



Paper

**Greening the economy – Greywater treatment and flow rate
regulation as a job generator, water, energy and CO2 saver**

By the Malta Business Bureau's EU LIFE+ Investing in Water Project

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Abstract

The EU LIFE+ Investing in Water Project has identified that an industry wide adoption of shower and wash-hand basin flow rate regulation, and grey-water treatment by hotels could lead to considerable savings in water and electricity consumption. The adoption of these three water saving measures would lead to an industry level reduction in water use of 37%, and significant energy savings on heating.

This paper is based on water audits carried out by the project in 63 hotels over the period February 2012 to December 2013, representing 45% of hotels in Malta. This paper explores the contribution of these key water saving measures to the Green Economy, and is a follow up to the project paper titled 'The Hotel Industry – a shift to greener, lower cost operations' published by the project on the 27th September 2013¹.

¹ This paper may be downloaded from the project website www.investinginwater.org/downloadables/

1. An industry wide adoption of key water saving measures

Experience carrying out water audits in nearly half of Malta's hotels shows that the three key water saving measures are:

- Flow rate regulation of showers
- Flow rate regulation of wash-hand basins
- Grey-water treatment and use

Optimal flow rates for showers and wash-hand basins were identified based on best practice implemented in key 5* hotels. During the audits, it was observed that most showers and wash-hand basins taps were issuing water at flow rates that were higher than these optimal flow rates, sometimes multiple times the recommended values.

Regulating these flow rates would result in considerable water savings. Given that showers and wash-hand basins also use heated water, regulating flow rates would also result in a reduction in energy used for water heating. Experience from the water audits carried out in hotels in Malta has shown that this energy reduction actually generates greater financial savings than those achieved through reduced water consumption.

In addition, hotels have a high demand for 2nd class water used mainly for flushing toilets, floor washing, and landscaping. In some cases 2nd class water use makes up for as much as 40% of total water use within the hotel. This demand can be met through grey-water recycling – which is the in-house treatment of shower and wash-hand basin wastewater to 2nd class quality for re-use.

An industry wide adoption of these three measures would result in the below estimated savings:

Hotels	Wash-hand basins	Showers	Grey water recycling potential (minimum)	% of current consumption
5 star	2.51%	9.00%	18.26%	29.77%
4 star	4.14%	14.28%	21.38%	39.8%
3 star	4.68%	5.70%	27.01%	37.39%
Totals	<u>3.73%</u>	<u>12.05%</u>	<u>21.75%</u>	<u>37.53%</u>

Table 1: Savings as a proportion of total water consumption, by hotel category

2. Financial savings through industry wide adoption of key water saving measures

The project has calculated the volumes that can be saved from the implementation of key water saving measures and the monetary value of the savings arising thereof. In order to do so the project used water consumption and guest night data tied to 2011 and/or 2012, as provided by audited hotels. Actual savings will depend on the guest nights, and therefore, as guest nights fluctuate slightly from year to year, the savings presented below can also be expected to fluctuate slightly from year to year.

2.1 Savings in water

In absolute volumes, the water savings that can be accrued from the implementation of the above mentioned water saving and water recycling measures are tabulated below.

Hotels	Wash-hand basins	Showers	Grey water recycling potential (minimum)	Totals
5 star	21,000	75,400	153,000	249,400
4 star	49,800	171,700	257,000	478,500
3 star	14,200	17,300	82,000	113,500
Totals	85,000	264,400	492,000	841,400

Table 2: Water savings arising from the implementation of water saving solutions in hotels (in m³/year)

These figures have been arrived at by using the results in Table 1, and actual water consumption figures for 2011/2012. The figures therefore reflect the hotel occupancy levels in 2011 and 2012, as well as the water use practices pertaining to these years. As hotel occupancy levels fluctuate slightly from year to year, so too will the savings figures.

Assuming that 80% of 5 star hotels get their water from their own seawater RO plants, falling to 60% of 4 star, 5% of 3 star and 0% of 2 star, out of a total 2,354,000 m³ of water used by hotels, then it can be seen that:

- 1,406,824 m³ of the total water used by hotels comes from hotel RO plants (60%)
- 947,176 m³ comes from the Mains water supply (40%)

At an estimated unit cost of EUR 1.65/m³² for RO water, and EUR 2.50/m³ for mains water, the total cost of production of water used by hotels in Malta works out at EUR 4,689,200/year or EUR 1.99/m³ on average. So, for a total savings of 841,400 m³/year at an average unit cost of EUR 1.99/m³, annual monetary savings become EUR 1,674,386.

