

Meeting Fannie Mae Multifamily Green Rewards or Freddie Mac Multifamily Green Advantage Requirements Through Innovative Hot Water Savings:

*Field study of the Auto Diverting Tub Spout System
within a 156-unit apartment complex in Frederick, MD*

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GREEN LOANS AND THE INNOVATIVE HOT WATER SAVINGS CONNECTION

One of the quickest and easiest ways to qualify for Green Loans from Fannie Mae (Green Rewards) and Freddie Mac (Green Advantage) by reducing your multifamily property's water and energy consumption is to focus on innovative hot water savings. Installing a single product within this category can help you achieve 25%, or more, of your water savings goal while simultaneously reducing energy use. Additionally, by creatively conserving hot water, property owners and managers will not only increase an apartment building's value and net operating income, they'll also improve property appeal while adding comfort and convenience to residents' bathing routines.

The key to creating qualified and sustainable Fannie Mae and Freddie Mack Green Loan savings results is to focus on innovative ways to save hot water without taking water away from residents while they're actually showering. In general, low flow shower heads are poorly perceived by many, if not most, residents. For example, the current best-selling shower head on Amazon.com is a 2.5 gpm model actively promoting removal of the unit's flow restrictor. Further evidence of attitudes towards low flow shower heads is demonstrated by a research report conducted by the Department for Environment, Food and Rural Affairs in the UK, a country of where "green" attitudes are more prevalent than in the US (DEFRA 2009). The report concluded:

- Water use is not a consideration for when purchasing shower heads
- Individuals have a general feeling that water efficient showers won't feel good
- When asked to choose their ideal shower, people ignore information on water consumption
- Powerful water flow showers are what most people aspire to owning

Additionally, a review of Google search terms for "low flow shower head" vs. "high pressure shower head" from 2004 to present reveals steady growth in "high pressure shower head" interest over time. In fact, the term "high pressure shower head" began to consistently surpass "low flow shower head" in August 2016 and is projected to be 3x greater than "low flow shower head" in March 2019.

Fortunately, as new technologies become available, low flow shower heads are no longer the only means for conveniently and cost effectively reducing both water and energy use. In fact, when it comes to innovative hot water savings and property management, multifamily owners and managers can improve Net Operating Income and delight residents by targeting the following key hot water savings areas:

- Reducing Structural Waste
This is the previously heated, but now cold, water that must be purged before hot water can arrive.
- Eliminating Behavioral Waste
This is the hot water that is inadvertently wasted before residents actually begin showering.
- Preventing Tub Spout Leaks
This is the hot water that unknowingly leaks past the tub spout diverter while the resident is showering.

Focusing on innovative alternatives to low flow shower heads for generating hot water savings has distinct advantages, not only in terms of resident satisfaction, but also in total gallons of hot water saved. Specifically, reducing Structural Waste eliminating Behavioral Waste and preventing Tub Spout Diverter Leaks can cost effectively save up to 10 gallons of hot water per shower while adding significant comfort and convenience benefits to residents' bathing routines. A matrix illustrating these factors is available in Figure 1.

HOT WATER SAVINGS OPPORTUNITY	RESIDENT COMFORT & CONVENIENCE	EST. HOT WATER SAVED*
Reducing Structural Waste	Faster Hot Water Delivery Times	.4 Gallons Per Shower
Eliminating Behavioral Waste	Freedom to Multitask While Waiting For Hot Water To Arrive	5.1 Gallons Per Shower
Preventing Tub Spout Diverter Leaks	Hot Water Lasts Longer	4.5 Gallons Per Shower

*Detailed calculations available in "Calculating Savings For Auto-Diverting Tub Spout System with ShowerStart TSV". Paper available upon request.

Figure 1.

AN INNOVATIVE HOT WATER SAVINGS SOLUTION – THE AUTO-DIVERTING TUB SPOUT SYSTEM

Evolve Technologies' Auto-Diverting Tub Spout System with ShowerStart TSV (ADTS), Figure 2., is a complete fixture replacement for tub/shower combination bathrooms.

The ADTS functions by first purging the cold water in the plumbing lines (Structural Waste) through its tub spout fixture. Because of its design, the tub spout expels Structural Waste more than 2X faster than possible through a shower head. Warming the shower in this manner not only significantly reduces hot water waits, but also reduces the volume of Structural Waste that must be purged before hot water can arrive. Due to its much higher velocity, less thermal loss occurs as the water travels through the plumbing line to the shower. Hot water arrives faster and the volume that must be purged before it does is reduced.



