

RETROFITTING FOR WATER EFFICIENCY: A HOTEL CASE STUDY

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ABSTRACT

Water efficiency in building makes good environmental, economic and social sense. There are improvements to water efficiency standards in new buildings – domestic and non-domestic which is influenced by recent changes to building regulations, increase in environmental awareness, corporate social responsibility, delivering better lifetime value to clients and customers etc. Retrofitting water efficiency in existing buildings however, can be more challenging due to uncertainties about the cost-benefits of certain technologies, existing building systems and products, existing and anticipated user response and engagement etc.

This paper will present a retrofitting case study of a small to medium sized hotel in Sussex, England. It will discuss the reason for the retrofit program from the hotel and water company perspective. It will then discuss the methodological approach to determining the potential and actual outcomes of the water efficiency retrofits, integrating the client and user perspective where necessary. The paper will conclude with lessons learned and recommendations to similar programmes on hotel sites.

This project is carried out collaboratively by the Lodge at Winchelsea, Changers Building Supplies, Southern Water and the Water Efficiency Lab, University of Brighton.

Keywords: Cost savings, small to medium sized hotel, water efficiency retrofits, water savings

INTRODUCTION

Water efficiency in buildings is promoted through building services design, water efficient plumbing fixtures and fittings and the efficient use of water by water users.

Previously, there has been significant interest and research application on the efficiency of plumbing fittings and behaviour change of water users particularly in domestic buildings. However, there is a changing trend to non-domestic buildings and strategies for water efficient retrofits in buildings; domestic and non-domestic.

Water efficiency for domestic uses goes beyond the use of water in individual houses and apartments. Collective water use in other 'residential' settings such as halls of residences and hotels is an important aspect of understanding and promoting water efficient practises when the water user is not directly responsible or accountable for their water use.

This paper presents a case study of water efficiency retrofit in a small to medium sized hotel in the South East of England. It discusses the purpose and approach taken to the retrofit program. It then presents the potential and actual outcomes of the water efficiency retrofits, integrating the client and user perspective where necessary. The paper concludes with lessons learned and recommendations to similar programs on hotel sites.

CASE STUDY AND METHODOLOGY

The case study hotel consists of 28 guest rooms of various sizes and capacity, a reception, bar and restaurant area, kitchen, 1 function room, guest and staff toilet facilities, laundry facilities, staff accommodation and predominantly hard standing landscaping with some planted hedges, planters and potted plants.

The analysis is derived from measured flow-rates in sampled rooms, use factors in the water efficiency calculator (DCLG 2009) and occupancy data factoring in seasonal differences and projected savings from retrofits to water using fittings in guest rooms. The efficacy of the water calculator has been reviewed by researchers (e.g. Churchill, Booth and Charlesworth 2014). This benchmark was nonetheless considered credible for use in the absence of actual use figures from guests during the study period.

The rationale for the pilot scheme from both the hotel and water company perspective are enumerated below.

The Hotel

As with most businesses in a competitive market, the case study hotel is always looking at ways to reduce wastage and, more importantly, cost. In doing so, the hotel is able to price its services attractively and maintain profit margins. The challenges to this are that some operational elements of consumption by the guests staying the hotel are hard to monitor and control such as electricity usage and water consumption in the guest rooms.

The Lodge's involvement in this project was aimed at reducing environmental impact and deriving further value for customers by achieving water savings in the guest rooms whilst making sure their experience remains positive and their comfort is not compromised or diminished.

The hotel manager was aware of some of the water saving retrofit options but by engaging with others to explore retrofit options, was delighted to see the large range of options that are now available. Also, the importance of engaging with guests in the process was crucial

"We are aware that changing bathroom facilities is not the whole solution to water usage and have introduced more information and guidance for guests in the rooms"

The project particularly demonstrates how organisations can work together to achieve business and environmental objectives.

Water Company

Southern Water undertook this pilot project to further its understanding of how it can effectively assist small and medium sized businesses (SMEs) with new products and services. This particular project is being carried out in conjunction with other key studies including a university, guest house, hairdresser and school to increase the understanding of the needs and challenges of delivering new products and services in its Business Plan over the next five years.

Following the roll out of its Universal Metering Programme and the forthcoming introduction of commercial competition in the water sector, Southern Water is adapting its services to reflect the changing needs of customers. This pilot study is modelling key elements including: 1) speed of service 2) financial impact 3) robustness of products and 4) customer service.

