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Coin-Operated Clothes Washers in Laundromats and Multifamily Buildings: Assessment of Water Conservation Potential

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August 21, 2012

WESTERN POLICY RESEARCH

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A report submitted to the California Urban Water Conservation Council as part of their PBMP evaluation series.

Acknowledgment

I am very grateful to the following individuals who freely shared their knowledge and data with us. These include Brian Wallace and Bob Neiman of the Coin Laundry Association (CLA), Ron Lane of the Golden State CLA, the local affiliate of the national CLA, and a representative of one large route operator in California who requested anonymity.

I would also like to thank Chris Brown for giving us the opportunity to work on this report, and James Fryer for acting as peer reviewer.

Responsibility for any remaining shortcomings in this document, however, is solely my own, not of the individuals that have shared information with me or reviewed my work.

Summary

- Our analyses suggest that there are roughly 480,000 coin-operated washers in California spread across commercial laundromats and common wash rooms in multifamily buildings. The prevalence of top-loaders among laundromats and multifamily buildings is 34 and 74 percent, respectively.
- With new federal efficiency standards going into effect in 2013, water demand associated with coin-operated washers will decline over time. Market transformation through financial incentives can accelerate this process. If the prevalence of top-loaders is brought down to 20 percent we estimate that future water demand associated with this end use could be lowered by 28,000 acre-feet per year.
- Given current avoided cost of water, and likely savings from retrofit of old top-loaders with high-efficiency front loaders, utilities can cost-effectively offer large financial incentives to promote water use efficiency in this sector. Energy savings, while not evaluated here, are also expected to be significant, making joint initiatives between water and energy suppliers an attractive option.
- The finding of cost-effective savings suggests that coin-op washer retrofits should be considered a best management practice, and water utilities following the Flex Track or GPCD Compliance Approach should consider adding such a program to their existing portfolio if this portfolio appears inadequate for meeting future targets.

1. Introduction

Coin-operated (coin-op) laundry machines are chiefly used in commercial laundromats, common wash rooms in multifamily housing (including condominiums), as well as common wash rooms in group quarter settings such as, college dormitories, military bases, RV parks, marinas, campgrounds, hostels, motels, etc. These coin-operated machines may be single top-loaders, single front loaders, or multi front loaders (anywhere between 25 and 125 pound washers).[1] Other types of large scale, non-coin operated laundries that exist in settings such as hotels, hospitals, etc. were covered in a separate 2006 Council report.[2]

For the purpose of this paper we have focused on coin-operated laundry machines found in commercial laundromats as well as in common wash rooms in multifamily buildings. Data about coin-operated washers in group quarter settings were unavailable, so this small segment of the coin-operated market remains unaccounted for in our estimates. But many of our qualitative observations about how the market for coin-op clothes washers works would apply to the group-quarter segment as well.

Water and Energy Efficiency Standards

Table 1 Federal Water and Energy Standards for Clothes Washers

Type	Effective Date	Applies to	Maximum Water Factor gal./cu. ft./cycle	Minimum Modified Energy Factor cu. ft./KWh/cycle
Residential clothes washers	January 1, 2007	Standard top or front loader (>1.6 cu. ft.)	9.5 (Federal)‡	1.26 (Federal)
	January 1, 2011		6.0 (EnergySTAR)	2.0 (EnergySTAR)
Commercial clothes washers	January 1, 2007	Top-loaders (< 4.0 cu. ft.)	9.5 (Federal)	1.26 (Federal)
		Front loaders (< 3.5 cu. ft.)	9.5 (Federal)	1.26 (Federal)
	January 1, 2011		6.0 (EnergySTAR)	2.0 (EnergySTAR)
	January 8, 2013	Top-loaders (< 4.0 cu. ft.)	8.5 (Federal)	1.6 (Federal)
		Front loaders (< 3.5 cu. ft.)	5.5 (Federal)	2.0 (Federal)

‡Federal water factor standards for the residential sector went into effect from January 1, 2011. Only the residential energy standard was in effect from January 1, 2007.

[1] Six percent of laundromats had converted to card operated payment systems as of 2011, per the Coin Laundry Association. Card operated systems are likely to spread for a number of reasons: (1) the vend price does not need to be in multiples of 25 cents; (2) the vend price can be changed quickly; (3) higher capacity machines require way too many quarters; and (3) card operated systems permit time-of-day pricing, data logging, and online monitoring, all evolving trends in this sector. On new trends, also see this article: http://articles.latimes.com/2010/jul/11/business/la-fi-smallbiz-laundry-20100702

[2] Riesenberger, J., "On-Premise Laundry Facilities," in *A Report on Potential Best Management Practices, Annual Report, Year 2, 2006*, prepared for the California Urban Water Conservation Council.

Commercial clothes washers have been subject to federal water and energy efficiency standards, as have residential clothes washers. These two standards were roughly the same in the past. However, in early 2010, federal standards for commercial clothes washers were revised: These more stringent standards will go into effect on January 8, 2013. Federal standards for residential clothes washers are also under review, and are expected to be released sometime in 2012. The revised commercial clothes washer standards provide a clue as to what the new residential standards will probably look like. Table 1 shows data about the water factor (WF) and modified energy factor (MEF) that clothes washers must meet in each sector as per the latest information.