Figure 2.

Structural Waste continues exiting the ADTS' tub spout fixture at high volume until hot water arrives. Once it does, the tub spout fixture automatically blocks the tub spout's out-flow and diverts hot water to the unit's shower head fixture. As hot water reaches the shower head, its flow is automatically paused (reduced to a trickle) until the bather is ready to begin showering. The shower head's pause eliminates Behavioral Waste by preventing hot water from inadvertently running down the drain while residents are away from the shower during the warm-up process. By eliminating the potential for Behavioral Waste, residents can gain the freedom to multitask while waiting for their hot water to arrive - without wasting hot water while they do so. Once ready to shower, residents' pull the shower head's lanyard to resume normal flow and shower as usual. After showering is completed, the ADTS automatically resets for its next use.

While showering, the shut-off that automatically diverted hot water to the shower head fixture, remains active. This tight, positively reinforced, thermostatically activated seal stops Tub Spout Diverter Leaks by preventing hot water from sneaking past the diverter and running out of the tub spout while residents are showering. Tub Spout Diverter Leaks are a very common, but often unrecognized contributor to significant hot water waste. In fact, field studies reveal that approximately 34% of all tub spouts exhibit a diverter leak while the shower is running and the average leak for those faulty diverters is .8 gallons per minute (Taitem 2011).

The Auto-Diverting Tub Spout's functionality is illustrated in Figure 3.

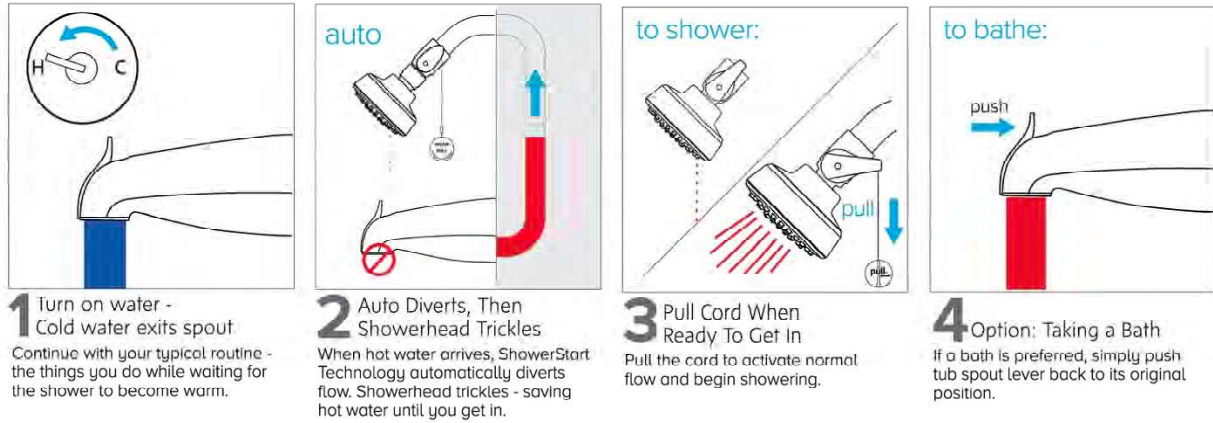


Figure 3.

ADTS FIELD STUDY - RESULTS FROM A 156 UNIT APARTMENT COMPLEX IN FREDERICK, MD

Field Study Background:

Applegate Apartments, owned and operated by Maryland Management, is located in a well-established residential area just outside of historic downtown Frederick, MD. The multifamily property contains two buildings comprising one, two and three bedroom apartments. Rents range from \$1074 to \$1709 per unit.

The property began installing 156 Auto-Diverting Tub Spout units in the summer of 2016. Installations were performed by the complex's maintenance staff over the course of several months and total water consumption was monitored via meter readings from the billing statements provided by the local water utility.

No other water saving products were installed during the monitoring period. Additionally, no savings were generated from the ADTS' shower head, as the unit's flow rate was identical to the flow rate of the shower head it replaced. A break-out of the key property characteristics are listed in Figure 4.