² includes amortisation of the RO plant over 15 years

2.2 Savings in energy

2.2.1 Savings in Electricity (kWh/year)

Table 3 shows the amount of electricity that can be saved from the national electricity grid (in kWh/year) if all hotels were to adopt restrictors on taps or showers (or use water saving showerheads), and if all hotels were to install greywater systems. The calculations assume that all the hotels in Malta are using town water and/or RO (i.e. bowser water supplies and the use of seawater for the flushing of toilets are not considered) and the energy saved is therefore the electricity saved in producing this water. This also includes the electricity used by WSC in producing the water and delivering it to the hotels.

Hotels	Wash-hand basins	Showers	Grey water recycling potential (minimum*)	Totals
5 star	106,900	383,300	701,200	1,191,400
4 star	257,000	886,500	1,198,800	2,342,300
3 star	76,600	93,300	401,100	571,000
<u>Totals</u>	<u>440,500</u>	<u>1,363,100</u>	<u>2,301,100</u>	<u>4,104,700</u>

Table 3: Electricity savings by implementing water saving measures (in kWh/year)

Assuming the cost of electricity at EUR 0.15/m³, as at current commercial prices, the total monetary savings in electricity amounts to EUR 615,705/year.

2.2.2 Savings in Fuel (litres/year)

Given that around 50% of the water used in showers and wash hand basins in guest rooms is hot water, any savings in water will result in a savings of fuel used in boilers to heat up the water that is used by guests in the guest rooms.

The fuel savings are calculated on the basis of information obtained from three hotels which implemented flow regulation devices (restrictors) on showers and wash-hand basins. These hotels used fuel to heat water, at a requirement of 8 litres of fuel per m³ of heated water. This figure may vary for other hotels, depending on the size and efficiency of their heating systems. Additionally smaller hotels may use electric geysers to heat water, while some have over recent years also installed solar water heaters. Nevertheless, since the majority of hotels use boilers for heating their water, the information shown in Table 4 is a useful indication of industry level fuel savings.

Hotels	Wash-hand basins	Showers	Grey water recycling potential (minimum*)	Totals
5 star	427,600	1,533,300	0	1,960,900
4 star	1,028,100	3,546,200	0	4,574,300
3 star	56,800	373,200	0	430,000
<u>Totals</u>	<u>1,512,500</u>	<u>5,452,720</u>	<u>0</u>	<u>6,965,520</u>

Table 4: Fuel savings (in litres per year) arising from the implementation of water saving solutions in hotels

Note that there are no direct fuel savings with greywater recycling because treated greywater is used for the flushing of toilets and therefore does form part of the hot water system of the hotel.

The hotels for which the project calculated savings on heating were purchasing fuel at EUR 0.87 per litre. Using this figure, and extrapolating on a national level, fuel savings are estimated at EUR 5,970,000/year.

2.3 Cost of implementation

Based on a technical and economical evaluation of a top-of-the-range and a basic greywater system operational in two local hotels, the project estimates the following:

- For 5 star hotels, for which the average greywater system size is 27.6 m³/day, a greywater system for a hotel would cost between EUR 40,000 – EUR 115,000 (depending on technology and distribution of hotel), with an average cost of EUR 75,000 per installation
- For 4 star hotels, for which the average system size is 17.5 m³/day, greywater systems would cost between EUR 20,000 – EUR 60,000 (depending on technology and distribution of hotel), with an average cost of EUR 40,000 per installation
- For 3 star hotels, for which the average system size is 6.5 m³/day, greywater systems would cost between EUR 12,500 – EUR 15,000, with an average cost of EUR 13,500 per installation
- For 2 star hotels, for which the average system size is only 2.4 m³/day, greywater systems would cost between EUR 8,000 – EUR 10,000, with an average cost of EUR 9,000 per installation

Apart from the installed cost of a greywater treatment plant, these costs include the cost of the separate greywater supply pipework required to convey greywater from the guest rooms to the greywater treatment plant and the cost of a greywater-receiving reservoir/tanks and some storage for the treated greywater. (The cost of a distribution system that conveys treated greywater to the toilets in the premises is not included, because some hotels already have this infrastructure in place).

The total costs per hotel category are therefore estimated to be:

- 5 star : EUR 1,125,000
- 4 star : EUR 1,760,000
- 3 star : EUR 742,500
- 2 star : EUR 189,000

The total industry investment cost in greywater infrastructure is therefore estimated to be EUR 3,816,500. The net annual savings offered by grey-water treatment are estimated to be EUR 942,200. The repayment on investment period would therefore be just under 4 years.

The cost of implementing flow regulation devices is calculated below. This assumes that only 75% of rooms will need to amend flow rates, with the 25% already meeting recommended flow rates. The amendment considered is the use of water saving shower heads and restrictors for wash-hand basins. Some hotels will be able to regulate their flows using existing infrastructure such as pressure regulators. Others may opt for restrictors fitted to shower heads, with a consequent decrease in investment cost.