California had adopted lower WF standards for residential clothes washers (effective 2007), but the state's legislation was challenged under the principle of federal preemption of state law in the case of appliance standards. Even though California's petition for a waiver from federal preemption was eventually upheld, so much time had been lost that California has implicitly agreed to work with the revised federal residential clothes washer standard expected to be released soon, since these new standards are likely to be equal to or better than what the state legislation had earlier proposed. Perhaps, not a whole lot was lost because of this disagreement between the state and federal government due to the existence of the highly visible and successful EnergySTAR labeling program. To obtain the EnergySTAR label a clothes washer has to meet more stringent standards than the basic federal standards. Surveys suggest that this labeling program is both understood by the consumer and has swayed consumer purchasing decisions in favor of more water and energy efficient products.[3] Table 1 also shows the latest EnergySTAR standards for residential and commercial clothes washers.

Two points should be noted about Table 1. First, federal water and energy standards for commercial clothes washers apply only to smaller machines. A 4 cubic foot top-loader or 3.5 cubic foot front loader amounts roughly to a double-load (approximately 25 pound) machine.

We mention this because historically washers were rated in terms of pounds of laundry washed per cycle, and some of the survey data used here also follow this nomenclature. Increasingly, however, washers are being rated according to their tub volume, which is a key input in the water-factor calculation.

Laundromats also have several triple loaders and a few washers that can handle five, even eight loads at a time, and these are not subject to any efficiency standards. But, the majority of the machines present in laundromats and multifamily buildings are usually at, or below, the double-load capacity. The second point to note is that separate

[3] EPA Office of Air and Radiation, Climate Protection Partnerships Division. *National Awareness of ENERGY STAR® for 2011: Analysis of 2011 CEE Household Survey*. U.S. EPA, 2012.

standards will go into effect for top- and front-load commercial washers from 2013 onward, with the front-load standards exceeding even the current EnergySTAR standards.

Top Load versus Front Load

The Department of Energy (DOE) adopted separate standards for top and front loaders for several reasons.[4] First, during the rulemaking process manufacturers of clothes washers stated that it is technically infeasible to design top-loaders that are as water and energy efficient as front-loaders. Adopting a uniform standard based on the capabilities of front-loaders would potentially eliminate top-loaders from the market, or cause existing inefficient top-loaders to be repaired instead of being retrofitted, both considered undesirable consequences.

Top-loaders appeal to a large segment of the coin-op market for several reasons. These include; (1) cost, top-loaders are cheaper than front-loaders; (2) cycle times are shorter for top-loaders because of more vigorous agitation, and these times are better matched with dryer cycle times leading to smoother throughput in a coin-op setting; (3) it is easier to add a forgotten garment to a top-loader than a front-loader after the wash cycle has started; and (4) top-loaders can handle overloading better, which is often a problem when users are paying by the load.

Equipment manufacturers also claimed that route operators often specialize either in top-load or front-load washers, so elimination of top-loaders from the commercial clothes washer market would adversely affect some operators. For all these reasons, the DOE instituted a separate standard for top- and front-loaders, even though the new top-load standard is less stringent than the new front-load standard.

Manufacturers typically base their commercial clothes washer designs on residential washers. However, the former are designed to be more rugged, vandal proof, and have a simpler user interface, omitting options such as the ability to run partial loads or vary wash cycle length. The wash cycles may also be redesigned to fit the commercial standard 25-minute wash cycle. Some recent high-efficiency entrants in the commercial market feature longer wash cycles, which suggests that a standard 25-minute wash cycle may not yield a quality wash if simultaneously water and energy efficiency goals are also pushed to the limit.[5]

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[4] Details can be found in *The Federal Register*, Vol. 75, No. 5/Friday, January 8, 2010.

[5] US Department of Energy, Appliance and Commercial Equipment Standards. *Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Dishwashers, Dehumidifiers, and Cooking Products, and Commercial Clothes Washers*, December 2009.
http://www1.eere.energy.gov/buildings/appliance_standards/residential/cooking_products_final_rule_tsd.html

Key Market Segments

The market for coin-operated clothes washers can be divided into three segments: (1) commercial laundromats; (2) multifamily buildings where the owner operates the common wash room; and (3) multifamily buildings where a route operator serves the common wash room. Group quarter settings are not analyzed here, but this segment accounts for a relatively small proportion of the coin-op market. Per Department of Finance's estimates, California's group quarter population only accounts for 2-3 percent of the total population.[6]

Market Segment 1

In the laundromat sector the owner is in charge of all decisions, such as, which machines to buy (leasing is rare in this sector), the vend price level, and of course for paying all the utility bills. Because investment in water and energy efficiency directly translates into lower utility bills and potentially an improved bottom line, the owners of these facilities do not suffer from any misaligned incentives.[7] Per the Coin Laundry Association's annual survey of its members, laundromat owners cite the high cost of utilities as their number one problem, which suggests that owners are fully aware of the financial benefits of investing in water and energy efficiency. If they do not always invest in greater efficiency it is because of limited financial resources, and the desire to fully recoup legacy investments. More efficient machines are in general also more expensive. Education, outreach, and financial incentives could all be used fruitfully in this segment to accelerate the retrofit of older machines with newer efficient machines.

Market Segment 2

In the case of multifamily buildings where the owner operates the common wash room—usually the case only in smaller buildings requiring no more than one or two washers—the owner is only partially incentivized to invest in water and energy efficiency because he does not see his common wash room utility bill separately from that of the overall complex. The owner may understand in theory that an efficient machine will pay for itself, but the extra initial cost may act as a deterrent since the utility savings are not explicit. For the transformation of this segment outreach, education, and financial incentives, all need to play a part.

