been included in this study, and only represent full-size, front-loading machines.

The full 2007 Waterwise database of dishwashers includes models that are integrated, semi-integrated, freestanding and other (e.g. countertop, undercounter, tabletop, etc.). Models that were 'other' have been excluded from this study on the grounds that they may be representative of technology different to the 'standard' models, and so would act as outliers in the study to skew results. Both full-size and slim-size models have been included, since both represent the same technology but with smaller capacities.

For both dishwashers and washing machines, there were a handful of models that were clear outliers - these were excluded from analyses in order to prevent distortion of results. These models were often of atypical capacity or marketed as 'heavy-duty' models with atypical water consumptions.

The full databases for 2007 can be accessed from the Waterwise website, in both PDF and Excel versions.[64]

[64] http://www.waterwise.org.uk/reducing_water_wastage_in_the_uk/house_and_garden/save_water_at_home.html.