Submetering, RUBS, and Water Conservation

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FINAL REPORT

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We hope that this analysis provides a starting point for a broader discussion on innovative and mutually beneficial ways to encourage water conservation for the millions of apartment residents across the country.

Additional copies of this report can be obtained from the National Apartment Association, either by phone (703/518-6141) or on their web site (http://www.naahq.org). Comments and suggestions can be sent to NAA (Barbara@naahq.com) or the authors (koplow@indecon.com).

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EXECUTIVE SUMMARY

To better understand how billing methods affect water consumption patterns, we examined detailed water and wastewater billing information for 32 properties across three states. The properties represented a mix of sizes, ages, and management companies. In addition, properties were grouped by whether they charged tenants directly for water using meters on each apartment; allocated water and sewer charges based on some mix of apartment size or number of people (referred to as Ratio Utility Billing Systems, or RUBS); or simply recovered these costs indirectly from tenants through the rents they charged (referred to as "in-rent").

To enable comparisons across this diverse sample, we developed a number of standardized metrics. These included cost and consumption per resident and per occupied square foot. Properties were also paired with a building of similar age, location, and size, but with a different method of charging for water, in order to compare consumption patterns.

Our key findings are presented below. All statistics refer to median values unless otherwise noted.[1]

- **Tenants who pay for their water use less.** Water consumption is generally lower in buildings where tenants pay for their own water than in buildings where costs are indirectly recovered through rents. Submetered properties, which have the most direct link between consumption within a single apartment and the monthly bills, used 18-39 percent less water than did in-rent properties. RUBS properties used 6-27 percent less than the in-rent sample.

- **Billing type is a more important influence on consumption patterns than either the cost of water/sewer or the age of the building.** Lower consumption per person for submetered and RUBS properties held true across a fairly wide range of water costs, suggesting that the impact of having to pay for water and wastewater directly affects behavior more strongly than changes in the unit cost of water. Because monthly water bills tend to be low (less than $20 per unit), we hypothesize that price increases do not affect monthly costs enough to trigger behavioral change. There was also no indication that older buildings were less efficient overall, or that in-rent properties were significantly older than the RUBS/submetered sample.

- **Incremental conservation within a building that converted to submetering or RUBS was not as large as expected.** Trends over time within a single building did not show a clear pattern. For example, we did not see clear evidence that shifting from including water charges within rent to submetering or RUBS led to decreased water use within that building. Given the clear finding that consumption per capita and per occupied square foot were both significantly lower in submetered and RUBS properties than in those without charge backs, the lack of clear trend data within

[1] Median values were used instead of average values because the sample population included a number of outliers.

converted properties was surprising. We hypothesize that the discrepancy is primarily the result of imprecise data. In many cases, our trend calculations do not include the full period of billing conversion. In addition, we had trouble obtaining precise historical data on headcount and common area water usage from property managers or billing companies. Further analysis of intra-property trends to more clearly identify the factors contributing to increased conservation within an apartment building would be warranted.

- **Billing system conversion needs to be carefully thought out and managed.** Our property sample included a wide range of experiences regarding conversion to either submetering or RUBS systems. Among the most common lessons mentioned: advance education of tenants is critical, as is the careful choice of a competent billing company. Testing of the billing system for a month or two before presenting tenants with bills is a useful exercise as there are often transitional problems. Many property managers also noted that perceived fairness was extremely important during the transition process. Costs charged back to tenants need to be decided with caution; for example, many properties chose not to charge tenants for common area water consumption since the tenants had no direct control over this demand. Where the transition was carefully managed, we heard of no examples of tenant dissatisfaction with the changeover.

- **Even with RUBS or submetering in place, price signals to consumers may be muted.** Municipalities add inaccuracies to water/sewer prices that can't be corrected even with allocated billing *within* the apartment building. For example, one locality in Florida bases a large part of its charges on the number of toilets in an apartment. This variable is unlikely to be well correlated with actual consumption. A number of towns in California include sewer charges with property taxes, breaking the link between consumption and cost. Bimonthly or quarterly billing also hides important information (e.g., new leaks) that consumers can use to modify water use. These types of factors will depress the observed conservation response relative to what would occur with accurate price signals. State apartment associations may find a joint strategy of correcting prices within the municipality and the building concurrently useful in encouraging increased conservation.

- **Despite rising water and sewer costs, few properties have effectively used available information to carefully manage these costs.** In many of the properties we examined water consumption trend data were not tracked and monthly spikes, often indicative of new leaks or other problems, were not brought to management's attention by billing companies. Many available and cost effective water conservation equipment options were not being installed in either apartment units or common areas. More complicated conservation techniques such as modifying landscapes to species requiring little water in water scarce regions (xeriscape), or requiring efficient washing machines from laundry room vendors, were not done at any of the properties we spoke with.

- **Current gaps in water conservation management offer large opportunities for the future.** Much can be done to expand the scope, and improve the efficiency, of water conservation options. This includes continuing efforts to demonstrate the efficacy and equity of RUBS systems. An expansion in the relatively straightforward billing services now provided by billing companies to a more comprehensive business model that offers enhanced water cost management services (as has occurred in the energy sector) would also be beneficial.

OVERVIEW

The cost of water and wastewater treatment services have risen rapidly in recent years. This trend reflects a number of factors, including the scarcity of clean water, an increasing share of delivery and treatment costs being passed onto the final consumer, and the elimination of declining block rates by many municipalities. Declining block rates provided volume discounts for bulk water consumers. In many cases, these have been replaced by increasing block rates, where bulk consumers of scarce water resources pay more, not less, for this privilege.

Rising prices have made these services more difficult for owners of multi-unit housing to ignore. Rather than continuing to absorb them in their general operating overhead costs, owners have attempted to control these rising costs by investing in water conserving capital, and by shifting the costs of water and wastewater services onto tenants. This is similar to a process that occurred in the early 1970s when rapidly rising oil prices drove up electricity charges.

Advocates of charging tenants for these services argue that only when tenants pay the costs of the resources will they change their behavior to conserve water. This change can be an extremely important component of efficient water use in many water-scarce regions of the country. The purpose of this study was to evaluate whether tenants paying for their water directly use less than those for whom water costs are a part of their rent.

The report begins with a discussion of the study approach, the sample profile, and the metrics used to enable cross-property comparisons. We then present our quantitative results based on our analysis of property-specific billing data. The primary focus of this discussion is on the multi-state results, since the sample population within any single state was relatively small. However, we do discuss some state-specific findings as well.

In the process of researching this report, we spoke to scores of people involved with different parts of the water billing issue. These included municipalities, property managers, maintenance staff, and billing companies. The experiences, suggestions, and unmet needs that these people communicated to us are included in the next section of the report. Our findings are summarized in the last section. A data appendix contains additional detailed exhibits related to our analysis that may be of special interest to people within the three states we analyzed.

STUDY APPROACH

The study involved evaluating a cross-section of properties in three states: Florida, Texas, and California. The target sample size was 12 properties per state, though we were not able to obtain a full sample for California. In total, we examined detailed billing and demographic information for 32 properties.

The sample properties represent a mix of sizes, billing types, and ages in order to examine water consumption patterns across a spectrum of market conditions. In addition, the samples were paired, so that one building of a particular size and age that does not charge tenants directly

for water and wasterwater utilities could be compared to a similar building in the region that does.

Of the 12 properties in each state, six do not charge tenants directly, three have installed submeters on each unit to charge tenants based on actual measurements, and three use some form of a ratio utility billing system (RUBS) to allocate the total water and sewer bills back to the tenants.[2] Buildings using the RUBS approach generally deduct a portion of the water/sewer bill to account for common area usage, then allocate the remainder among the tenants based on some mix of unit square footage and the number of residents.

Sample Selection Criteria

Properties evaluated volunteered to participate in the NAA/NMHC study. NAA gathered a pool of candidate properties for the study through an outreach campaign, and through discussions with specific members. Industrial Economics chose the final set of participants based on a number of property characteristics, such as geography, demographics, ownership, and extent of conversion. Our objectives for each one are described below:

- **Geography.** Water and sewer rates and policies are often made at the city, county, or water district level. We chose as many properties as possible clustered in a single area, so that the consumption patterns we observed across properties were not influenced by exogenous factors such as water/sewer rates or local programs such as conservation incentives. Because clustered properties were not always available, we tried to choose municipalities that didn't differ markedly in their water policies. In addition, we included price as a dimension in our results, to illustrate both the impacts of billing type and water/sewer rates on observed consumption levels.

- **Demographics**. Property characteristics such as age, number of units, and market position (e.g., luxury, moderate income) can also affect consumption patterns. For example, newer buildings are more likely to have better water conservation equipment installed. Luxury properties are likely to be less sensitive to water prices overall. We tried to have a mix of building sizes and ages across our property sample.

- **Ownership**. The management company affects observed water consumption patterns in a number of ways. They often have cross-property programs related to installing water conservation equipment, fixing leaks, or managing irrigation. They may choose a single RUBS method, or a single billing company, both of which can affect the price signals sent to tenants. Again, to the extent possible, we tried to have a mix of property owners to reduce the impact of cross-property policies on our results.

[2] The California sample includes three RUBS properties, three submetered properties, and two in-rent properties.

- **Extent of Conversion.** Once a property decides to move to a submetering or RUBS system, there is a transition period that can sometimes last a couple of years. This is because most property managers will not begin charging tenants for water until move-in or lease renewal. Some California properties will only charge new tenants; in these situations it can be many years before all tenants are paying for their water. When a portion of the tenants are still not incurring the water/sewer costs, and therefore haven't adjusted their consumption patterns, the observed reduction in water consumption is likely to be less than what will eventually be realized. For this reason, we wanted to have properties that were fully converted for at least a year whenever possible. The full year of data is important in order to avoid distortions from seasonal variations in water consumption.

Establishing a Common Basis of Comparison

In order to draw any general conclusions about the relationship between billing type and water consumption levels, it was first necessary to establish standardized metrics that would allow data from very different types of properties to be compared. The two metrics chosen were:[3]

- **Per capita consumption.** Consumption data were divided by the average number of residents living in the property during a particular year. This adjustment ensured that observed patterns related to consumption were not related to independent factors such as occupancy levels. Per capita metrics are useful because there is a strong relationship between the number of people living in an apartment and the amount of water that gets used. Unfortunately, many properties do not have an accurate count of all their residents, especially for past years.

- **Consumption per occupied square foot.** This metric also takes account of differing occupancy levels, by scaling down the total square footage in apartment units based on vacancies. Properties generally had more accurate information regarding the number of units occupied in a particular year than they did on the average number of residents. However, the linkage between apartment size and water consumption is not as strong as with the number of residents.

One factor that these metrics were unable to control for was differing costs of water/sewer across the municipalities in which we had sample properties. As a result, we have generally included the cost of service information with each consumption value, ensuring that links between cost and consumption levels would be visible. We also adjusted water charges to reflect costs directly related to water and sewer use. Specifically, we included any taxes on the services,

[3] These metrics have the added advantage that both are commonly used as allocation bases in RUBS programs around the country. We were not able to evaluate any of the RUBS approaches in detail to identify how closely the allocations mirror actual usage patterns, but this may be an area worthy of additional research.

since these are reflected in the prices charged to apartment owners and users. However, we excluded unrelated charges, such as the cost of maintaining a fire line or stormwater fees, since these costs have no direct relationship to tenant behavior.

QUANTITATIVE RESULTS

Our sample data are presented using three evaluative frameworks: the first evaluates consumption intensity across the sample population; the second compares pairs of similar properties; and the third looks at time trends within a single property. As noted above, most of our discussion focuses on multi-state results, since the sample size within a single state was relatively small.

- **Consumption intensity.** Average gallons of water consumed per person and per occupied square foot are compared for different billing systems, and different water/wastewater costs. This presentation provides a useful overview of trends across all of the properties examined.

- **Pair comparisons.** As noted above, each property using either RUBS or submetering has been paired with a control property of similar size, age, and location so that consumption levels can be compared. This presentation provides a more localized comparison among properties within the sample.