This particular hotel was chosen because it was a good example of a robust medium sized business, similar to many spread across the Southern Water region. It also has an engaged hotel manager that is actively looking at ways of cutting costs and had already demonstrated an understanding of water saving through the requesting of save-a-flush bags to cut usage in hotel toilets. An effective water efficiency programme relies on several important factors, one of the most important is the passion of individuals and businesses to actively engage and put in place the dedication and planning to make a real difference.

OVERVIEW OF INTERVENTIONS IN GUEST ROOMS

The billing data from May 2012-13 and the water use and fittings audit in October 2013 found that the water use in guest bedrooms including housekeeping accounted for a little over 80% of the Lodge's total water consumption. Pre-retrofit analysis show a 25% potential savings from the current retrofit programme and a further 10-15% savings if the WC cisterns and hot/cold basin taps are replaced and guests reduce shower times to an average of 5 minutes.

The breakdown of water consumption in guest rooms is shown in Figure 1 below, calculated using occupancy factors and the use factors specified in DCLG (2009). The

current figures do not account for behavioural variations and they are based on aggregated annual occupancy percentages alone.

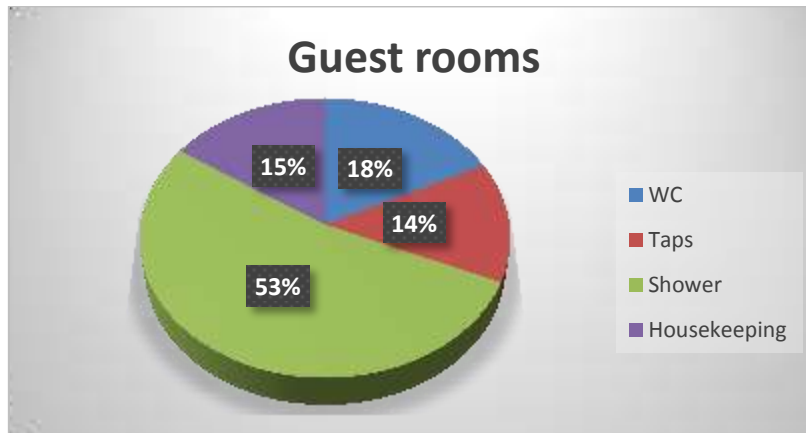


Figure 1: Percentage breakdown of water use in guest rooms

Taps

Figure 1 show that there is potential for further water savings in the proposed tap retrofits. Majority of the guest rooms have single hot and cold water taps as shown in Figure 2 below. The average flow rate of cold water taps was 20 litres per minute (l/m) and 8l/m for hot water taps. By comparison, the average flow rate from the mixer taps with flow regulators was 5l/m.



Figure 2: Separate hot and cold water in majority of guest rooms

It is understood that there are plans to upgrade the existing single hot/cold basin taps in the near future and the previous figures highlight the savings possible from efficient taps. Considering the wide variance in flow rates in the existing hot and cold taps, retrofitting to 4-5 litre mixer taps can potentially provide a further 20-40% savings on current tap use figures.

Toilet cisterns

Majority of the guest rooms currently have a 13 litre per flush cistern which were retrofitted to provide dual flush capability i.e. 13/6.5 litre flushes, or an average of 9.5litres per flush. This retrofit has the potential to reduce water used for flushing by

between 20-25% on current consumption levels, with a further savings of up to 25% if the old systems are replaced with 6/4litre dual flush cisterns.



Figure 3: Ecobeta® cistern retrofit

Showers

The performance of a shower is affected by a number of variables; existing water supply pressure, the type of shower supply and control mechanisms, shower head design etc. The range of the existing shower types and supply/operation systems, as well as low water pressure in parts of the hotel meant that the most significant savings occurred in the rooms with pressurised shower systems – potential saving of up to 9litres per minute if retrofitted with the Methven's® range of Eco-showers.



Figure 3: Typical shower cubicle in the upper floor guest rooms

Based on the data generated from sampled rooms and assuming 8-minute average shower duration, the current retrofit program potentially offers 35-40% savings on current water consumption in showers. A further 20% is possible with successful behaviour change interventions that result in shorter 4-5 minute showers per guest.

Housekeeping

Water use in housekeeping is a significant percentage of water use in guest rooms and can be equivalent to an extra 0.5-1 person in the room in some instances. Assuming 1 x toilet flush, 1min x tap and shower use, housekeeping accounts for up to 19% of water use in the guest rooms. Retrofitting water saving fittings offers potential savings of 25-35% on existing water use for housekeeping.

Other areas

Due to insufficient data, it was not possible to offer projections on water use in other areas of the hotel. These areas include; public/staff guest 3 x washrooms, kitchen, bar, staff accommodation and laundry facilities.