The figures presented below should therefore be considered the higher end of potential investment costs.

	Number of rooms	Cost of restrictors	Cost of shower head	Totals
5 Star	3562	EUR 5	EUR 32	EUR 98,900
4 Star	7209			EUR 200,000
3 Star	5159			EUR 143,100
2 Star	636			EUR 17,600
Totals	16,566			EUR 459,600

The savings arising from the implementation of these measures would be 349,400 M³ per annum, representing financial savings of EUR 695,300. Add to this the savings on heating due to less hot water being used, and savings could increase by an additional EUR 5,970,000/year. The repayment period would therefore be around 1 month.

3. Generating jobs through industry wide adoption of key water saving measures

Of the three key water saving interventions the regulation of showers and wash-hand basins are the easiest to implement, and can be done by existing engineering or maintenance staff within hotels. It is usually a one-time small intervention to the water system and would therefore not result in any new jobs being created.

Widespread adoption of grey-water treatment would however entail an element of job creation – through the installation of such systems in hotels, but also through the operation, maintenance and occasional troubleshooting that would be necessary to keep the systems operational. It should be noted that at present only 3 out of 138 hotels in Malta are equipped with greywater recycling systems.

To estimate the number of jobs that may be generated by adopting greywater systems as the state-of-the-art in all hotels in Malta the number of hours required for installing, operating and maintaining different sizes of greywater systems was first estimated. The summation of the man hours for 138 installations in all hotels in Malta then gave the full-time green job equivalent on an industry wide basis.

This resulted in:

- Installation - 97,500 man hours employed in the installation of greywater systems, which equate to slightly more than 10 full time jobs for 5 years (assuming all 138 installations are carried out in 5 years).
- Operation - 7 full time job equivalent (for as long as the plants remain operational)
- Maintenance - 3.5 full time job equivalent (for as long as the plants remain operational)

The total number of jobs that are estimated to be generated through an industry wide adoption of grey-water treatment is therefore 20.5 full time equivalent.

When considering that the private water treatment industry in Malta currently employs 20-25 full time equivalent positions, this industry-wide installation of greywater systems would nearly double the current work-force engaged privately in waste water treatment. Moreover, all the jobs qualify as Green Jobs as they directly relate to the recycling of wastewater.

4. Environmental benefits to industry wide adoption of key water saving measures

4.1 Estimated water savings

Malta is one of the world's top ten countries for water scarcity. With only an estimated 70m³ of naturally occurring freshwater per capita, there is simply not enough water to meet the country's demands. Consequently, Malta has to produce water artificially, using energy-intensive seawater desalination (by a process called Reverse Osmosis) to meet its demands and this has an impact on Malta's carbon footprint.

Malta is currently estimated to extract over 50% more groundwater than is sustainably available. Since main water is a 45-55% mix of groundwater to reverse-osmosis water, increasing the efficiency with which water is consumed serves to directly reduce the pressure on groundwater sources.

The adoption of these three key water saving measures is estimated to save around 841,400 m³ per annum. Of this, 701,800m³ would be reverse-osmosis water generated through hotel's in-house units or forming part of the mains supplied mix, while 139,600 m³ would be groundwater forming part of the mains supplied mix.

4.2 Estimated energy savings

Energy savings would be achieved through a reduced demand for reverse-osmosis water, and through a reduced demand for heated water through more efficient flow rates in showers and wash-hand basins.

The maximum amount of heating fuel saved is estimated at 6,965,200 litres translated into direct monetary saving for industry. The amount of electricity saved from the national electricity grid is estimated at 4,104,700 kWh/year. Part of this cost is incorporated in the WSC water tariff, and therefore would not appear as an additional monetary saving for industry. It does, however represent an annual monetary saving for the country, and a reduction in CO₂ emissions.

Conclusions

The cost of equipping all hotels in Malta has been estimated at EUR 3,816,500. This investment would return water savings of approximately EUR 942,200, leading to a repayment on investment period of just under 4 years.

This measure would result in the creation of an additional 20.5 full time equivalent jobs within the private waste-water treatment sector, representing what is almost a doubling in the current workforce. This measure would also result in the industry saving 492,000 M³ of water per annum. National electricity savings in the production and distribution of water would reach 2,301,100 kWh/m³ per year, primarily from the reduced production and distribution of RO water.

Add to that flow rate regulation of showers and wash-hand basins, and the savings increase as follows:

Investment required	EUR 4,276,000
Water volume saved	841,400 M ³ /annum
Heating fuel volume saved	6,965,520 litres/annum
Total financial savings	EUR 7,806,920 per annum

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