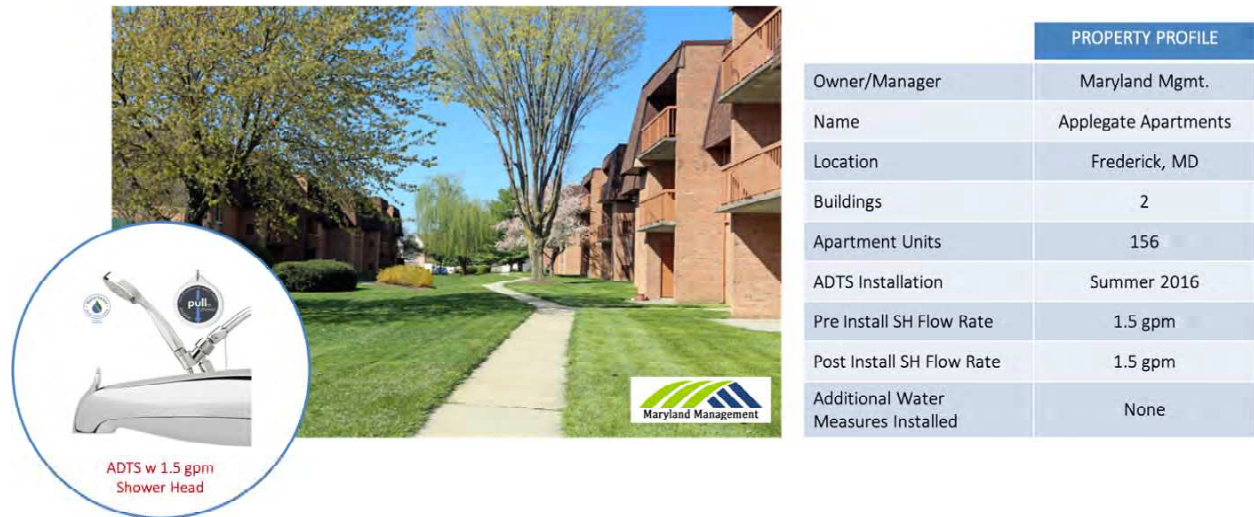


Figure 4.

Predicted Yearly Hot Water Savings:

Prior to completion of the field study, Evolve Technologies endeavored to predict the water savings associated with Applegate’s installation of the 156 Auto-Diverting Tub Spout Systems by using the following formula:

$$[\text{apartment units}] \times [\text{bathrooms per apartment}] \times [\text{persons per apartment}] \times [\text{showers per person per day}] \times [\text{days per year}] \times [\text{occupancy rate}] \times [\text{ADTS predicted gallons saved per shower}]$$

The property’s known Occupancy Rate averaged 90% and, based on conversations with the property owner, an average of 2 persons per apartment was assumed. Additionally, it was assumed that residents, on average, showered .75 times per day (approximately 5 times per week) and the ADTS unit would save 10 gallons of hot water per shower by reducing Structural Waste, Eliminating Behavioral Waste and Preventing Tub Spout Diverter Leaks as defined in Figure 1.

Upon calculation of the prediction formula, it was projected that the ADTS would save Applegate Apartments 769,217 gallons of hot water per year as illustrated in Figure 5.

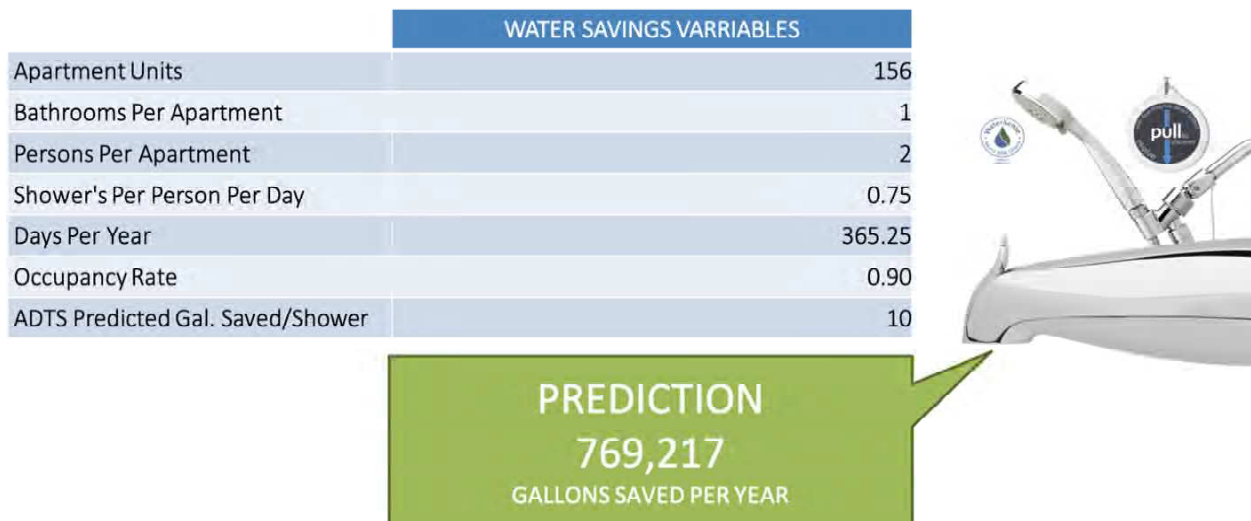


Figure 5.