- **Self comparisons.** For each property, we have evaluated consumption trends over the time period for which we have data (one to five years, depending on the site). This presentation is useful for comparing consumption trends over time, and for evaluating changes as a new billing system is implemented.

One additional data variant is worth mentioning. A number of the exhibits include consumption values with and without common area consumption. Common area consumption refers to water use in parts of an apartment complex outside of the actual apartments, such as pools and landscaping. Water demand in these external areas is not influenced by whether or not tenants are charged for water and sewer directly. Thus, by excluding common area usage, we hoped to provide a clearer picture of the demand response to RUBS and submetering systems. Unfortunately, the data on the common area share were not precise enough -- especially historically -- to further clarify consumption trends as hoped. This issue is discussed in greater detail later in the report.

Consumption Intensity Significantly Lower in Submetered and RUBS Properties

Overall, water consumption was significantly lower in properties that allocated water and sewer charges back to tenants than in properties that did not. These results are summarized in Exhibit 1.

The median submetered property used between 18 and 39 percent less water than the in-rent sample. The median RUBS property used between 20 and 27 percent less. When common area usage estimates were excluded, the savings were lower, with the median RUBS property using between 6 and 22 percent less than the in-rent sample. Because we were not able to get accurate common area usage values for many of the properties in the sample, we have less confidence in these values than in the total consumption values. Savings were higher on a per capita basis for submetered properties, and higher on a per occupied square foot basis for the RUBS properties.

Exhibit 2 provides another way to view the consumption intensity of the sample. Of the ten *most* efficient properties we examined on a per occupied square footage basis, only 20 percent did not charge tenants for water. This value was 40 percent for the per capita consumption measure. Yet, for the ten *least* efficient properties, the in-rent sites dominated, comprising 80 percent on a per occupied square foot basis and 70 percent on a per capita consumption basis.

Exhibit 1

Multi-State Consumption Patterns, by Billing Type

(Median Values)

	Submetered		***RUBS***		***In-Rent***
	Values	**Versus In-Rent**	**Values**	**Versus In-Rent**	**Values**
Consumption (1,000 gpy/resident)					
All consumption	28	-39%	37	-20%	46
Excluding common areas	23	-33%	32	-6%	34
Estimated common area share	25%		15%		18%
Consumption (gpy per occupied sf)					
All consumption	73	-18%	65	-27%	89
Excluding common areas	57	-22%	57	-22%	73
Building Age (years)	12		14		15
Cost					
Average cost (cents/gallon)	0.27		0.50		0.32
Cost per apartment ($/month)	$12.4		$18.8		$17.4
Sample Size (# properties)	9		9		9

Notes:
Abbreviations: sf = square foot; gpy = gallons per year.

PRSumType

Exhibit 2

Distribution of Sample Population, by Billing Type

	Submetered	RUBS	In-Rent
Per Capita Water Consumption			
10 Most Efficient Properties	50%	10%	40%
10 Least Efficient Properties	10%	20%	70%
Consumption per Occupied Square Foot			
10 Most Efficient Properties	30%	50%	20%
10 Least Efficient Properties	10%	10%	80%

Notes:
(1) Consumption rankings based on total water consumed, including in common areas.
(2) Total number of properties in sample equals 32.

PRSumDistr

Consumption Trends Not Due to Differential Cost or Age

Although the patterns regarding direct charges for water are fairly strong, we wanted to explore a couple of possible explanations other than billing type for the observed results: cost of service and property age.

Cost of Service

Under this hypothesis, the most efficient properties would be the ones with the highest cost of service. Although these might also be RUBS/submetered (since properties with a higher cost would have a larger incentive to switch billing systems), it would be the cost, rather than the method of charging, that drove the consumption efficiency.

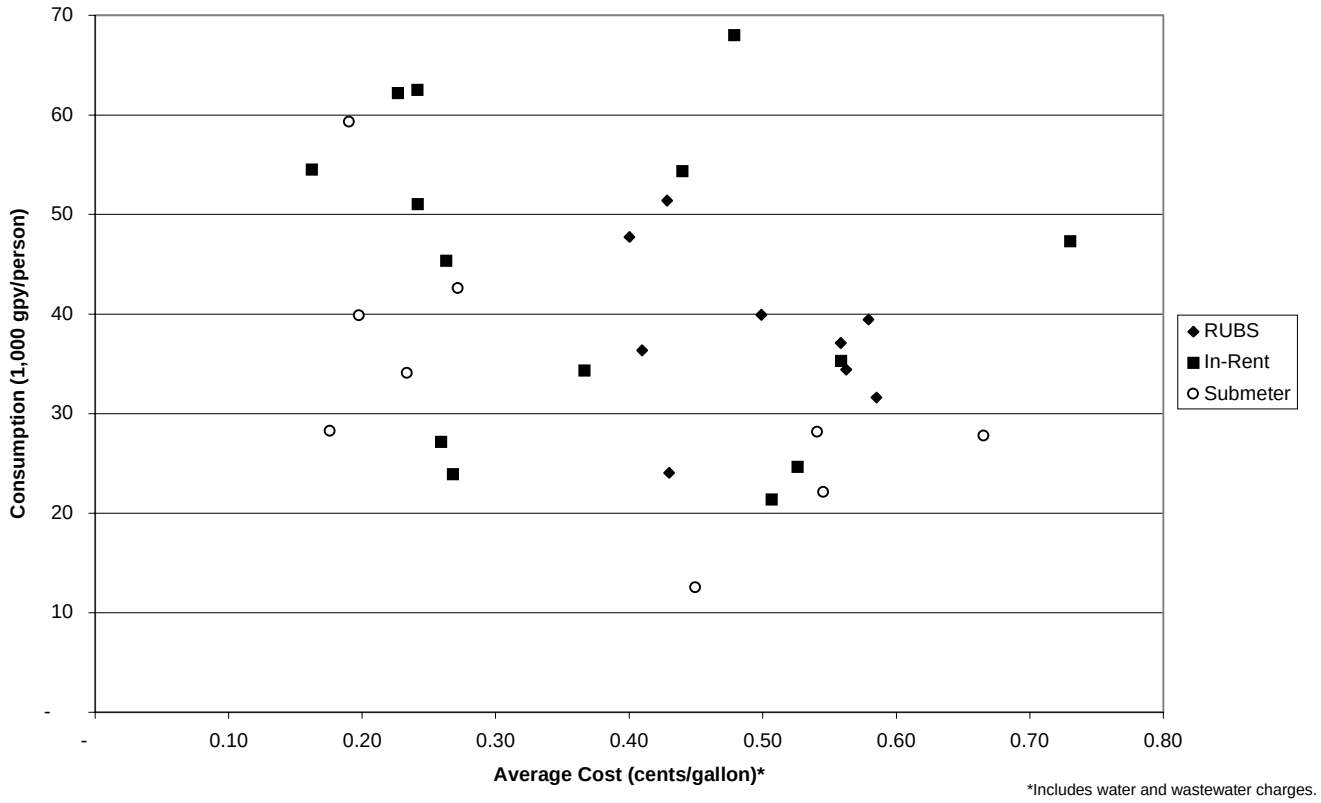
To evaluate this possibility, we plotted per capita consumption against the average cost per gallon of service at each property.[4] These results are shown in Exhibit 3. The plot distribution shows no clear link between cost and consumption. Although there are more low

[4] The average price was used instead of the marginal price for a number of reasons. First, we did not have data on marginal prices. Second, both submetering and RUBS systems generally charge tenants the average rather than the marginal cost, with higher cost water under increasing block rates averaged across all users. Thus, the actual price signal that tenants are responding to is, in fact, the average price.

efficiency properties in lower cost water districts, and more high efficiency properties in higher cost water districts, there is a fairly wide dispersion. Median costs for each grouping (see Exhibit 1) show that submetered properties have both lower costs, and lower consumption than in-rent sites.

RUBS properties are located in districts with higher average costs of service. However, when costs are viewed on a monthly charge per apartment, there is a difference of only $1.40 per month between the RUBS and in-rent populations. It is the monthly bill, not the average cost per gallon, that tenants see and that drives changes in consumption patterns. In this case, the prices are too similar to explain the difference in observed consumption behavior described above.

Exhibit 3
Per Capita Consumption, by Billing Type and Cost



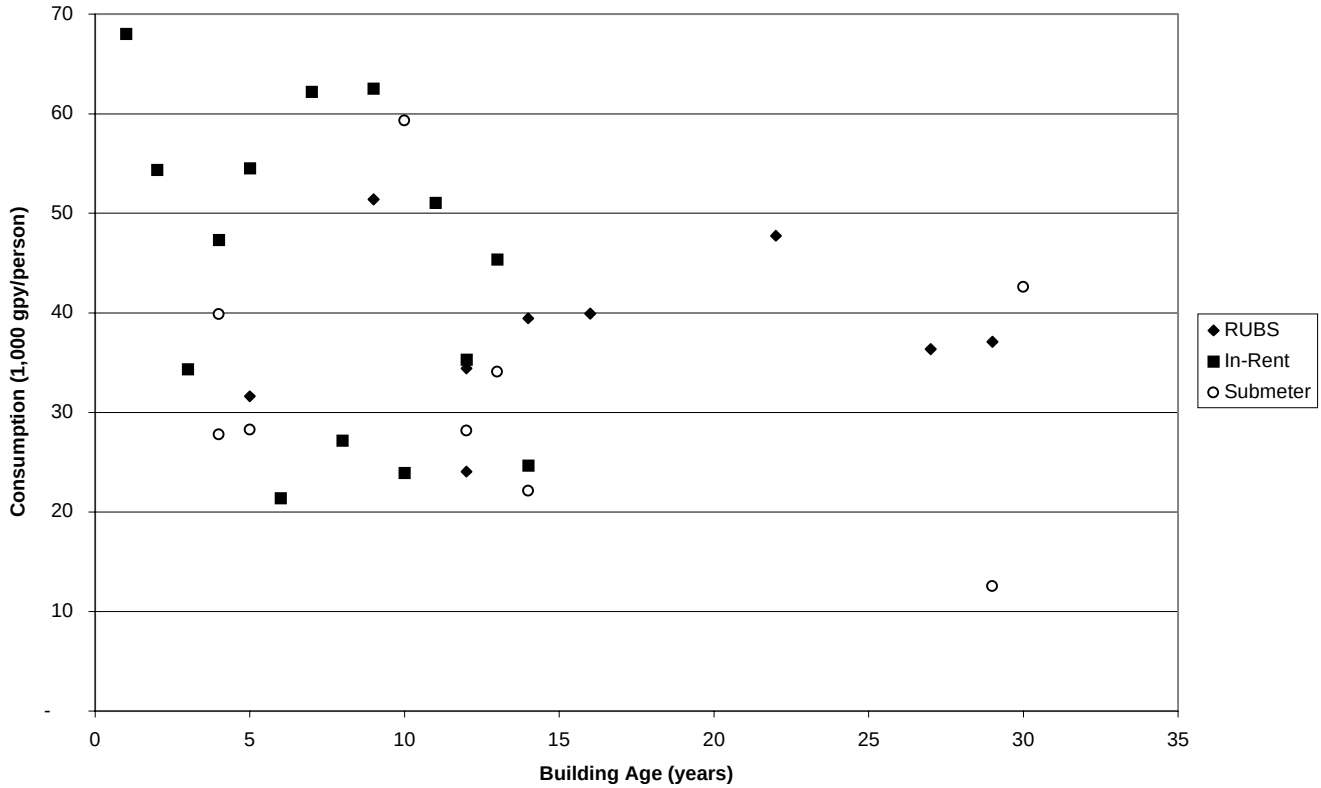
*Includes water and wastewater charges.

Age of Water Infrastructure

The second factor we considered as an alternative explanation for lower water consumption in submetered and RUBS properties is the age of water infrastructure, for which we use building age as a proxy. If submetered and RUBS properties were significantly newer, they would potentially have more efficient water-related infrastructure installed, and performance of this equipment would be closer to the optimum than in older buildings.