Market Segment 3

The third segment includes multifamily buildings where the common wash room is serviced by a route operator. Route operators are companies that offer a range of services to such building owners: These can include a machine lease, maintenance, and revenue sharing contract, or a machine sale, maintenance, and revenue sharing contract.

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[6] California Department of Finance. *E-5 County/State Population and Housing Estimates*, 2009.

[7] Although not a common pattern, some laundromats located in strip malls may receive water through a master meter. While, in theory, this may weaken investments in water-use efficiency, we doubt the effect is large. Apart from saving wash water, efficient washers also substantially reduce drying energy.

Apartment owners can also opt to do their own collections if they wish. In all cases, however, the apartment owner is responsible for the utility bills. Contracts between route operators and building owners can run anywhere from a few months to 10 years, but the most common is 5-7 years. In theory it should be possible for both of these parties to strike a deal that leads to investments in water and energy efficiency, sufficient profitability for the route operator, and sufficient payoff for the building owner. However, the revenue share for the owner is reduced when the route operator installs efficient, but also more expensive machines. While this reduced revenue stream may be more than offset by reduced utility expenses, the owner cannot explicitly assess this fact.

Conversations with a leading route operator in California suggest that the operator's ability to promote more efficient machines is largely dependent on the strength of the owner's desire to maximize his laundry revenue. In lower-income communities several factors can become inhibitors, such as owners not being willing to forgo any revenue share and not having the ability to raise their vend price, residents not wanting to spend more for the detergent optimized for high-efficiency machines, and so on.

In wealthier communities, on the other hand, building owners can probably charge a higher vend price to compensate for reduced revenues from the route operator, and to justify this price they can create the perception of value by offering additional time-saving features particularly attractive to busy professionals, such as web-based tracking of machine availability and time-to-go for a machine in use.[8] Residents and owners may also be more environmentally conscious to begin with in such settings.

All the key route operators in California (for example, WASH Multifamily Laundry Systems (formerly WEB) and Coinmach Corporation) are partners in the EnergySTAR program, so it does not appear as if they are the barriers to improving water use efficiency in the coin-op market.[9] In fact they should be seen as important partners for transforming this market. Targeting education and outreach efforts and financial incentives towards apartment buildings, especially those located in lower-income neighborhoods will probably have the greatest payoff in this market segment.

[8] US Department of Energy, Energy Efficiency and Renewal Energy. *EnergyStar Clothes Washers Save Money, Please Residents*.
http://www.energystar.gov/ia/products/appliances/clotheswash/508_ColesvilleTowers.pdf
[9] A list of route operators that are EnergySTAR partners can be found at:
http://www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers_routeops

2. Size of the Market

Coin-op Laundromats

We obtained basic data about the commercial coin-op market through the Coin Laundry Association. They were kind enough to share their *2011 Coin Laundry and Industry Survey* with us and point us to resources of the Census Bureau from where we obtained estimates about the total count of coin-op laundromats in California. Per the Census, there were roughly 3,405 coin-op laundromats in California in 2007. Given the economic recession this number probably has not increased significantly in recent years. Table 2 shows the distribution of machines by size in the average coin-op laundromat for the Western US (data specifically for California are unavailable from the Coin Laundry Association's survey.)

Table 2 Average Distribution of Washers in Laundromats

Washer Type	Average # of Units per Coin-Op	Total Coin-Op Laundromats in California	Total Units in California	Percent
Top load washer	11.5		39,158	33.8%
Front load washer: 18 lb.	9.2		31,326	27.1%
Front load washer: 25 lb.	4.3		11,577	10.0%
Front load washer: 30-40 lb.	7.0	3,405	23,835	20.6%
Front load washer: 50-55 lb.	2.0		6,810	5.9%
Front load washer: 75-80 lb.	0.3		1,022	0.9%
Front load washer: other	0.6		2,043	1.8%
Total	34.0		115,770	100.0%

SOURCE: *Coin Laundry and Industry Survey, 2011*, and US Census Bureau.

Based on Table 2's data it appears that on average a laundromat has 34 clothes washers, of which approximately 25 units (71 percent) are subject to federal efficiency standards. These include all top-loaders and those front-loaders that are rated for 25 pounds or less. Overall, the stock of clothes washers in the state's laundromats appears to number roughly 116,000 units.

It is quite striking that this market segment's washer stock includes only 34 percent top-loaders, on average. This estimate is supported by other studies[10], and given laundromat owners' documented sensitivity to high utility bills, appears to be plausible. However, anecdotal evidence also indicates significant variation in this estimate across different parts of California.

[10] Water Management Inc. *Assessment of Water Savings for Commercial Clothes Washers*, 2006. A Report prepared for the San Diego County Water Authority. This study found the prevalence of top-loaders in San Diego laundromats to be roughly 39% in 2005. That this prevalence estimate could have dropped to 34% by 2011 is quite plausible.

Multifamily Buildings

To estimate the number of coin-op washers present in multifamily buildings we have used published data, assumptions, as well as anecdotal information. Data about the number of multifamily buildings cross-classified by the number of units in the building, and the prevalence of in-unit washers were obtained from the American Housing Survey, 2009, and then calibrated to match Department of Finance's statewide summaries. These data were then combined with washroom sizing rules-of-thumb used by route operators to estimate the total stock of coin-op clothes washers that likely exist in this sector. Anecdotal evidence provided by a route operator was used to break out the likely number of coin-op washers that are owner operated. Table 3 presents these estimates.