The newly installed 3 x 200litres water butts on site should sufficiently offset outdoor water use at the hotel.

PRE- AND POST-RETROFIT ANALYSIS

Using billing data from May 2012-13, the per capita consumption per guest per annum at the hotel was approximately 270-310m³ per occupied bed, with total occupancy of approximately 6160 guests per annum. The best consumption figure for hotels is 227 m³ per bed and worse 435 m³ per bed (City West Water 2012).

In the first quarter since the retrofit, per capita consumption per guest reduced to on average 242 litres, ranging from 210-267 litres per guest for the months between November 2013 and February 2014. Therefore, the aggregate annual per capita consumption (per guest) is projected to be in the range of 210-250 litres after retrofits. If this trend continues, this equates to approximately 20-24% savings in the overall water use on the site including guestrooms, communal facilities and outdoor functions compared to original figures will be achieved.

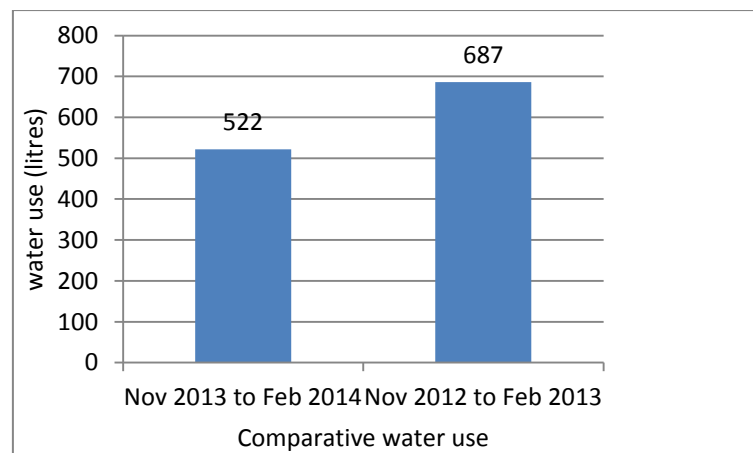


Figure 4: Current normalised savings show 24% water savings since the retrofit program was implemented.

The granularity of the audit data conducted prior to the retrofit program allows for further analysis of water use in the guest rooms. This was carried out using water consumption and occupancy data for the quarter as well as projected use factors.

It was found that retrofits to the taps and showers led to water use savings in these fittings. Comparatively, a measured increase to water use in WCs and a slight increase to the water used for housekeeping were observed. The increase in water use in WCs can be due to a number of factors including; increase in use by guests or misuse repetitive use linked to the performance of the retrofit systems on the old cisterns, inappropriate use of the dual flush cisterns where installed. This however needs further exploration.

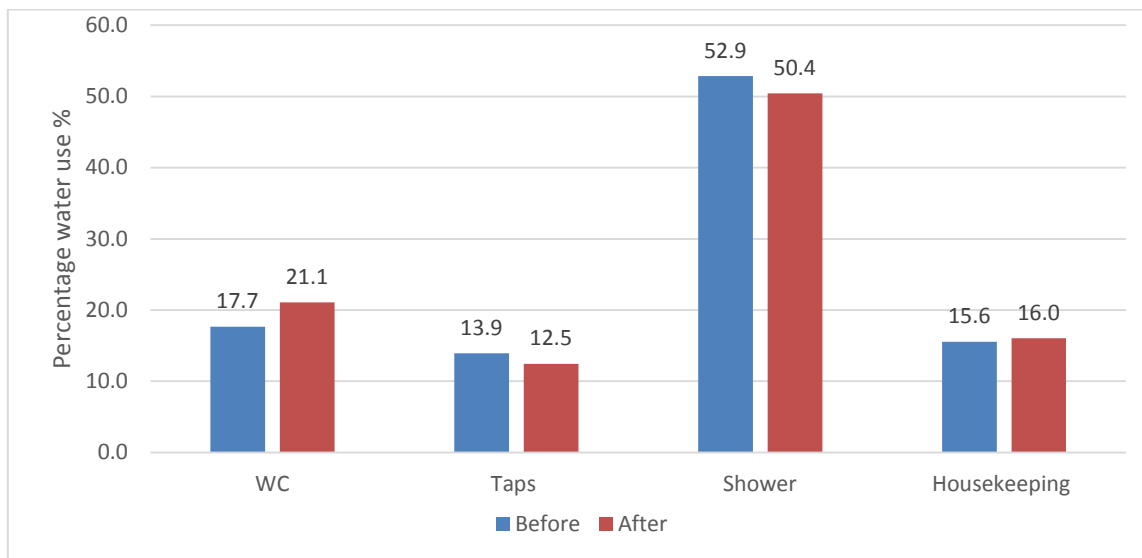


Figure 5: Percentage breakdown of water use in guestrooms, showing before and after the retrofits