Actual Yearly Hot Water Savings:

To calculate hot water savings resulting from installation of the Auto-Diverting Tub Spout Systems, Evolve Technologies reviewed quarterly metering and billing statements from Applegate’s water utility, The City of Frederick, MD.

Statements for the 4 consecutive quarters prior to installation we’re reviewed to determine water use for the Year Prior To Install. Quarterly statements for a period of one year after installation were reviewed to determine water use for the Year After Install. To neutralize the impact of occupancy rate variances within the analysis, water use was adjusted to assume 100% occupancy using the following formula:

$$[\text{total gallons used}] / [\text{average occupancy rate}]$$

Actual monthly occupancy rates during the measurement period ranged from 88% - 96%.

Additional details driving the Actual Yearly Hot Water Savings analysis are available in Figure 6.

	BILLING DATE	PERIOD START DATE	PERIOD END DATE	BLDG. 1 GALLONS USED	BLDG. 2 GALLONS USED	TOTAL GALLONS USED	AVG. OCC. RATE	OCC. ADJUSTED TOTAL GAL USED	OCC. ADJUSTED GALLONS USED
YEAR PRIOR TO INSTALL	12/1/15	7/30/15	10/26/15	1,577,400	883,800	2,461,200	95%	2,590,737	11,234,157
	3/1/16	10/26/15	1/21/16	1,395,300	1,149,500	2,544,800	92%	2,766,087	
	6/1/16	1/21/16	4/20/16	1,309,200	1,150,000	2,459,200	90%	2,732,444	
	9/1/16	4/20/16	7/27/16	1,596,900	1,233,500	2,830,400	90%	3,144,889	
YEAR AFTER INSTALL	12/1/16	7/27/16	10/26/16	1,307,400	1,140,600	2,448,000	90%	2,720,000	10,448,803
	3/1/17	10/26/16	1/26/17	1,294,600	1,167,500	2,462,100	88%	2,797,841	
	6/1/17	1/26/17	4/27/17	1,208,400	1,039,500	2,247,900	90%	2,497,667	
	9/1/17	4/27/17	8/2/17	1,433,100	708,200	2,141,300	88%	2,433,295	

Figure 6.

Comparing water use from the Year Prior To Install to the Year After Install reveals 785,345 gallons saved. This savings represents a combined 7% reduction in total water use for the Applegate multifamily property (Figure 7). Notably, the Actual Yearly Hot Water Savings came within 2% of the Predicted Yearly Hot Water Savings results.