In Exhibit 4, we plot per capita consumption against building age. There is a slight difference in the median age of the building populations, with the in-rent locations being one to three years older than the RUBS and submetered properties. However, this is a very small age difference, and the available construction technologies are unlikely to have differed markedly across the sub-sample groupings. Furthermore, as shown in Exhibit 4, the oldest buildings are not the least efficient from a water use perspective; in fact, the most efficient property shown is nearly 30 years old.

Exhibit 4
Per Capita Consumption by Billing Type and Building Age



Consumption in RUBS and Submetered Properties Lower than In-Rent Pairings

The goal of the property pairings was to compare the water consumption profile of two similar properties, one with direct charges for water (i.e., RUBS or submetering) and one without them. Thus, for each property with direct charges for water, we chose an in-rent match that was located in the vicinity, and was roughly the same age and size. Because of the smaller California sample, we have only 14, rather than 18, pair comparisons.

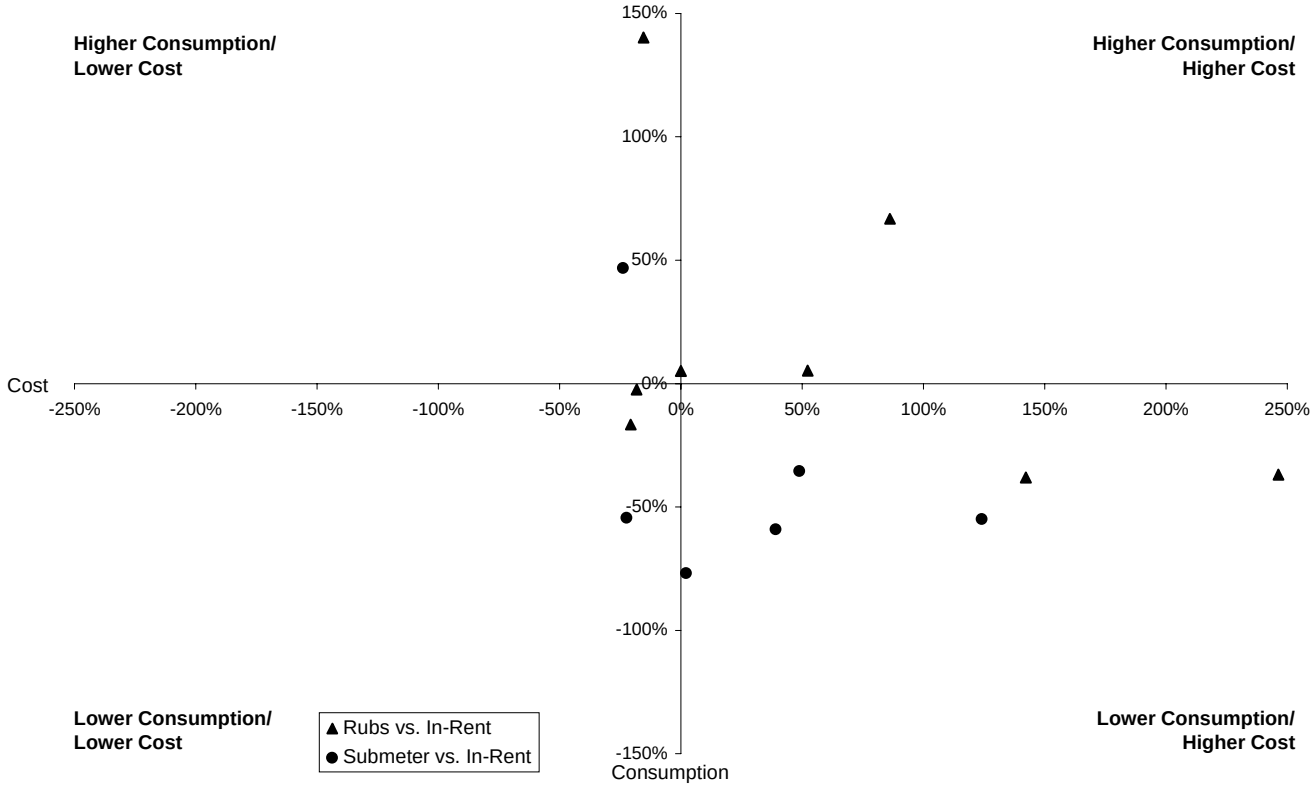
Consumption per capita and per occupied square foot were compared across each pair, with the results shown in Exhibits 5 and 6. Each quadrant of Exhibit 5 represents a mix of cost/consumption comparisons. Where a RUBS property had both lower consumption and lower

cost than its in-rent pair, it would be plotted in the lower left-hand quadrant. If the consumption was lower but the cost higher, it would show up in the lower right-hand quadrant.

Overall, in-rent properties were significantly more efficient than their submetered or RUBS pairs in only three of the 14 pairs evaluated. As shown in Exhibit 6, the median submetered property used 50-55 percent less water per capita, and 26 percent less per occupied square foot. The RUBS properties showed mixed results, with no significant difference on a per capita basis, but 30 percent lower median usage on a per occupied square footage basis.[5]

Some caveats are in order regarding these results. First, average costs were also higher (by about 20-25 percent) in the RUBS/submetered sample, suggesting that at least a portion of the observed consumption differential could be due to prices rather than billing type. Second, there are many possible reasons that water consumption in two buildings may differ independent of age, size, and billing type. Because the sample size was so small, care should be taken in generalizing the findings from the pairs analysis too broadly.

Exhibit 5
Comparative Consumption by Paired Properties
(% Difference from In-Rent Control Property)



[5] This difference is driven by a lower relative headcount/square foot in the RUBS sample than in the in-rent sample.

Exhibit 6

Paired Properties, Multi-State

(Median Values)

	Submetered vs. In-Rent	***RUBS vs. In-Rent***
Per Capita Consumption (% difference in per capita consumption)		
All Consumption	-55%	1%
Excluding common areas	-50%	-5%
Consumption per Occupied Square Foot (% difference in consumption per occ. sf)		
All Consumption	-26%	-32%
Cost Differential % difference in average cost per gallon	21%	26%
Sample Size (# pairs)	6	8

PRSumPair

Intra-Property Consumption Over Time Shows No Clear Trend

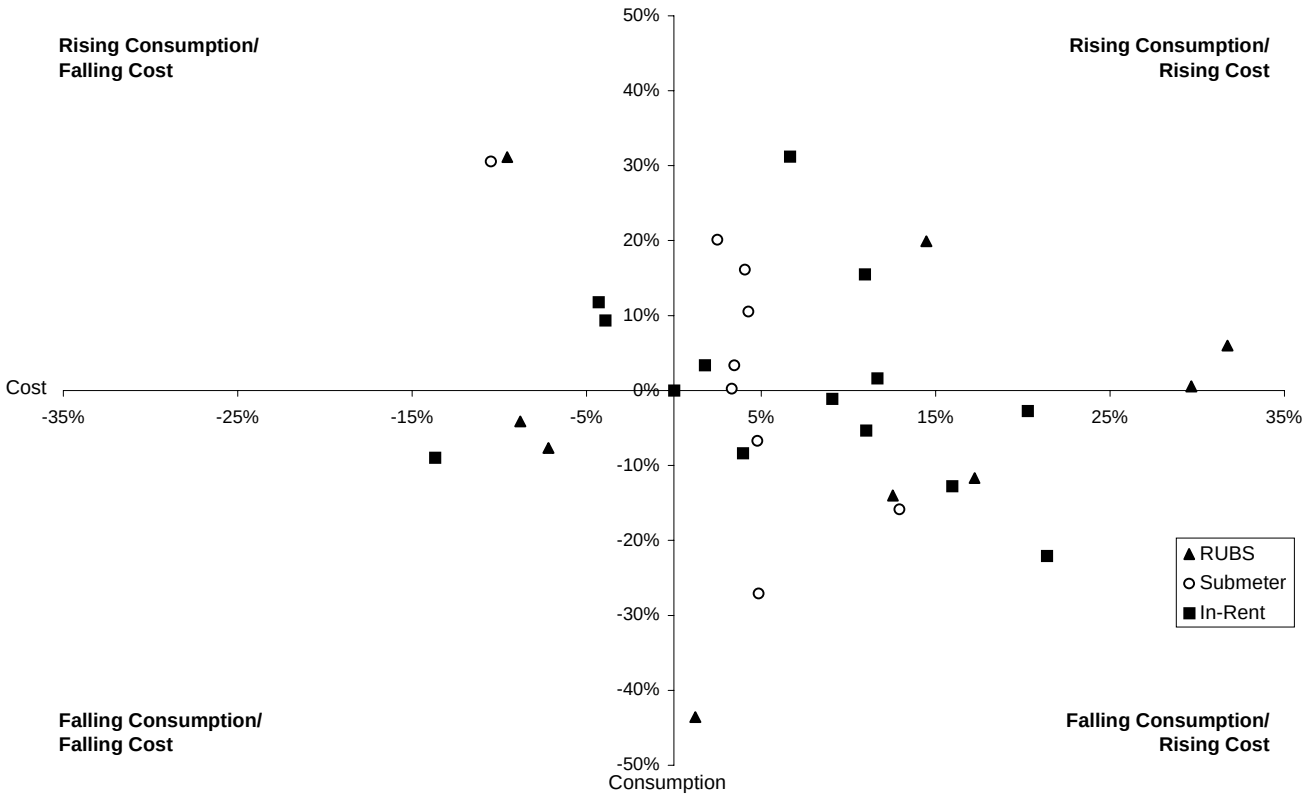
The final framework used to evaluate the impact of billing methods on water consumption was to look at consumption patterns within a single property over time. Ostensibly, many of the differences between two buildings (location, management, etc.) would not differ within a single property over time, providing a cleaner view of how consumption changes with the billing method. The intra-property time trend approach seemed especially promising where a property has recently switched from indirect charges for water and sewer to direct charges.

What we expected to find was a drop in the consumption intensity as properties shifted from in-rent recovery of water and sewer to RUBS or submetering systems. This drop would reflect the conservation response to new charges borne by the tenants.

What we actually found (Exhibits 7 and 8) is much less clear. Of the 32 properties evaluated, 14 actually showed and *increase* in per capita consumption over the period of data availability. Fifteen showed decreasing per capita consumption, but even this trend is at least

partly explained by the fact that the vast majority also faced rising costs. The remaining properties either showed no change or had only a single year of data, precluding a trend analysis.

Exhibit 7
Change in Per Capita Consumption over Time
(% Change Over Period of Available Data)



Given that there was a strong linkage between billing type and overall efficiency, the lack of clear improvements within at least a majority of the properties was surprising. The most likely explanation is that our trend analysis was simply unable to capture the conservation improvements due to limitations in the data available to us. This explanation makes sense for a number of reasons.

- **Limited Years of Data.** Depending on the particular property, our time trend metric is comprised of two to five years of data. The shorter the period of analysis, the more likely the period of analysis missed much of the conservation response.

- **Baseline Problems.** Conservation improvements begin when the changeover to a RUBS or submetered system is announced, and end after all apartments are paying for their water. Many of the properties in our sample had already begun the conversion at the point our data started. Others still had not converted everybody over by the end of 1998, when our trend analysis ended. In either case, the conservation response will tend to be understated in our data. Though we tried up-front to choose properties that

did not have baseline problems with conversion, we were simply unable to get enough properties that met these criteria.

- **Sensitivity to Headcount and Occupancy Information.** In standardizing the data across properties, accurate information on headcount and occupancy levels is critical in adjusting the per capita and per occupied square footage values. These data tended to be less available and less accurate the more years back we went; these inaccuracies also affect the baseline of our trend analysis.

- **Common Area Usage Data.** Because tenants only control consumption in their own apartments, the conservation response will be strongest for this portion of total consumption within the property. Though we tried to focus our analysis on just the consumption in the apartment units, data on common area usage were not precise enough to support the breakout. As with headcount and occupancy, data were less accurate the more years back we went. In almost no case were we able to obtain precise common area consumption estimates over time.