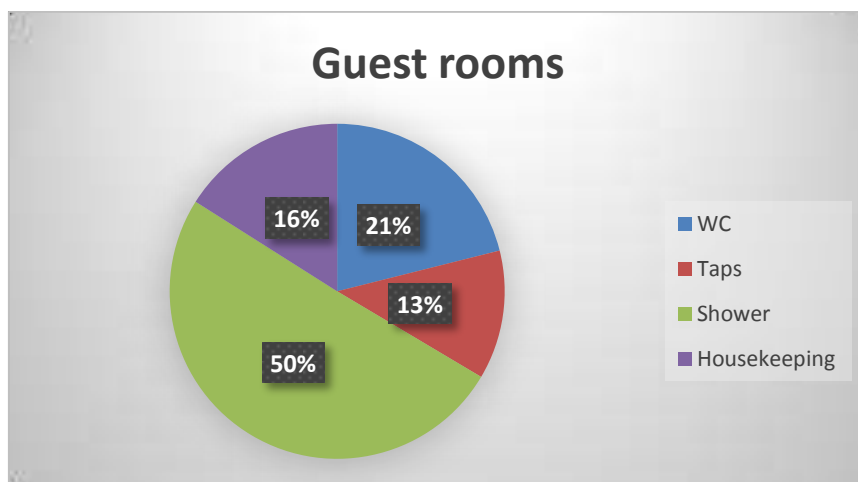


Figure 6: Percentage breakdown of water use in guest rooms post-retrofit (first quarter)

The retrofit program covered fittings and fixtures that were quick and easy to change and excluded changes that would lead to disruption in the operation of the hotel, or require large capital investment. There is therefore further scope to reduce water consumption to below 200 litres per guest per day. That is if the flow rate of all basin taps are reduced to 5litres per minute (4 x average daily use factor), all showers use on average 7litres

/minute (1.5 x 8minute shower duration), all toilets use 9.5 or 6 litres maximum accounting for the Ecobeta retrofits (4 x average daily use factor).

COST PROJECTIONS AND CURRENT SAVINGS

The capital cost of the retrofit program was around £2500.00; Labour £800 (Incl travel cost), Materials £1700 (Shower Heads & Regulators, Retrofit Dual Flush Cistern Devices, Mixer Regulators, Water Butts and Hose Triggers).

Table 1: Projected cost savings from retrofit interventions

	Breakdown of charges														Annual projected savings
	Number of days in billing period	Total Usage	% of water returned to sewer	Wastewater volume in cubic metres	Clean Volume/variable charge	Clean standing charge	Wastewater Drainage	Waste standing charge	Surface Water Drainage charge	Highway Drainage charge	Total excl VAT	VAT	VAT rate	Total incl VAT	
Bill data from May 2012-2013	377	1909.00	95.00	1813.55	2173.26	18.74	3799.27	13.29	0.00	7.25	6011.81	603.37	0.20	6615.18	
<i>Resolved to 1 calendar year of 365 days</i>	365	1848.24	95.00	1755.82	2104.08	18.14	3799.27	12.87	0.00	7.02	6011.81	584.17	0.20	6404.61	
Annual at 20% less water	365	1478.59	95.00	1404.66	1728.47	18.14	3087.44	12.87	0.00	7.02	4853.94	970.79	0.20	5824.73	579.88
Annual at 40% less water	365	1108.94	95.00	1053.49	1296.35	18.14	2315.58	12.87	0.00	7.02	3649.96	729.99	0.20	4379.96	2024.66

The analysis prior to the retrofit program showed projected savings of 35% on current retrofits, so a conservative range of 20-40% was anticipated. Based on billing figures and an annual consumption from May 2012-13 of 1909.00m³, at the time of the retrofit program, a projection of best and worst case savings was calculated as shown in Table 1.