Table 3 Estimate of Washers in Multifamily Buildings

# of Units in Building	Total Units	# of Units with In-Unit Residential Washers	# of Buildings Without In-Unit Washers	% Buildings with Coin-op Washers, Route Operator	% Buildings with Coin-op Washers, Owner Operator	# of Washers per Building	Total Coin-op Washers, Route Operator	Total Coin-op Washers, Owner Operator
2 units	376,788	202,417	87,186	0%	0%	1	0	0
3 units	157,522	79,068	26,151	0%	0%	1	0	0
4 units	535,392	138,861	99,133	50%	50%	1	49,567	49,567
5 units	124,660	57,041	13,524	50%	50%	1	6,762	6,762
6 units	296,470	68,531	37,990	50%	50%	1	18,995	18,995
7 units	96,981	21,612	10,767	50%	50%	1	5,384	5,384
8 units	418,646	105,410	39,155	50%	50%	1	19,578	19,578
9 units	86,188	23,222	6,996	50%	50%	1	3,498	3,498
10 units	129,780	37,514	9,227	50%	50%	1	4,614	4,614
11 units	22,333	0	2,030	50%	50%	1	1,015	1,015
12 units	172,613	71,289	8,444	50%	50%	1	4,222	4,222
13-24 units	657,961	137,288	29,509	100%	0%	2	59,018	0
25-36 units	278,446	68,880	6,965	100%	0%	3	20,895	0
37-48 units	139,962	25,498	2,706	100%	0%	4	10,824	0
49-60 units	159,939	8,565	2,872	100%	0%	5	14,360	0
61-72 units	71,709	17,348	817	100%	0%	6	4,902	0
73-84 units	58,684	13,845	573	100%	0%	7	4,011	0
85-96 units	41,040	6,978	379	100%	0%	8	3,032	0
97 or more	387,649	130,985	1,732	100%	0%	>=9	22,200	0
Total	4,212,763	1,214,352	386,156				252,875	113,633

SOURCE: American Housing Survey, 2009 and California Department of Finance

California had roughly 4.2 million multifamily units in 2009, of which roughly 29 percent had in-unit clothes washers. In-unit washer prevalence appears higher in the smaller buildings. For example, buildings with only 2 units accounted for a total of 376,788 units, and of these 202,417 had in-unit washers (54 percent).

It is very unlikely for a multifamily building to have both in-unit washers as well as a common wash room with coin-ops. And even if a building had both, the common wash room would be sized according to the number of units without in-unit washers, not the total number of units. To account for these factors, we subtract the number of units with in-unit washers from the total number of units before estimating the stock of buildings that potentially require a common wash room. For example, in the case of 2-unit buildings, we estimate the number of units without in-unit washers and then divide this number by 2 to estimate the number of buildings with common wash rooms. A similar exercise was performed for larger buildings. Data for buildings with more than 12 units is shown in an aggregated manner for the sake of brevity, but the estimates are derived in exactly the same way. First, buildings with common wash rooms are estimated for each building size; then these data are aggregated for a size category.

Common wash room design guidelines suggest that on average 1 washer should be provided for every 10-15 units.[11] We used the estimate of 1 washer for every 12 units to estimate the stock of coin-ops in apartment buildings. The results are not sensitive to this assumption because buildings with 12 units or less, with a common wash room, account for almost 88 percent of all such buildings. So whether we assume 1 washer per 10 units or 15 units, the vast majority of buildings only get allocated 1 washer under any reasonable assumption.

Next, we factored into our calculations anecdotal evidence provided by a large route operator. This route operator told us that it is much more common in California for owners of small buildings to operate their own wash rooms, and perhaps 50% of such buildings are owner operated. This route operator also suggested that very small buildings, if they do not have in-unit washers, are also unlikely to have a common wash room with coin-operated washers. The owner may provide a free washer in a garage or some other common space, or the residents may use commercial laundromats, but the presence of a coin-op is unlikely because the revenue stream from 2 or 3 apartment units is not attractive either to the building owner or to a route operator. We have taken this anecdotal evidence and operationalized it as follows: (1) first, we assume that if a 2 or 3-unit building does not have an in-unit washer, neither will it have a coin-op washer; (2) second, that half of the buildings with only 1 washer (4 through 12 units) are likely to be owner operated.

[11] Additional details can be found on the Multi-Housing Laundry Association's website: http://www.mla-online.com/guide.htm

Combining all these data, assumptions and anecdotal evidence, leads to the estimate of roughly 253,000 coin-op washers under the purview of route operators and 114,000 under the purview of multifamily building owners in the state of California. The former estimate was considered reasonable by the route operator we discussed these data with; for the latter there is no published data to validate against.

These data suggest that route operators have the largest share of all coin-op washers in California, and that owner-operated coin-ops may be as prevalent as coin-ops in commercial laundromats. Each segment probably requires a different marketing and targeting strategy.

Validation of Market Size

To validate our bottoms-up estimate about the size of the coin-op market we compared our estimate to that published by the Consortium for Energy Efficiency (CEE). The CEE reports that there are approximately 2-3 million coin-op washers in the US.[12] Using the higher end of this range, and assuming that California's share of the national stock is proportional to California's demographic share of the US (12 percent), our estimate of California's coin-op stock should have worked out to roughly 360,000 washers. However, we have estimated a California stock of roughly 480,000 washers, which implies a national stock closer to 4 million. There is considerable uncertainty about the stock of coin-op washers in owner-operated multifamily buildings, so it is possible that our estimate of the size of this market is too large.[13] But, our coin-op count in laundromats is based on survey data collected by the Census and the Coin Laundry Association, so has a strong foundation. We have spoken to a leading route operator in California and doubt that our estimate for this segment is off by much. The owner-operated segment remains the real wild card. Some amount of field work is necessary to validate these estimates.