Demonstrating the conservation benefits of billing conversion may be important in overcoming resistance to direct billing for water and sewer in some locations. As a result, additional research on intra-property trends to address these data limitations may be warranted.

Exhibit 8

Intra-Property Time Trends, by Billing Type

(Median Values)

	Submetered	RUBS	In-Rent
Per Capita Consumption			
% (decrease) increase in per capita consumption	13%	-4%	-1%
Cost Trend			
% (decrease) increase in average cost per gallon	4%	8%	8%

Notes:

(1) Because both occupied square feet and headcount are pro-rated based on the same changes in occupancy within a property, results on a per occupied square footage basis did not differ from those on a per capita basis for this table, and were excluded.

(2) Time trends span a period of one to five years, depending on the property and the availability of the necessary data.

(3) Values are sensitive to data quality. Many properties within the sample had already shifted to charging tenants at the beginning of the time period analyzed, or have not yet completed this conversion. In either case, the conservation benefits of a change in billing methods will be understated.

PRSumTime

Single State Findings

Exhibit 9 provides an overview of the key findings by state. The Florida sample generally had the lowest consumption and the highest prices of the three states examined. It's properties also tended to be newer than those in Texas or California. Despite more expensive cost of service in Florida, the median monthly bill was still only $19, about the cost of basic cable. The fact that monthly costs are so low even in water scarce regions underscores the relative lack of responsiveness in consumption levels as unit costs rise. In fact, despite the higher prices, consumption in Florida was generally close to that in the other states.[6]

Rate structures did vary widely across the states. In California, for example, water costs were often two to three times as high as sewer charges. In Florida, the reverse is true, with sewer costs dominating. Sewer fees also dominated in the Texas sample, but by a much smaller margin. There is no obvious reason for these differences, and it is possible that water charges are too low in Florida, and sewer charges are too low in California. The existing rate structures can certainly encourage counterproductive behavior. For example, in one Florida community, water charges are heavily based on the number of toilets within an apartment, even though many other factors affect overall consumption. Our sample property was thus able to begin irrigating its grounds with city water with little change in their monthly cost of service despite large shifts in gallons used.

A detailed presentation of the state-by-state findings can be found in the data appendix tables and graphs. In all states, the general trends brought out in the multi-state summary were also evident: median consumption was lower in the RUBS and submetered properties in both the overall sample and in the pairs analysis; and there were no clear trends in the intra-property analysis.

One thing that a detailed look at the individual property data does show is that in each state there are some very efficient properties that do not direct bill for water or sewer. These examples highlight the importance of a strong commitment to water conservation by either the municipality, the property management, or both. For example, one of the most efficient properties examined in California is an in-rent property located in San Diego. It is likely that education and public attention about the need to conserve water induced this property and its residents to change water use patterns even without direct billing for water usage.

[6] Note that this *incremental* cost differs from the change in *total* cost associated with billing conversion (which shifts the monthly cost for water from zero to between $10 and $35, a much larger jump). This difference likely explains why consumption is lower in direct billed properties than in-rent properties even though there is little behavior change associated with higher average costs per gallon.

Exhibit 9

Consumption Patterns, by State

(Median Values)

	Florida	Texas	California
Consumption (1,000 gpy/resident)			
All consumption	37	36	39
Excluding common areas	32	31	32
Consumption (gpy per occupied sf)			
All consumption	66	79	78
Excluding common areas	46	65	63
Building Age (years)	13	15	22
Cost			
Average cost (cents/gallon)	0.49	0.26	0.34
Cost per apartment ($/month)	$19.0	$15.9	$14.4
Sample Size (# properties)	12	12	8

Notes:
Abbreviations: sf = square foot; gpy = gallons per year.

PRStateSum

Common Area Water Use Estimates Generally Too Low

One peripheral finding of our analysis is that estimates of common area water consumption are generally too low. As shown in Exhibit 10, it is when consumption in common areas is actually metered that the values are the highest (this is also the reason that the common area share is higher in our submetered population). Property managers tend to estimate the common area share at the lowest level, with median values only one-third as high as the actual meter reads.

The implications of understanding common area shares are multi-fold:

- **Tracking the conservation benefits of RUBS/submetering is more difficult.** Unless common area usage can be accurately segregated from tenant usage, tracking the conservation response in tenant water consumption behavior becomes much more difficult. As a result, the benefits of converting to direct charges for water are likely to be understated.

Exhibit 10

Common Area Water Usage

(Median Values)

	Percentage of Total Water Consumed			
	All States	**FL**	**TX**	**CA**
Summary by Billing Type				
Submetered	25%	30%	27%	21%
RUBS	15%	20%	12%	10%
In-Rent	18%	18%	12%	30%
Summary by Basis of Estimate				
Meter Reads	30%	36%	23%	30%
Meter Reads Plus Management Estimate (note 1)	23%		25%	
Property Manager Estimate	10%	10%	11%	10%
Billing Company Estimate	18%	18%	10%	20%
Industrial Economics Estimate (note 2)	20%	20%	15%	26%

Notes:

(1) Some properties have separate meters for a portion of their common area use, such as irrigation, but rely on judgment to estimate other common area applications.

(2) Industrial Economics estimates were developed by comparing the common area water amenities with common area estimates at other properties with similar amenities.

PRSumCommArea

- **RUBS systems are less equitable than they would otherwise be.** Underestimating common area usage generally results in a higher portion of total water/sewer costs being passed back to tenants in the form of user charges, even for properties that had intended to pay for common area usage themselves. Since tenants have no control over common area usage, this is less equitable and can potentially cause resentment about the RUBS system overall.

- **Conservation incentives.** Tenants are more likely to modify their consumption behavior when they pay for their own water and sewer. So too with management. When management pays for the full cost of common area usage, they are more likely to investigate ways to bring these costs down, and to implement improved systems to conserve water.

QUALITATIVE FINDINGS: SUGGESTIONS AND OPPORTUNITIES

Common Challenges Facing Property Managers

In the course of gathering quantitative data on water consumption and billing, we had the opportunity to speak with numerous people involved with water billing issues. These contacts included a variety of perspectives, such as building managers, building maintenance staff, tenants, and public officials. A number of useful common themes and suggestions emerged from these conversations and are summarized here.

Phase-in Strategies: Suggestions for Shifting to Direct Billing

We found a surprising consensus among building managers on how a transition to charging tenants for their water should be managed. This consensus included not only managers who had implemented their system the way we describe, but a few who had done it other ways but ran into problems. Elements to a successful program transition include:

- **Advance notice and education.** In every case, managers thought it was extremely important to provide their tenants with advance notice of the pending change in their water and sewer charges. Coupled with information on what would happen, how large the charges were likely to be, and ways tenants could reduce their charges, most of the transitions were made with little tenant resentment. Describing how the change would encourage additional conservation of scarce water resources carried substantial weight with tenants in arid parts of the country such as Texas.

- **Transition period retrofits.** During the period between when the change in water/sewer billing was announced and when it was to take effect, many building managers took steps to help tenants conserve water. This involved, at a minimum, fixing leaks within the units. However, some buildings actually retrofitted key water consuming equipment such as toilets, faucet aerators, and shower heads. These changes not only helped reduce the costs that the tenants would eventually bear, but greatly enhanced tenant goodwill and reduced the feeling by tenants that their building was just "dumping" costs on them. Though toilet retrofits can be expensive, some regions of the country have low-flow toilet rebates that make the upgrades extremely cost-effective.

- **Charge back of common area water use.** Many states that allow tenants to be charged for water allow the full costs of water/sewer to be shifted to residents. This includes both water consumption within the apartments as well as that in common areas. Despite the fact that charging tenants for common area water use is generally *legal*, there was fairly broad consensus that it was a bad idea. In one building, the owner very much wanted to charge through all costs, but the property manager was concerned that this incremental additional charge was going to greatly increase the number of complaints he would have to deal with. Among the other reasons not to allocate through common area water/sewer charges:

- Tenants broadly perceived this as unfair, and it could undermine their support for the rest of the allocated system.

- Tenants would get very upset any time they saw an incident of water waste in common areas (e.g., a broken sprinkler), and would not want to be charged for something they viewed as a management lapse.

- In addition to tenant perceptions, having management continue to pay the common area costs mirrors the way most apartments treat other utilities such as gas and electric. Furthermore, it retains the proper incentives to building management to implement common area retrofits and conservation, something they can control, but over which tenants have little influence.

- **Pay attention to market conditions.** Many building managers noted that market conditions mattered in terms of their ability to change the billing system for water and sewer. Part of this is intuitive: in general, high vacancy rates will preclude shifting any additional costs to tenants, including water charges. This applies to vacancy rates within a particular class of rental property for a given city. However, even in markets with low vacancies, common practice influences how easy it is to modify the charges. If no other properties charge for water, it may be necessary to reduce rents slightly to adjust for the new cost to tenants. Where a change in billing approaches is important for environmental reasons as well as cost control, such as in water-scarce regions, local apartment associations can work with the local water authority to make a change in billing mandatory, thereby eliminating a potentially large barrier to the shift.

While less attractive than being able to simply change who pays the bills, shifting water and sewer costs can still make sense even if rents need to be reduced slightly. This is because the aggregate costs of the building will decline as improved water conservation takes place. Thus, rents can be reduced less than the current cost of water/sewer paid by management. In addition, because rents can be adjusted yearly, much of the slight drop in rent can be recovered in future years once people are used to the water/sewer charges.

Use of Billing Companies

Many apartments like to use billing companies because they reduce the administrative burden associated with direct billing for water, and avoid the impression that the management company is earning a profit from water charges (this is not generally allowed, but the perception can still be damaging). However, building managers who have used the billing companies had a number of suggestions to help the process go more smoothly:

- **Choose carefully.** Where billing companies were good, properties thought that they helped tremendously with the conversion to RUBS or submetering. However, a number of the sample properties had bad experiences with their initial billing company choice. In some cases, the problems had actually triggered tenant

resentment, making the allocation program more difficult to implement. Check references and research the company you will be using carefully.

- **Conduct initial "dry runs" of the new system.** It is important to test the new system before you send bills to tenants, since the billing system rarely works well the first month or two. Dry runs help identify problems and aberrations that would cause tenant ill-will if not caught, such as excessively high and incorrect bills.

- **Don't ignore the cost of the billing service.** Charges tend to be as a fixed rate per bill. These fees for billing and collection can be quite high, up to nearly $3 per bill. With water charges sometimes only $8-10 per month, the administrative overhead becomes a significant drain on net revenues collected. It is important to consider this overhead up-front. Bi-monthly rather than monthly billing may make sense in these circumstances.

Last Month Issues

Collecting unpaid water and sewer bills associated with the last month of a tenant's occupancy is a problem for many properties. Managers need to think about this problem up-front as well, in order to build a solution into the water/sewer billing system from the outset. We encountered a number of techniques managers had developed to address the problem. Some instituted a water deposit of $25 or $50, applicable to any unpaid bills. Many others modified lease language so that unpaid bills could be deducted from the general security deposit.

These solutions work only where there is some type of security collected from the tenant. A few apartments we visited in Texas mentioned that they regularly run "sales" to attract new tenants where the security deposit is waived. In these cases, pro-rating the utilities in advance of the tenant's departure is one technique that has been applied with some success.

Cost Control

Properties are concerned about controlling their rising water and sewer bills. There are a number of easy-to-implement approaches that we encountered to control costs, that could be adopted more widely.

Improved Metering

It is increasingly common for sewer charges to actually exceed the water bill. Nonetheless, sewer charges are generally derived directly from water consumption data, with the assumption that all water (or some fixed proportion of the water) taken into a property is later returned to the sewers for wastewater treatment.

In reality, not all water consumption follows this pattern. Irrigation water, often the largest common area water use, is not returned to the sewers at all. In many cities, if you install a

separate water meter on the irrigation portion of your water consumption, you don't have to pay sewer charges on this portion of your bill. While the potential savings can be large, many apartment managers were not aware they could do this.