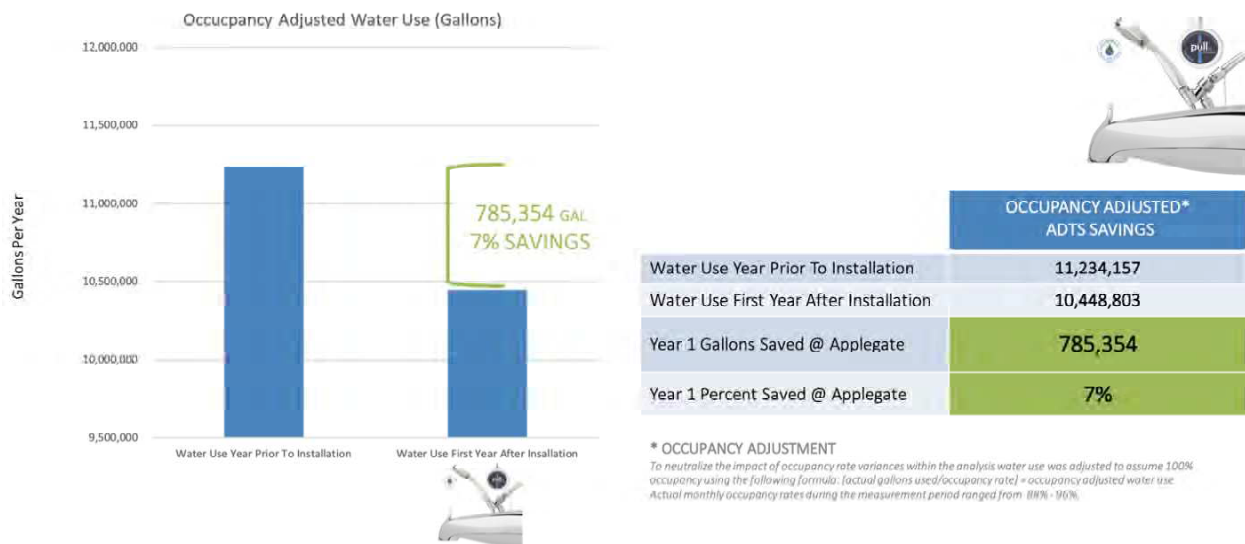


Figure 7.

Water & Sewer Savings Payback:

Based on the Occupancy Adjusted water consumption data, payback for purchase of the Auto-Diverting Tub Spout System is 11 months, assuming a \$.013 water and sewer cost derived by using the following formula:

$$[\text{bill total}] - [\text{fixed cost}^*] / [\text{gallons used}]$$

*Water Service Base Charge, Bay Com EDU Sewer and Storm Water

Payback times for purchase of the Auto-Diverting Tub Spout System shrank to just 9 months when conducting a straight comparison, without an occupancy adjustment, of water use for the Year Prior To Installation vs. the First Year After Installation as illustrated in Figure 8.

WATER AND SEWER BILL
 For Billing Inquiries Please Call
 301-600-1421
 Between 8:00 AM and 4:30 PM

METER READING AND USAGE INFORMATION

METER NO.	READING LABELS	FROM	TO	DATE	BEFORE	AFTER	READING	USAGE IN GALLONS
1047007		01/21/2018	10/22/2018	87	150734	155964	5230	

WATER SERVICE

Base Charge	\$1.76
Volume (up to 5 to 9 gal)	\$1.84
Volume (up to 10 to 15 gal)	\$3.96
Volume (up to 15 to 22 gal)	43.47
Volume (up to 22 to 35 gal)	45.31
Volume (up to 35 to 45 gal)	51.13
Volume (up to 45 to 60 gal)	56.95
Volume (up to 60 to 75 gal)	62.77
Volume (up to 75 to 90 gal)	68.59
Volume (up to 90 to 105 gal)	74.41
Volume (up to 105 to 120 gal)	80.23
Volume (up to 120 to 135 gal)	86.05
Volume (up to 135 to 150 gal)	91.87
Volume (up to 150 to 165 gal)	97.69
Volume (up to 165 to 180 gal)	103.51
Volume (up to 180 to 200 gal)	109.33
Volume (up to 200 to 220 gal)	115.15
Volume (up to 220 to 240 gal)	120.97
Volume (up to 240 to 260 gal)	126.79
Volume (up to 260 to 280 gal)	132.61
Volume (up to 280 to 300 gal)	138.43
Volume (up to 300 to 320 gal)	144.25
Volume (up to 320 to 340 gal)	150.07
Volume (up to 340 to 360 gal)	155.89
Volume (up to 360 to 380 gal)	161.71
Volume (up to 380 to 400 gal)	167.53
Volume (up to 400 to 420 gal)	173.35
Volume (up to 420 to 440 gal)	179.17
Volume (up to 440 to 460 gal)	184.99
Volume (up to 460 to 480 gal)	190.81
Volume (up to 480 to 500 gal)	196.63
Volume (up to 500 to 520 gal)	202.45
Volume (up to 520 to 540 gal)	208.27
Volume (up to 540 to 560 gal)	214.09
Volume (up to 560 to 580 gal)	219.91
Volume (up to 580 to 600 gal)	225.73
Volume (up to 600 to 620 gal)	231.55
Volume (up to 620 to 640 gal)	237.37
Volume (up to 640 to 660 gal)	243.19
Volume (up to 660 to 680 gal)	249.01
Volume (up to 680 to 700 gal)	254.83
Volume (up to 700 to 720 gal)	260.65
Volume (up to 720 to 740 gal)	266.47
Volume (up to 740 to 760 gal)	272.29
Volume (up to 760 to 780 gal)	278.11
Volume (up to 780 to 800 gal)	283.93
Volume (up to 800 to 820 gal)	289.75
Volume (up to 820 to 840 gal)	295.57
Volume (up to 840 to 860 gal)	301.39
Volume (up to 860 to 880 gal)	307.21
Volume (up to 880 to 900 gal)	313.03
Volume (up to 900 to 920 gal)	318.85
Volume (up to 920 to 940 gal)	324.67
Volume (up to 940 to 960 gal)	330.49
Volume (up to 960 to 980 gal)	336.31
Volume (up to 980 to 1000 gal)	342.13