[12] Consortium for Energy Efficiency, *Commercial Clothes Washer Fact Sheet*, 2007. Eileen Eaton, point of contact listed on the *Fact Sheet*, was queried about the reliability of these estimates, and she admitted that these estimates are old and may be outdated (e-mail communication).

[13] David Horta of PWS Laundry, a large distributor of commercial laundry equipment in California, found our estimate of total coin-ops in California to be quite plausible, most likely an underestimate (phone communication).

3. Estimating Conservation Potential

Coin-op Laundromats

Many data inputs are required to estimate the conservation potential of coin-ops in laundromats, including the baseline mix of top and front-loaders, their respective water factors, forecasts of how the composition of front and top-loaders might change in the future, and how often these machines are used. Table 4 first discusses estimation of the baseline and future year water factors and usage per cycle.

Table 4 Present and Future Usage, Gallons per Cycle

Washer type	Water Factor Pre-2007‡	Federal Standard Water Factor 2007 +	Water Factor (Base Year)	Federal Standard Water Factor 2013 +	Average Tub Volume (cu. ft.)	Gallons per Cycle (Base Year)	Gallons per Cycle (Future Year)
Top load	13	9.5	11.6	8.5	2.8	32.5	23.8
Front load: 18 lbs.	11	9.5	10.4	5.5	2.9	30.2	16.0
Front load: 25 lbs.	11	9.5	10.4	5.5	3.5	36.4	19.3

‡From field study in San Diego cited earlier.

For clothes washers manufactured prior to 2007, we relied on a study from San Diego to estimate the water factors of single top loaders and single and double front loaders.[14] These are the only types of commercial clothes washers that are subject to federal appliance standards (larger capacity multi-loaders are not, and also were found to have water factors well above 5.5 in many cases in the San Diego study.) For the federally regulated washers, water factors were estimated to be roughly 13 for top-loaders, and 11 for the single- and double front loaders.

All commercial washers manufactured after January 1, 2007 are required to have a water factor under 9.5. By 2012, due to natural turnover, many of the pre-2007 washers would have been replaced with more efficient machines. It is estimated that a commercial clothes washer's life is roughly 10 years on average (slightly less than 10 years for top loaders, slightly more for front loaders), which implies a natural replacement rate of 10 percent per year. At this rate of natural turnover, only 59 percent of the present stock of washers should be of the pre-2007 kind; 41 percent should have the lower water factor of 9.5.[15] Both prior literature and data from a route operator

[14] Water Management Inc. *Assessment of Water Savings for Commercial Clothes Washers*, 2006. A Report prepared for the San Diego County Water Authority.

[15] At a 10% turnover rate, only 90 percent of this year's stock would make it to next year, 81percent (90 percent of 90 percent) to the following year, and so on. After five years the estimate would work out to 59 percent. In other words, only 59 percent of 2012 stock of washers would have been manufactured prior to 2007.

(discussed later) support this rate of natural turnover. Taking a weighted average of pre- and post-2007 water factors we estimate the baseline (2012) water factors to be 11.6 for single top-loaders and 10.4 for the single and double front loaders.

The revised federal standards that will go into effect from January 8, 2013, namely a water factor of 8.5 for top loaders and 5.5 for front loaders then becomes the level of efficiency that clothes washers can potentially reach in a future year.

To convert water factors into estimates of gallons per cycle requires information about the average tub volume. We consulted machine specifications from leading manufacturers of coin-operated washers such as, Speed Queen, Huebsch, and Maytag to estimate these data. Tub volumes for the 18 and 25 pound front loaders are fairly consistent across different manufacturers. However, tub volumes can easily vary between 2.5 and 3.3 cubic feet for top loaders across different manufacturers. Lacking specific data, we have assumed that top loaders have a tub volume of 2.8 cubic feet on average. Tub volume data do not always display the same level of proportionality as the pound-based nomenclature, but it is the former that drives water use.

Table 5 Estimation of Conservation Potential for Coin-Op Laundromats

			Future Scenarios			
			Scenario 1		Scenario 2	
	Market Share (Base Year)	Gallons per Cycle (Base Year)	Market Share (Future Year)	Gallons per Cycle (Future Year)	Market Share (Future Year)	Gallons per Cycle (Future Year)
Top load	33.8%	32.5	33.8%	23.8	20.0%	23.8
Front load: 18 lbs.	27.1%	30.2	27.1%	16.0	40.9%	16.0
Front load: 25 lbs.	10.0%	36.4	10.0%	19.3	10.0%	19.3
Weighted average		32.2		20.2		18.6

Annual Savings Calculation

# of machines subject to federal standards (Table 2) = 82,601

# of loads per day = 6

Savings under scenario 1 = 82,601*6*(32.2-20.2)*365/325900
=6,661 AF/year

Savings under scenario 2 = 82,601*6*(32.2-18.6)*365/325900
=7,549 AF/year

NOTE: The market share of front loaders with capacity exceeding 25 pounds has been kept constant and has not been used for calculating conservation potential because these washers are not subject to federal efficiency standards.