One other area where separate metering would be useful is pools. In southern climates, a significant amount of pool water is lost through evaporation and also does not require treatment. No apartment complexes we visited had tried to install a separate outflow meter on their pools to ensure that they were only charged sewage fees on actual discharges. In fact, this is an area where there is little information on whether the water utility would even allow it. However, the savings could be large enough to warrant trade association inquiry into the matter.

Appliance Strategies

There is a wide variation in the water efficiency of common appliances such as dishwashers and washing machines. Our research indicated that the water conservation profile of these appliances is generally ignored when purchase decisions are made. Rather, capital cost and reliability are the only two factors evaluated. Where machines are used in common areas (e.g., laundry rooms), cost considerations should be done on a life cycle basis, with operating as well as capital costs are considered. Ideally, these considerations should go into in-unit appliance purchase and replacement decisions as well. There are likely numerous models that are water efficient while at the same time being reliable and reasonably priced.

The costs associated with many other water saving devices such as flow aerators, low flow showerheads, and toilet flapper retrofits, are generally a secondary issue. Most of the devices have a relatively fast payback. The key issue noted by a number of building managers is the quality of the devices: if the tenants are dissatisfied (such as by a poor quality shower), there is little to be gained by installing the equipment in the first place.

Cost Centers for High Volume, Specialized Uses

We saw an extremely wide variation in common area water use applications. Outside of irrigation, the largest uses for common area water were often specialized applications such as car washing, clothes washing, and in one case, a marina for boat washing. These are all examples where managers may want to separate all of the costs associated with these services (including separate water metering), and recover them through special charges on the users. While many properties do charge for using common washing machines, there has been little effort to better manage other specialized uses.

Learning from Your Bills

A final way to better control costs is to pay closer attention to the water and sewer bills you receive. By tracking patterns, properties can quickly spot changes in consumption levels, often indicative of leaks. The bills will need to be standardized to per capita or per square foot

measures in order for real trends to be evident. Despite the large cost savings associated with more careful tracking of costs, a surprising number of properties in our sample had periods when per capita water consumption actually doubled without anybody noticing.

New Opportunities for Improved Cost Management

There is much to do to make water and sewer costs easier to manage. While some of these unmet needs may require additional effort by trade associations, many of them represent business opportunities for water utilities and billing companies.

Facilitating Conversion to Direct Charges for Water

Many states impede or prohibit direct billing of water and sewer costs to tenants. Our analysis has shown that there are significant water conservation benefits from a move to direct charges, and that the actual tenant costs involved are smaller than most other utility bills already paid by the tenant. However, moving the policy debate forward may require some additional effort:

- **Prove that RUBS systems are equitable.** Additional work needs to be done to analyze existing RUBS programs. Common area usage estimates need to become more rigorous, and efforts should be made to evaluate how much allocated charges differ from actual use. If it can be documented that the inaccuracies in RUBS systems versus actual use are only a few dollars per month, resistance to the RUBS approach will likely lessen substantially

- **Know the local policy environment.** Property managers don't have time to learn the state and local regulations, water conservation programs, and the required process for converting properties to RUBS or submetering. Trade associations and billing companies do have an interest in knowing this information, and can do a better job making conversion to direct billing easier to do.

Enhanced Billing Services

Many billing companies provide extremely basic services to their properties. They read meters in occupied apartments and send bills to tenants; or they allocate the total water charges to a property using a RUBS formula, and send bills to tenants. They have part of the information needed to really help the properties understand their waters costs, and could take some additional steps to make this data much more usable -- and hence more valuable -- to the properties.

- **Meter consolidation.** One of the reasons that properties don't spot changes in their water consumption is that the information they receive from municipalities is often quite difficult to use. If they have multiple meters, they may receive as many as 60 different bills. Data are rarely totaled in useful ways. Billing companies (as well as

municipalities) could consolidate meters in ways that help the properties track trends over time, across properties, and between tenant use and common area use.

- **Bill consolidation.** Many states also fragment the full cost of water and sewer by sending up to three separate bills: one for water, one for sewer, and one for the capital costs of the sewer (which comes on the regular property tax bill). Integrating these charges for properties would help them develop more efficient RUBS programs and identify promising opportunities for cost control.

- **Standardized comparative metrics.** Raw data are rarely useful in identifying trends or problems. The water utility industry should develop industry-wide standardized metrics that help users interpret the data. Values per capita and per occupied square foot are obvious examples. Others may be more sophisticated. For example, gas utilities use a measure called the "degree-day" which estimates the demand for heating services. This metric adjusts consumption values for changes in the weather. A similar metric could be used to measure the demand for outdoor watering, helping to identify changes in common area usage patterns.

- **Variance analysis and benchmarking.** Many of the enhanced billing services will help identify changes in usage patterns. Billing companies can provide near-real time notification for such variances from past patterns, helping their clients find problems early. The use of standardized metrics will also enable the companies to compare consumption profiles across similar buildings, identifying properties are either lag or lead in the water conservation area.

- **Benchmarking and utility rate structures.** Benchmarking does not just help the property, but can also identify municipalities with particularly bad rate structures based on observed consumption patterns. Careful benchmarking can help improve regional planning efforts aimed at increasing water conservation.

Demand-side Management: From Information to Action

Better data helps properties identify where they have problems. Determining how to rectify them can be extremely difficult as well, but offers another potentially large market for water service companies.

- **Communicate key options for cost-effective retrofits.** By collecting and tracking data on water usage, billing companies can be the first to identify opportunities for changes in equipment or operations to save money. This information is extremely valuable to the properties, and can become an important competitive advantage for billing companies that do it well.

- **Know the details about key retrofit areas.** Billing companies or their affiliates should have detailed cost and performance data on key water consuming appliances. This information can both help property managers to integrate the water-related

operating costs of particular equipment into their purchase decision, and reduce the amount of work that property staff need to do to in order to identify and install high quality, money saving equipment.

- **Shared-saving retrofits.** In the energy industry, many energy service companies will pay a portion of the cost of installing high efficiency equipment in another company, in return for a share of the savings in utility bills over a period of years. This arrangement can be especially attractive to smaller companies that don't have adequate capital to pay for the entire retrofit up front. There is no reason that a similar arrangement can't become widespread in the water arena as well.

- **Landscaping.** The largest use of common area water in many apartment buildings is to irrigate the grounds. In water scarce regions, this can be a large cost item, yet none of the properties we spoke with had planned their landscapes with the goal of water conservation in mind. The use of native plants that require little water, known as xeriscape, offers potentially large cost savings to many properties. However, the knowledge required to implement it effectively makes independent action by a property unlikely. Again, billing companies or their affiliates can provide this specialized expertise to a range of customers.

The combination of refined data collection and increased expertise regarding cost-effective water retrofit options offer tremendous opportunities for billing companies or other water service companies over the next decade.

SUMMARY

Based on our analysis of 32 properties in three states, properties that charge their tenants directly for their water and sewer costs have significantly lower water consumption. The median submetered property used between 18 and 39 percent less water, depending on the metric used; the value for RUBS properties was 6 to 27 percent less. The method of billing for water affects consumption levels more strongly than either the unit cost of water or the building age. Of the ten least efficient properties in our sample, between 70 and 80 percent did not charge tenants directly for water.

When direct charge properties were paired with in-rent properties of a similar age, size, and location, we saw similar results. The median submetered property used between 26 and 55 percent less water than its in-rent pair; the median RUBS property used a roughly equivalent amount of water on a per capita basis, but 32 percent less on a per occupied square footage basis.

Our analysis intra-property time trends in consumption did not show any particular patterns linking improvements in water use efficiency with billing systems. We hypothesize that this was due to limitations in our data which did not allow us to measure changes in consumption over the entire period of conversion from in-rent to RUBS or submetering. Additional work in tracking intra-property trends, as well as in establishing the equity of RUBS systems, would likely help to overcome some of the political resistance to these systems that currently exists.

Despite the lower water consumption associated with RUBS and submetering properties, there remained a wide range of consumption levels even within the direct charge group. This range is indicative of the substantial opportunities that exist for additional, cost-effective, improvements in water use efficiency. Enhanced billing services and demand-side management services both offer broad market opportunities for billing companies or other water service companies over the coming decade.

DATA APPENDIX

Multi-State Appendix Exhibits

Exhibit ALL-1: Per Capita Consumption by Billing Type and Cost, Excluding Common Areas (graph)
Exhibit ALL-2: Consumption per Square Foot, by Billing Type
Exhibit ALL-3: Consumption per Square Foot, Excluding Common Areas, by Billing Type
Exhibit ALL-4: Comparative Consumption by Paired Properties, Excluding Common Areas
Exhibit ALL-5: Intra Property Time Trends, State Detail

Florida Summary Data

FL-1a: Per Capita Consumption, by Billing Type and Cost
FL-1b: Per Capita Consumption by Billing Type and Cost, Excluding Common Areas
FL-2: Per Capita Consumption by Billing Type and Building Age
FL-3a: Consumption Per Square Foot, by Billing Type
FL-3b: Consumption Per Square Foot, Excluding Common Areas, by Billing Type
FL-4a: Comparative Consumption by Paired Properties
FL-4b: Comparative Consumption by Paired Properties, Excluding Common Areas
FL-5: Change in Per Capita Consumption Over Time

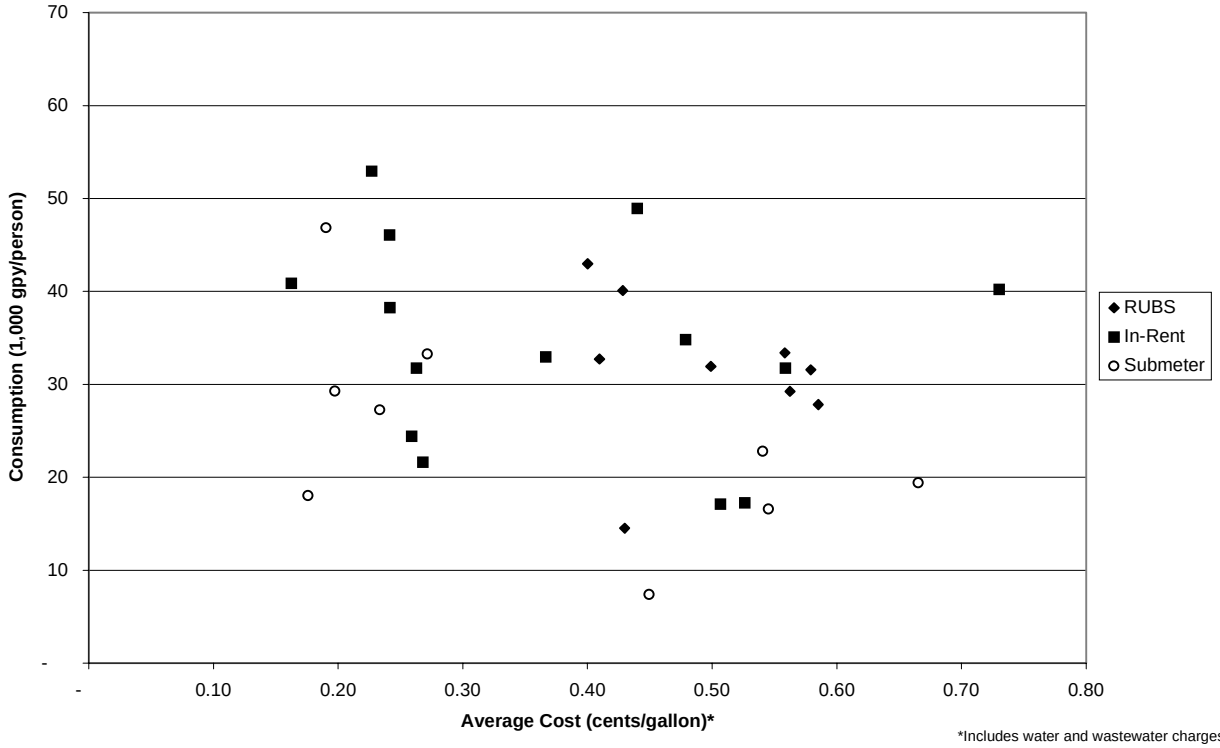
Texas Summary Data

TX-1a: Per Capita Consumption, by Billing Type and Cost
TX-1b: Per Capita Consumption by Billing Type and Cost, Excluding Common Areas
TX-2: Per Capita Consumption by Billing Type and Building Age
TX-3a: Consumption Per Square Foot, by Billing Type
TX-3b: Consumption Per Square Foot, Excluding Common Areas, by Billing Type
TX-4a: Comparative Consumption by Paired Properties
TX-4b: Comparative Consumption by Paired Properties, Excluding Common Areas
TX-5: Change in Per Capita Consumption Over Time