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Bill Total	\$	8,185.00
Fixed Cost Bay Com EDU Sewer	\$	- 360.00
Fixed Cost Storm Water	\$	- 942.00
Fixed Cost Base Charge	\$	- 68.48
Net Cost For Water & Sewer	\$	6,814.52

PAYBACK IN LESS THAN 1 YEAR ON WATER SAVINGS ALONE

- does not consider energy savings
- does not consider shower head savings

PAYBACK CALCULATIONS	
Water/Sewer Cost Per Gallon	\$.013
ADTS Cost	\$60.00
Gallon Cost Per ADTS	4,631
ASTS Units Installed	156
Gallon Savings Required To Break Even	722,498
Year 1 Gallon Savings – Occupancy Adjusted	785,354
Payback Months – Occupancy Adjusted	11
Year 1 Gallon Savings	996,300
Payback Months	9

* Typical ADTS costs range from \$69 - \$79 based on sales channel and purchase volume. Applegate paid \$60 to offset internal costs for monitoring and sharing water use information.

Figure 8.

Water & Sewer Savings ROI

The investment for Applegate's purchase of the 156 Auto-Diverting Tub Spout Systems at \$60* per unit was \$9,360. Installation expenses were not factored into this calculation because the units were installed by the complex's in-house maintenance staff.

Given the previously derived \$.013 Water/Sewer Cost Per Gallon and Occupancy Adjusted Water Savings of 785,354 gallons per year, Annual Water & Sewer Bill savings for Applegate are \$10,174.31. That's a First Year Return On Investment of 109% (Figure 9.).





ADTS ROI ANALYSIS	
Annual Water/Sewer Bill Savings	\$10,174.31
ADTS Cost Per Unit	\$60.00
ADTS Units Installed	156
ADTS Cost Of Investment	\$9,360
ADTS Est. Useful Life - Years	10
ADTS Gain From From Investment	\$101,743.10
ROI (Yr 1)	109%

ROI = Gain From Investment / Cost Of Investment. First year's savings only.

Figure 9.

Estimated Annual Energy Savings:

In addition to lowering Applegate’s total water consumption by 7% and saving \$10,174.31 per year in water and sewer charges, the Auto-Diverting Tub Spout System also reduces the amount of electricity or gas used for water heating. Depending upon the fuel type used, and other environmental and regional factors, operating costs for Applegate could be decreased by an additional \$4,305 (gas savings) to \$11,147 (electric savings) per year while using the ADTS (Figure 10.).

	Structural & Behavioral Waste Savings	Shower Head Savings	Tub Spout Diverter Leak Savings	Per ADTS Energy Saved	ADTS Units Installed	Occupancy Rate	Total Energy Savings	Total \$ Savings
ELECTRIC	323 kWh	0 kWh	281 kWh	604 kWh	156	.91	85,744 kWh	\$11,147
GAS	14.2 Therms	0 Therms	12.4 Therms	26.6 Therms	156	.91	3,776 Therms	\$4,305

ASSUMPTIONS:

- * 2 persons per apartment
- * .75 showers per person per day
- * 56.8 F avg. water mains temp
- * 105F – 101F showering temp range
- * \$.13 per kWh (chooseenergy.com)
- * \$1.14 per Therm (energy-models.com)

Figure 10.

Depending upon rent structures and other factors, residents may be directly responsible for the energy costs associated with water heating. In these instances, multifamily properties may be able to further enhance their Net Operating Incomes through resident energy savings by modestly increasing rents. This can be achieved by effectively marketing the conservation, comfort and convenience aspects of each apartment’s main bathroom as a result of its ADTS.

Combined Water, Sewer & Energy Savings Impact:

Assuming water, sewer and estimated energy savings, Maryland Management is increasing its Applegate property’s Net Operating Income by \$14,479.31 to \$21,321.31 per year by innovatively saving hot water without taking water away from residents while they’re actually showering. Water savings alone represent nearly 25% of the total reduction goal necessary to qualify for Fannie Mae Multifamily Green Rewards or Freddie Mac Multifamily Green Advantage loan programs.

REFERENCES - IN ORDER OF CITATION

(DEFRA 2009) [Public Understanding of Sustainable Water use in the Home](#)

(Taitem 2011) [Taitem Tech Tip – Leaking Shower Diverters](#)