Table 5 calculates potential savings under two different scenarios. Under the first scenario we assume that the relative share of top and front loaders remains the same, only each machine would have a lower water factor in the future corresponding to the revised federal standards. In the first scenario, savings emanate from more stringent standards in essence, but not from any significant market transformation. In the second scenario, we assume that the share of top-loaders drops to 20 percent from the present 33.8 percent, to factor in the effects of potential market transformation that may occur either naturally or through inducements offered by water and energy utilities. We doubt that the market share of top-loaders will reach zero any time soon for all the reasons mentioned earlier, but note that the 20 percent future market-share assumption is simply a guesstimate on our part. For calculating savings we assume that each washer is used 6 times per day on average.[16] The calculations yield savings of 6,661 acre-feet per year for the first scenario; 7,549 acre-feet per year for the second scenario.

The reader will notice that we have not tried to estimate savings that could potentially emanate from top-loaders being replaced with multi-loaders of 30 pounds capacity or greater. There are several reasons for this: (1) the higher capacity multi-loaders are not subject to standards and manufacturers do not typically report water factors for these machines as they do for the washers subject to federal appliance standards; and (2) evidence from prior studies (for example, the one completed in San Diego cited earlier) shows that multi-loaders can have a range of water factors, some around 5.5, but some also significantly greater. Without additional data from manufacturers, and field trials, it is difficult to pin down multi-loader retrofit savings at this stage. But, these savings may be significant. As Table 2 shows, almost 30 percent of laundromat washers are high-capacity front-loaders, and anecdotal evidence suggests that laundromat owners wish to increase the presence of such washers in their stores.

Multifamily Buildings

After much pleading a large route operator provided us both a count of the total number of washers under their supervision, as well as the breakdown of this count by top- and front-loaders, and by the pre- and post-2007 categories. In this market segment, 18 pound front loaders are the most common, not 25 pound front loaders. For the sake of maintaining anonymity, which this route operator requested, we have refrained from reporting their total washer count. Instead, we only report percentage shares by age and washer type (Table 6).

This table shows that the vast majority of coin-operated machines in multifamily housing are still top-loaders (74 percent). And that roughly 43 percent of the total stock consists of machines manufactured after 2007. As mentioned earlier, assuming a 10

[16] Taken from Chapter 6 of DOE's *Technical Support Document* cited earlier. There is considerable spread in this estimate across different studies, but since this was DOE's best estimate which they used while revising the commercial clothes washer standard, we have used it as well for lack of better data.

percent natural turnover rate leads to the prediction that roughly 41 percent of the stock of washers in 2012 should be of the post-2007 kind, which matches quite well with data provided by this route operator.

Table 6 Distribution of Washers for One Route Operator

Washer Type	Proportion of Total Stock (pre-2007)	Proportion of Total Stock (2007 +)	Total
Top load	44%	30%	74%
Front load: 18 lbs	13%	13%	26%
Total	57%	43%	100%

SOURCE: Data provided by a route operator with significant presence in California.

Table 7 Estimation of Conservation Potential in Multifamily Buildings

			Future Scenarios			
			Scenario 1		Scenario 2	
	Market Share (Base Year)	Gallons per Cycle (Base Year)	Market Share (Future Year)	Gallons per Cycle (Future Year)	Market Share (Future Year)	Gallons per Cycle (Future Year)
Top load	74.0%	32.5	74.0%	23.8	20.0%	23.8
Front load: 18 lbs.	26.0%	30.2	26.0%	16.0	80.0%	16.0
Weighted average		31.9		21.9		17.5

Annual Savings Calculation
Owner operators
# of machines subject to federal standards (Table 3) = 113,633
# of loads per day = 3.4

Savings under scenario 1 = 113,633*3.4*(31.9-21.9)*365/325900
=4,327 AF/year

Savings under scenario 2 = 113,633*3.4*(31.9-17.5)*365/325900
=6,231 AF/year

Route operators
# of machines subject to federal standards (Table 3) = 252,875
# of loads per day = 3.4

Savings under scenario 1 = 252,875*3.4*(31.9-21.9)*365/325900
=9,629 AF/year

Savings under scenario 2 = 252,875*3.4*(31.9-17.5)*365/325900
=13,866 AF/year

Table 7 calculates potential savings under two different scenarios. Under the first scenario we assume that the relative share of top and front loaders remains the same, only each machine has a lower water factor in the future. In the second scenario, we assume that the share of top-loaders drops to 20 percent from the present 74 percent as a result of aggressive market transformation efforts undertaken by water and energy utilities. For calculating savings we assume that each washer processes 3.4 loads per day on average.[17]

Assumptions about the relative share of top and front-loaders, as well as loads per day are held the same for both route-operated and owner-operated multifamily washer segments. Circumstantial evidence suggests that the market share of top and front-loaders in the owner operated buildings may not be that different from the buildings serviced by route operators. For example, the *Residential Energy Consumption Survey* indicates that in California's single-family homes and multifamily units with in-unit washers taken together (the data are not broken out by single/multi), 24 percent had front loading washers as of 2009.[18] Data from a large route operator (Table 6) lead to a comparable estimate (26 percent versus 24 percent) suggesting that these relative shares are determined more by the general population's tastes than by choices made by building owners or route operators. So, until better data become available, it is reasonable to assume that the share of top and front-loaders is roughly the same across these two market segments.

Summary of Conservation Potential

Table 8 summarizes our estimates of conservation potential for all the three market segments analyzed here.