California Summary Data

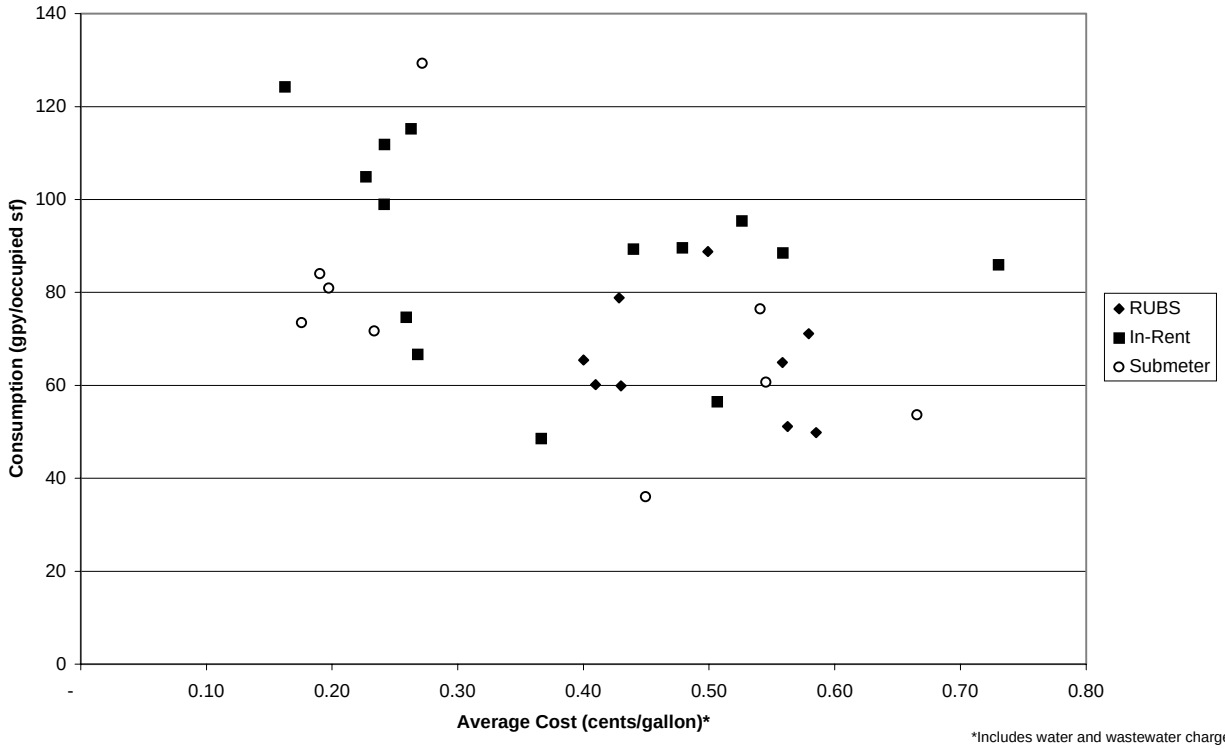
CA-1a: Per Capita Consumption, by Billing Type and Cost
CA-1b: Per Capita Consumption by Billing Type and Cost, Excluding Common Areas
CA-2: Per Capita Consumption by Billing Type and Building Age
CA-3a: Consumption Per Square Foot, by Billing Type
CA-3b: Consumption Per Square Foot, Excluding Common Areas, by Billing Type
CA-4: Change in Per Capita Consumption Over Time

Exhibit ALL-1
Per Capita Consumption by Billing Type and Cost, Excluding Common Areas



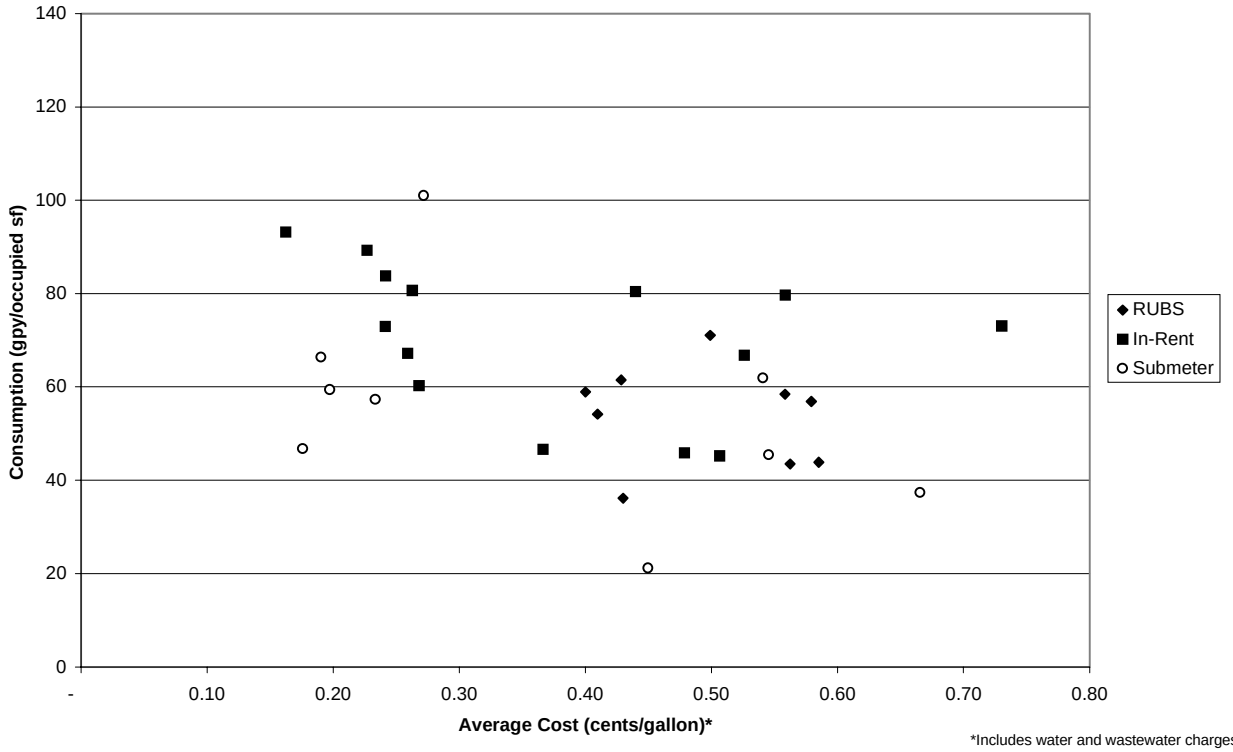
*Includes water and wastewater charges.

Exhibit ALL-2
Consumption per Square Foot, by Billing Type



*Includes water and wastewater charges.

Exhibit ALL-3
Consumption per Square Foot, Excluding Common Areas, by Billing Type



*Includes water and wastewater charges.

Exhibit ALL-4
Comparative Consumption by Paired Properties, Excluding Common Areas
(% Difference from In-Rent Control Property)

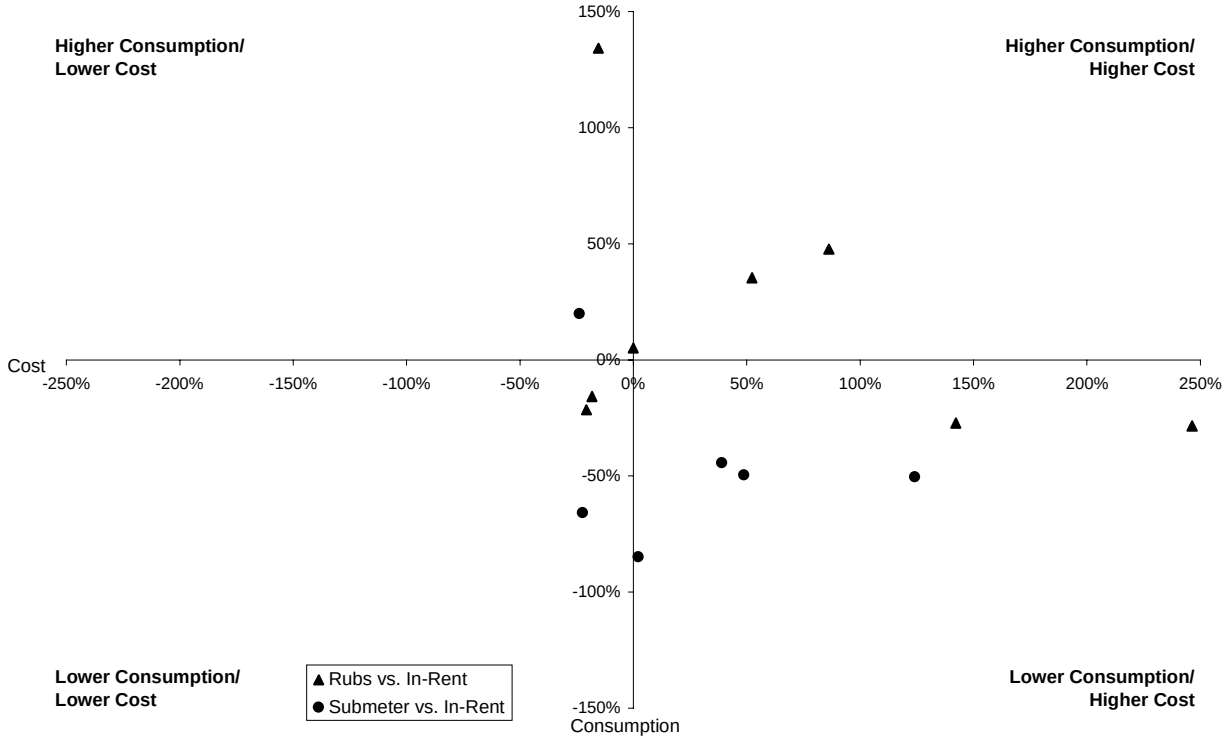


Exhibit ALL-5

Intra-Property Time Trends, State Detail

(Median Values)

	Florida	Texas	California
Per Capita Consumption			
% (decrease) increase in per capita consumption	2%	1%	-4%
Cost Trend			
% (decrease) increase in average cost per gallon	4%	5%	11%

Notes:

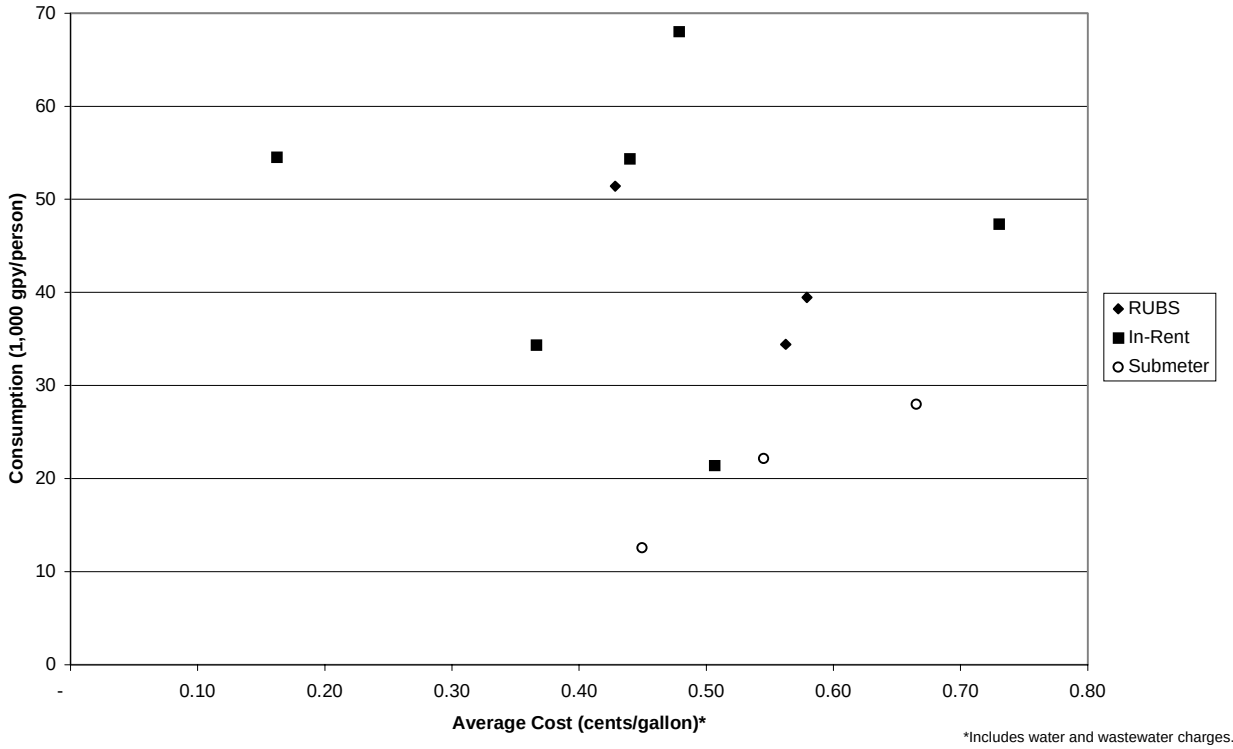
(1) Because both occupied square feet and headcount are pro-rated based on the same changes in occupancy within a property, results on a per occupied square footage basis did not differ from those on a per capita basis for this table, and were excluded.

(2) Time trends span a period of one to five years, depending on the property and the availability of the necessary data.

(3) Values are sensitive to data quality. Many properties within the sample had already shifted to charging tenants at the beginning of the time period analyzed, or have not yet completed this conversion. In either case, the conservation benefits of a change in billing methods will be understated.

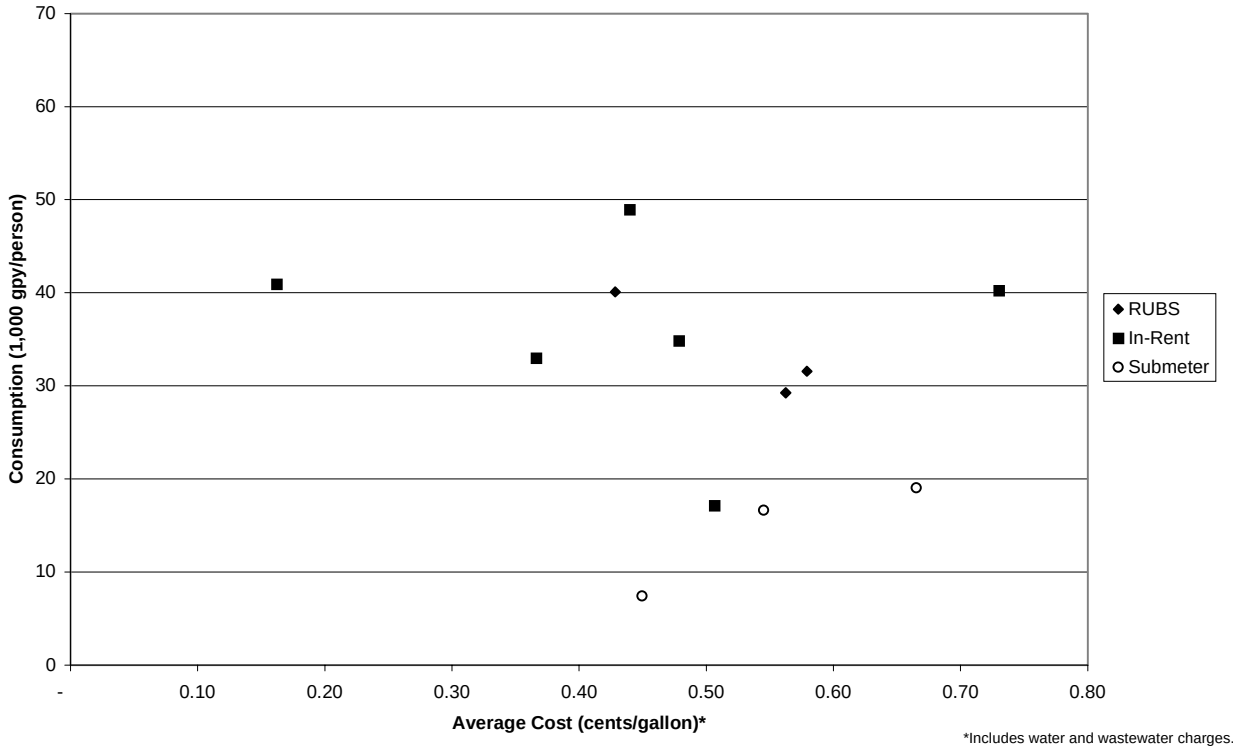
PRStateTime

Exhibit FL-1A
Per Capita Consumption, by Billing Type and Cost



*Includes water and wastewater charges.

Exhibit FL-1B
Per Capita Consumption by Billing Type and Cost, Excluding Common Areas



*Includes water and wastewater charges.

Exhibit FL-2
Per Capita Consumption by Billing Type and Building Age

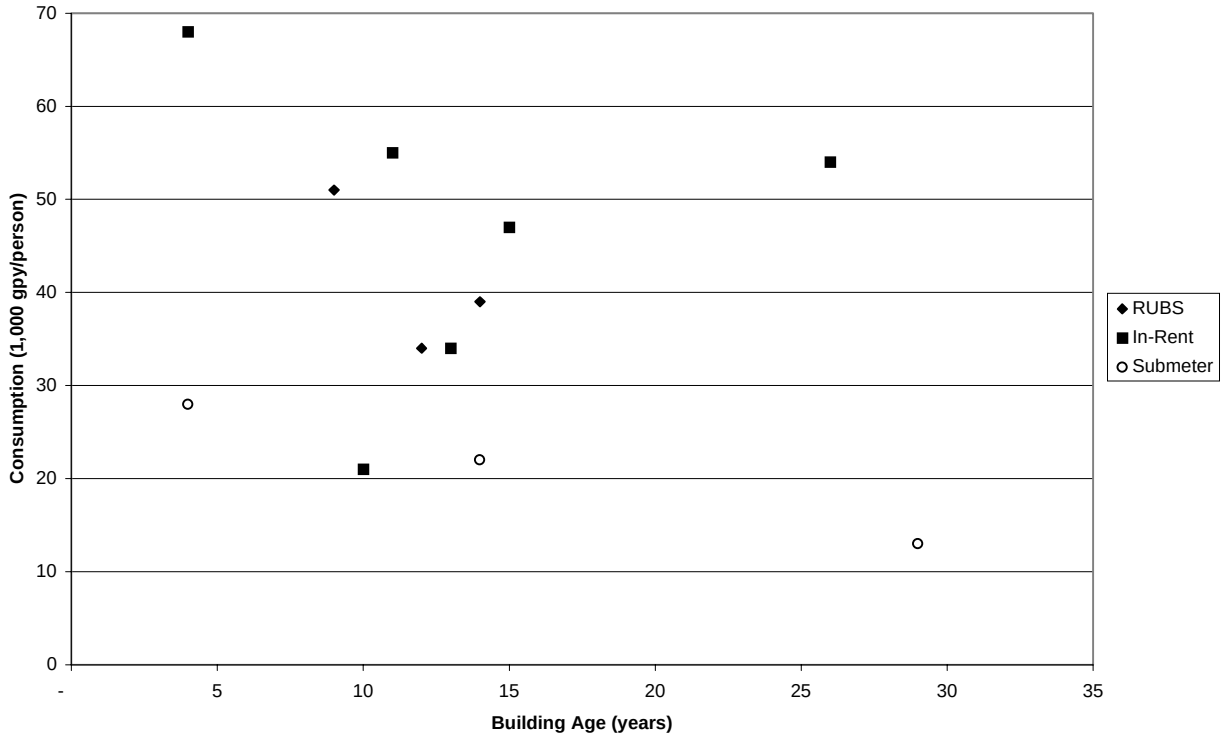
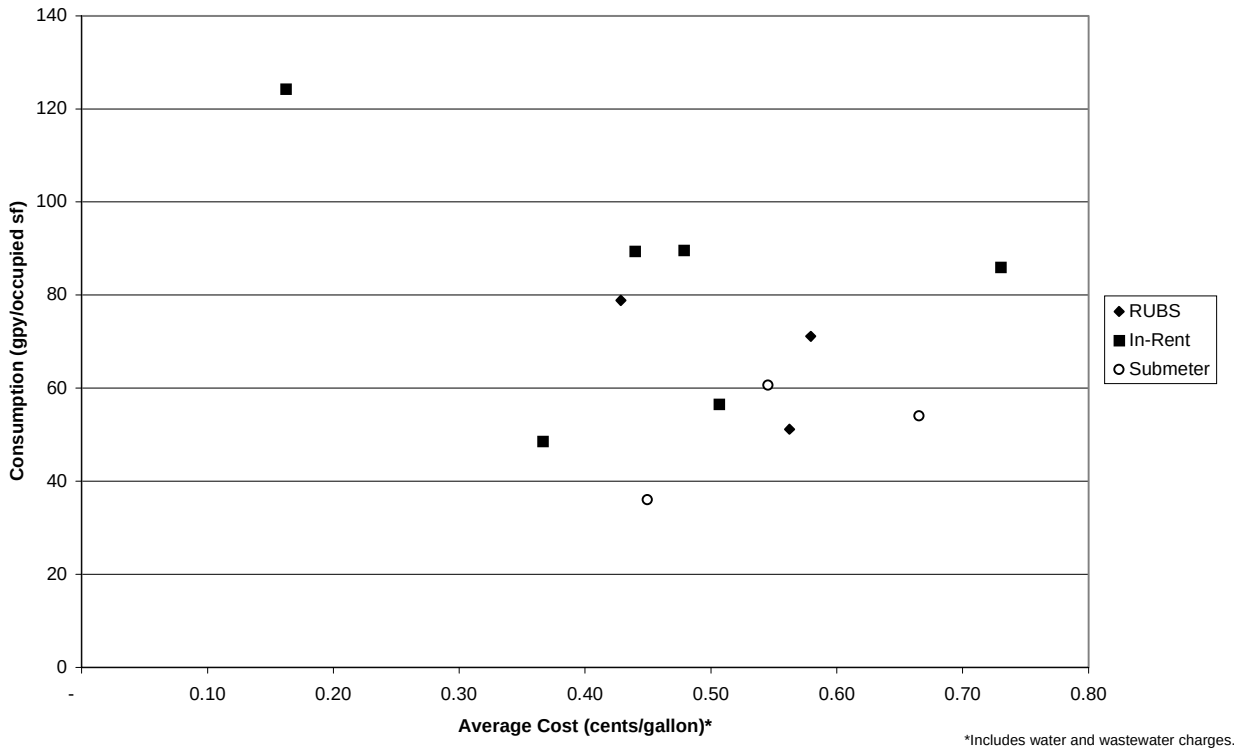
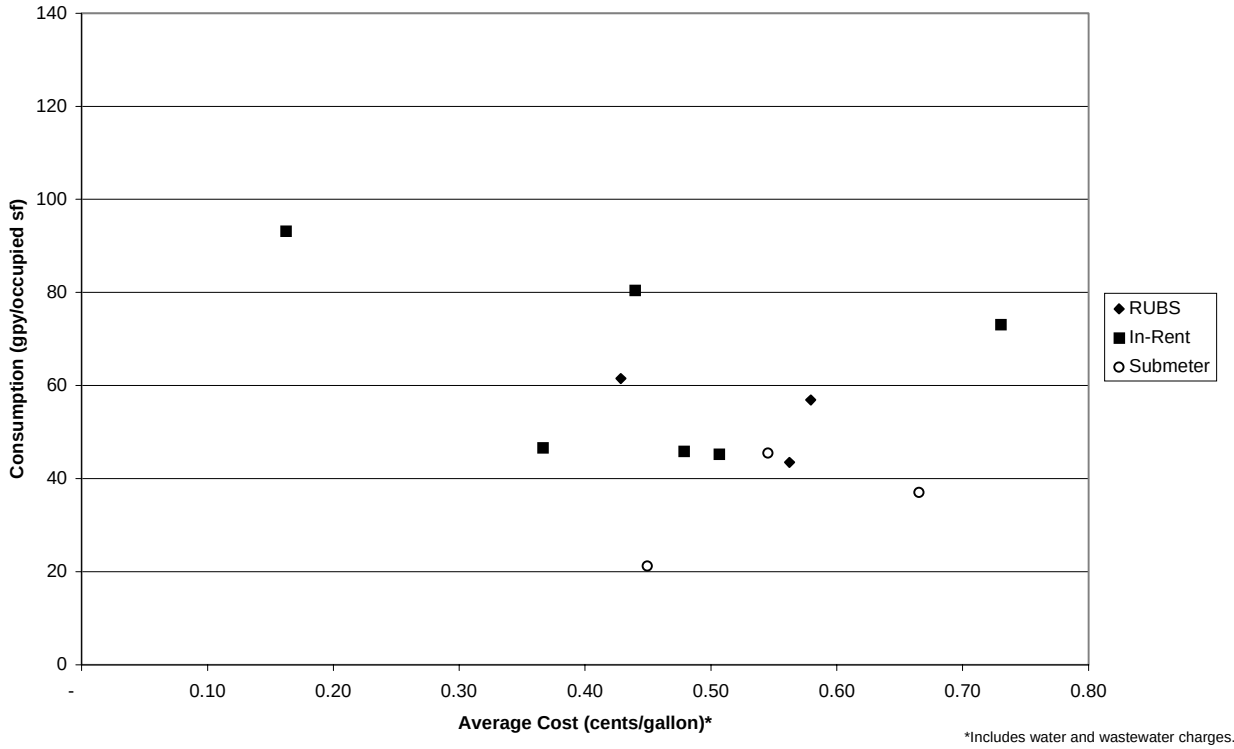