Table 2: Actual cost savings from retrofit interventions

Actual	Breakdown of charges													
	Number of days in billing period	Total Usage	% of water returned to sewer	Wastewater volume in cubic metres	Clean Volume/variable charge	Clean standing charge	Wastewater Drainage	Waste standing charge	Surface Water Drainage charge	Highway Drainage charge	Total excl VAT	VAT	VAT rate	Total incl VAT
Bill data from Nov 2013-Feb 2014	122	521.54	95.00	495.46	609.68	4.20	1089.03	3.29	0.00	1.91	1708.11	341.62	0.20	2049.73
<i>Resolved to 1 calendar year of 365 days</i>	365	1560.35	95.00	1482.33	1824.04	12.57	1089.03	9.84	0.00	5.71	1708.11	1022.06	0.20	6132.39
Bill data from Nov 2013-Feb 2014 (without tariff change)	122	521.54	95.00	495.46	591.43	2.75	1030.56	1.89	0.00	1.04	1627.67	325.53	0.20	1953.20
<i>Resolved to 1 calendar year of 365 days</i>	365	1560.35	95.00	1482.33	1769.43	8.23	1030.56	5.65	0.00	3.11	1627.67	973.93	0.20	5843.60
Bill data from Nov 2012-Feb 2012 (without tariff change)	190	1069.20	95.00	1015.74	1212.47	2.75	2112.74	1.89	0.00	1.04	3330.89	666.18	0.20	3997.07
Normalised Bill data from Nov 2012-Feb 2012 (without tariff change)	122	686.54	95.00	652.21	778.54	2.75	1356.60	1.89	0.00	1.04	2140.82	428.16	0.20	2568.98

The figures above takes into account the tariff changes during the period. Based on a good and better scenario, the figures suggest a 9-30% cost savings on water and sewerage bills for the hotel.

Table 2 shows a breakdown of savings based on the actual billing figures in the first quarter (November 2013 to February 2014) since the retrofit.

The billing analysis shows £519.25 savings per quarter if compared directly with the previous year; achieving the forecast minimum of 20% savings. Since February 2013, there has been a tariff increase of about 3% and 5% for clean and waste water respectively. When the tariff changes are considered, then cost savings of 24% was achieved compared to the same winter quarterly period in the previous year.

Therefore at current levels of water savings, the payback for the retrofit scheme is 1.25 years, and about one year, if the tariff increase is factored in.

DISCUSSION

The previous sections have introduced and discussed the rationale, method and findings for retrofitting water efficiency in an hotel in South East England. An interim water consumption and billing data analysis for the first quarter of the year since the retrofit show a 24% reduction in water use across the hotel and a 20% cost savings on the water bill.

Reduction in water use was also found in the use of taps and showers in the water fittings. However, a slight increase was found in water use in WCs and this will be further explored in the following months.

It is however worth noting that these data are from water use during the first quarter since the retrofit scheme was implemented. Further data collection and analysis is required to determine whether these savings will be sustained, or whether they increase or decrease over time. Continued data collection will also confirm if there are seasonal changes to water use in the hotel and the extent to which this affects the effectiveness of the scheme to deliver water and cost savings year on year. The study team will also explore the potential to further improve the granularity of the datasets to improve the capacity to determine the extent to which the water and resulting cost savings are due to the water fittings retrofit, guest behaviour or a combination of both.

Further steps in the study include:

- Continued metering and occupancy data: Regular metering data combined with periodic occupancy data will help to deconstruct the water use in the guest rooms and provide further insights into percentage water use in other areas of the hotel.
- Further audits and user data is required for water use analysis in the remaining areas of the hotel.

CONCLUSION

The retrofit program discussed in this paper was embarked on to deliver some water and associated cost savings to the hotel, and to provide some evidence to further demonstrate the viability of such schemes on a wider scale. This to a large extent has been achieved, and the monitoring of the potential for continued savings from the scheme is ongoing. However, to achieve sustained cost benefits and water savings from the scheme, targeted information is recommended for staff and guests to include advice on how to use the new fittings as well as an encouragement to 'adjust' their behaviour to suit. This baseline information is necessary for the effective design and implementation of information and behaviour change strategies.

Further steps

Since this preliminary review, the hotel has implemented further work in some of the guest rooms to upgrade some single flush toilets to dual flush.

The introduction of more information and guidance for guests in the room folders has had some impact but on a very small scale in comparison to the bathroom refitting. Guests behave differently in hotels and are generally more wasteful than they would be at home. As a result highly visual awareness notices are likely to be more effective and the hotel hopes that the water company will again produce tasteful stickers as they have done before in collaboration with the Tourism Board.

In terms of the effect this retrofit has had on the case study hotel, the feedback from the manager is that:

"We are delighted to be saving not only costs but water too. Our customers have been impressed with the facilities and even though we are a budget hotel we are providing facilities above expectation. I wholeheartedly recommend other hoteliers seriously consider the improvements they could be making to their profits and the environment with some simple changes to their bathroom facilities and a bit of educational material for their clients."

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