Table 8 Summary of Annual Conservation Potential from All Market Segments

Market Segment	Scenario 1 (savings from standards only)	Scenario 2 (savings from standards and market transformation)
Coin-op Laundromats	6,661	7,549
Multifamily-owner operator	4,327	6,231
Multifamily-route operator	9,629	13,866
Total	20,617	27,646

UNITS: Acre feet per year.

When the pre-2012 stock of washers is fully replaced by washers built to the revised standards that will go into effect in 2013, which could take a few years, our estimates

[17] Also taken from Chapter 6 of DOE's *Technical Support Document* cited earlier.

[18] Data from the *Residential Energy Consumption Survey* (RECS) can be found at the US Energy Information Administration's website: http://www.eia.gov/consumption/residential/data/2009/

suggests that water demand of the coin-op washer segment as a whole should drop roughly by 20,617 acre-feet per year. And if the market can be transformed to lower the market share of top-loaders to 20 percent or less, these savings would increase to 27,646 acre-feet per year. Market transformation efforts would have a greater proportional payoff in the multifamily sector since the market share of top-loaders is still very high in this segment.

Our estimates of conservation potential may be somewhat biased because we have assumed that future washers will just meet the water factors stipulated in the law even though many high efficiency washers available in the market today already have much lower water factors. On the other hand, our estimate of the baseline water factors may also be too high if washers installed after 2007 were more efficient than the federal standards applicable at the time. The direction of the net bias between these two countervailing possibilities is difficult to predict.

4. Cost Effectiveness

The purpose of this section is to evaluate the maximum financial incentive that can be economically justified for promoting the replacement of top-loaders with front loaders. This is different from asking whether the extra cost of an efficient top or front-loader will pay for itself via reduced utility bills. The answer to this question is an overwhelming yes! Per the DOE's analysis, top-loaders designed to meet the future 2013 standard will recover the higher initial cost relative to today's top-loaders in 3 to 5 years. Future front-loaders relative to today's front-loaders are expected to recover the higher initial costs in less than 1 year.[19]

DOE also estimates that the price difference between an "installed" top and 18 pound front-loader designed to the 2013 federal standards is likely to be around $400 ($974 for top-loader versus $1,388 for an 18 pound front-loader), which is the more relevant piece of information for our analysis. Calls to distributors confirmed DOE's estimates, at least for coin-ops used largely in multifamily buildings.[20] For coin-ops used in laundromats, preliminary evidence suggests that the price difference between a top-loader and a ruggedized 18 pound front loader may be closer to $600. But, much more market research is needed to pin these costs down.[21]

If a utility could persuade customers to choose a front loader while replacing their old top-loader, how valuable would the water savings be to a water utility? To address this question we assume that a utility only offers rebates if a pre-2007 top-loader is retrofitted with the latest front-loader designed to the 2013 federal standards so as to maximize savings.

Table 9 shows the key inputs required to address this question. We first calculate savings per wash cycle between a pre-2007 top-loader and a post-2013 front-loader, which works out to 20.5 gallons per cycle for an 18 pound washer and 26.2 gallons per cycle for a 25 pound washer[22]. Assuming that a front-loader's physical life is 10 years on average, and that the real discount rate is roughly 3 percent (5 percent borrowing rate minus 2 percent general rate of inflation) leads to a net economic life of 8.5 years. By estimating benefits on the basis of this shorter discounted life, we implicitly take into account the opportunity cost of raising capital to fund a retrofit program.

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[19] Mentioned in *The Federal Register*, Vol. 75, No. 5/Friday, January 8, 2010, page 1123.

[20] Pride Laundry Systems, Inc., a leading distributor for Maytag coin-ops confirmed that the price difference between a current top-loader and an 18 pound front-loader should be in the $300-400 range (telephone conversation).

[21] Rough cost estimates for coin-ops used in laundromats are as follows: (1) top loader, $900; (2) front loader, 18 pounds, $1,500; (3) front loader, 25 pounds, $3,000; (4) front loader, 30 pounds, $4,200; (5) front loader, 40 pounds, $5,000; (6) front loader, 60 pounds, $7,000; (7) front loader, 80 pounds, $10,000. Installation for the larger multi-loaders can run into thousands of additional dollars (data courtesy of Ron Lane of the Golden State Coin Laundry Association.)

[22] For a 25 pound machine the savings are derived as (36.4x1.25 - 19.3)

Over this discounted period of 8.5 years, an 18 pound front-loader retrofit is expected to save 1.17 acre-feet in a laundromat setting, and 0.66 acre-feet in a multifamily building setting. A 25 pound front-loader retrofit would save 1.5 acre-feet in a laundromat setting, but such front loaders are rarely found in multifamily buildings.

Table 9 Estimation of Savings from Selective Retrofits

Washer Type	Water Factor	Tub Volume (cu. ft.)	Gallons per Cycle	Physical Life (Years)	Economic Life @ 3% Discount Rate (Years)
Pre-2007 top loader	13.0	2.8	36.4		
Post-2013 front loader: 18 lbs.	5.5	2.9	16.0	10	8.5
Post-2013 front loader: 25 lbs.	5.5	3.5	19.3		
Difference (TL vs. FL: 18lb.)			20.4		
Difference (TL vs. FL: 25 lb.)			26.2‡		

Laundromats

Lifetime savings per 18 lb. retrofit = 20.4 gals/cycle*6.0 loads/day*365 days*8.5 years / 325900
= 1.17 acre-feet

Lifetime savings per 25 lb. retrofit = 26.2 gals/cycle*6.0 loads/day*365 days*8.5 years / 325900
= 1.50 acre-feet

Multifamily Buildings

Lifetime savings per 18 lb. retrofit = 20.4 gals/cycle*3.4 loads/day*365 days*8.5 years / 325900
= 0.66 acre-feet

‡We assume that 1 load in a 25 lb. front loader amounts to 1.25 loads in a top loader based on the ratio of their tub volumes. Generally machines run full in pay-by-load settings.

Assuming the avoided cost of water at the retail level is approximately $800 per acre-foot in California[23] suggests that the value of the saved water to a retail utility is roughly $936 in laundromat settings and $528 in multifamily settings for an 18 pound front loader retrofit. For a 25 pound washer retrofit in a laundromat the value of saved water rises to $1,200. This is without including the value of other benefits such as, reduced drying energy and wastewater savings. Thus, if a consortium of water, wastewater, and energy utilities were to promote the retrofit of pre-2007 top loaders, fairly large financial incentives could be justified. But, as mentioned earlier, what can be offered versus what should be offered are two different questions. Utilities should offer incentives just sufficient to tip consumer decisions in favor of front loaders, but in no case should this be greater than the price difference between a future top and front loader.

[23] This estimate is perhaps more reflective of Southern California. It is what Metropolitan's customers pay on average for what they consider to be their marginal supply. Utilities can easily substitute their own avoided cost data to estimate the value of saved water from coin-op retrofits.

At present several water utilities are offering incentives for high-efficiency commercial clothes washers subject to Federal standards. These include the Santa Clara Valley Water District and the San Francisco Public Utilities Commission (SFPUC), each offering rebates for coin-op washer retrofits of $400 and $200 respectively. The Council's Smart Rebate program also includes an incentive of $400 for high-efficiency commercial clothes washers.

Evaluation of the uptake of these programs provides an indication of the level of financial incentives that are necessary to generate a certain level of program activity. For example, the Santa Clara program has rebated 4,000 washer retrofits since 1999 when it first went into effect.[24] The SFPUC has rebated 415 washers since 2007 in its retail service area (SFPUC is also a wholesaler), which includes the city and county of San Francisco.[25]

While not the entire explanation, these two examples suggest that the rebate level is a key driver of program activity, and therefore must be carefully weighed relative to conservation goals. It is also important to note, however, that Santa Clara's program appears to have generated greater activity because the water supplier closely coordinates their coin-op retrofit program with route operators that service their territory, which only bolsters our earlier observation that route-operators must be treated as partners in the delivery of such programs.

[24] Personal communication with Karen Morvay of the SCVWD.
[25] Personal communication with Kevin Galvin of the SFPUC.

5. Conclusions and Recommendations

The analyses presented here show that coin-op washers are used in three distinct market segments. These include laundromats, multifamily buildings where the owner services the common wash room, and multifamily buildings where a route operator services the common wash room. All three market segments could improve their water and energy efficiency further and would benefit from market transformation efforts if such efforts are undertaken by California's water and energy utilities.

The prevalence of top-loaders is still very high in multifamily buildings (74 percent), less so in laundromats (34 percent). Laundromat owners are much more sensitive to the high cost of water and energy, which is probably why they have voluntarily switched to front loaders faster than any other segment. Anecdotal evidence, however, suggests that there may be significant regional variation in the prevalence of top-loaders across laundromats, so some water suppliers may stand to gain disproportionately by promoting retrofits of old top loaders.

Our cost-effectiveness analyses show that given the avoided cost of water and the level of expected savings, water and energy utilities can justify offering significant financial incentives to current coin-op users if they would switch out their pre-2007 top loaders and replace them with either 18 or 25 pound front loaders designed to the latest federal standards that will take effect in 2013. If the prevalence of top-loaders in all coin-op washer segments were lowered to 20 percent, statewide water demand accounted for by this end use would correspondingly drop by roughly 28,000 acre-feet per year.

The finding of cost-effective savings suggests that coin-op washer retrofits should be considered a best management practice, and water utilities following the Flex Track or GPCD Compliance Approach should consider adding such a program to their existing portfolio if this portfolio appears inadequate for meeting future targets.

Whether incentives should be offered for higher capacity multi-loaders is a more complicated question for many reasons. These washers are not subject to appliance standards, their water and energy efficiency characteristics are not openly published by manufacturers, and preliminary evidence shows a wide range of water factors. We believe the issue of high capacity multi-loaders deserves greater scrutiny because there may be significant potential for water and energy savings, but one that still remains poorly documented.

It is also worth examining whether rebates should be tied to the number of new high-efficiency washer purchases or to the number of old top-loaders removed. In other words, if a laundromat owner removes 10 top-loaders and replaces them with 2 five-load washers (in terms of tub volume, not the pound-based nomenclature), under most existing programs the owner would qualify for two rebates, which in this scenario

would not be much of an incentive. But, if the rebates were tied to the number of old top-loaders removed (and removed for good, as a qualifying condition) perhaps it would generate greater retrofit activity that would also be economically justifiable for the sponsoring water and energy suppliers. As a point of reference, note that the 2006 San Diego commercial clotheswasher evaluation cited earlier offered a rebate of $775 for the replacement of existing top-load washers with multi-loaders (30 pounds or greater capacity) and yet had to actively market these rebates to attract study participants.