Exhibit FL-3A
Consumption per Square Foot, by Billing Type



*Includes water and wastewater charges.

Exhibit FL-3B
Consumption per Square Foot, Excluding Common Areas, by Billing Type



*Includes water and wastewater charges.

Exhibit FL-4A
Comparative Consumption by Paired Properties
(% Difference from In-Rent Control Property)

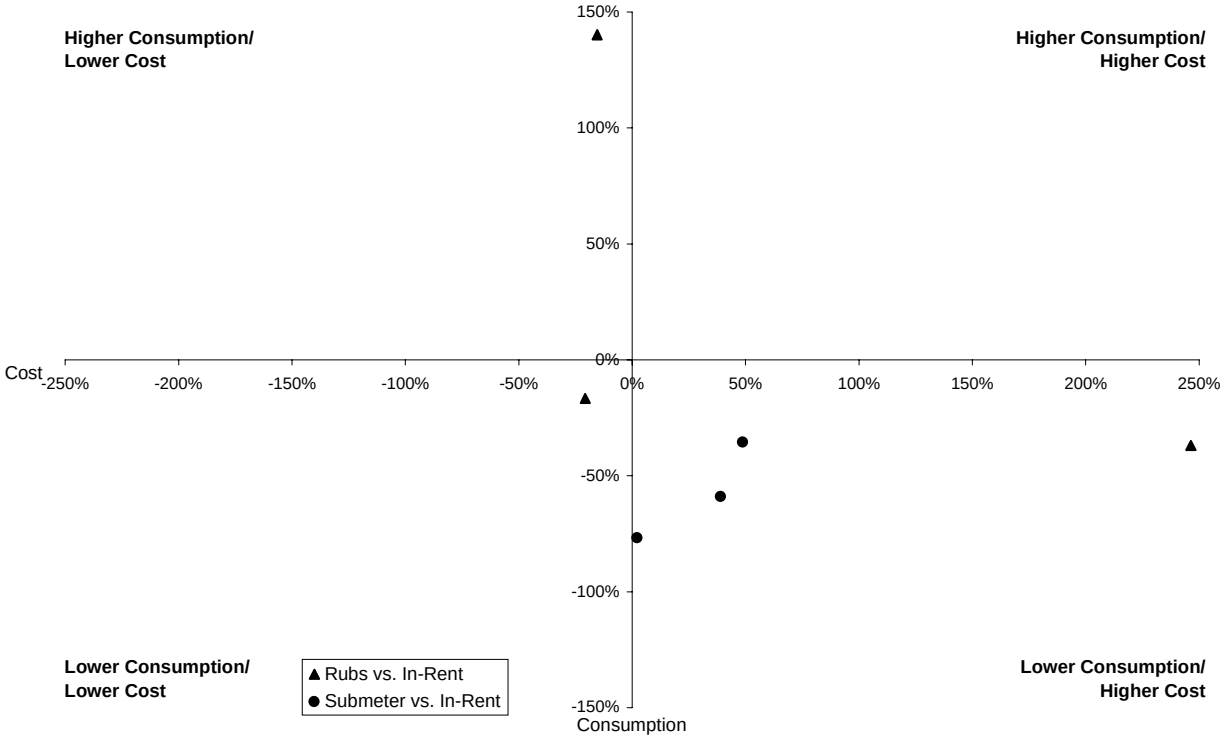


Exhibit FL-4B
Comparative Consumption by Paired Properties, Excluding Common Areas
(% Difference from In-Rent Control Property)

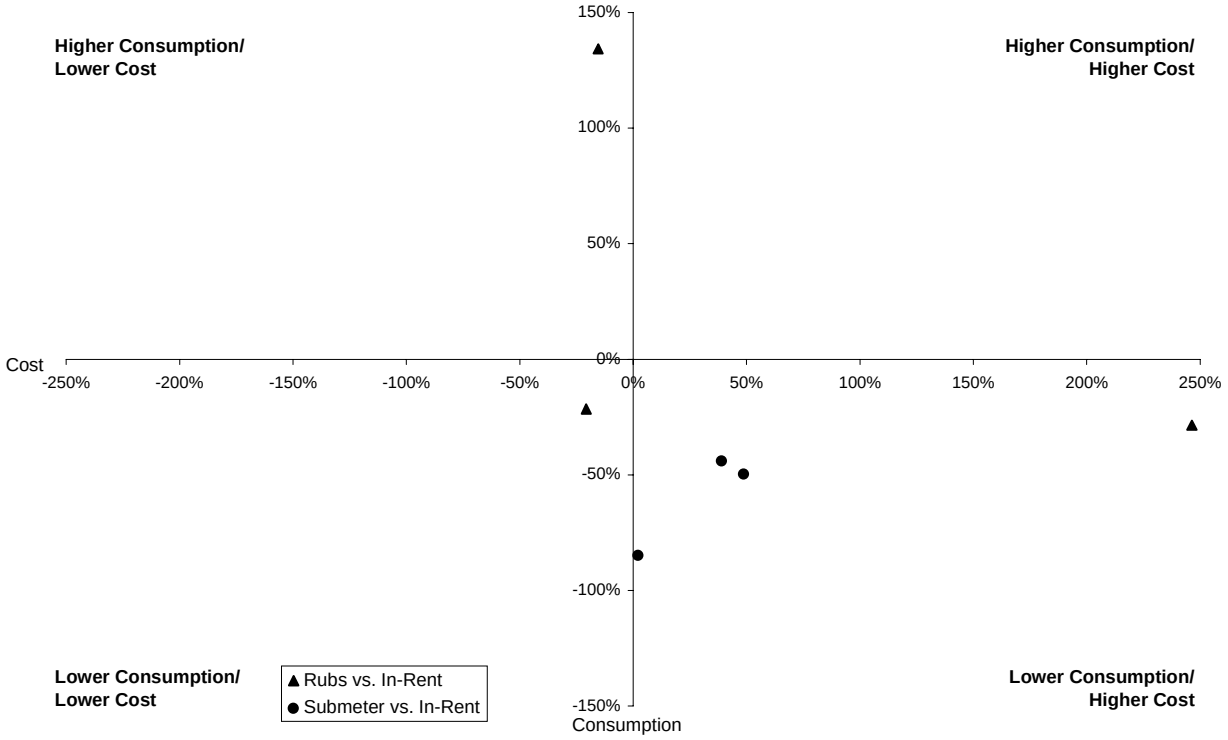


Exhibit FL-5
Change in Per Capita Consumption over Time
(% Change Over Period of Available Data)

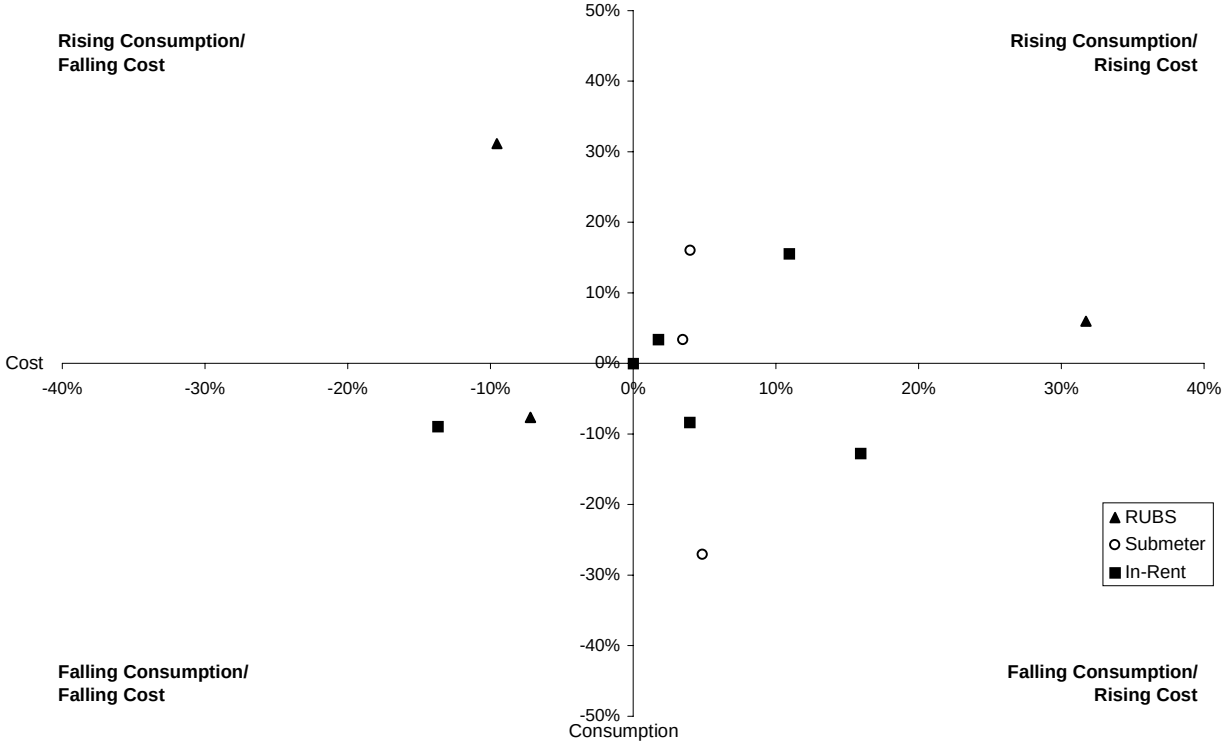
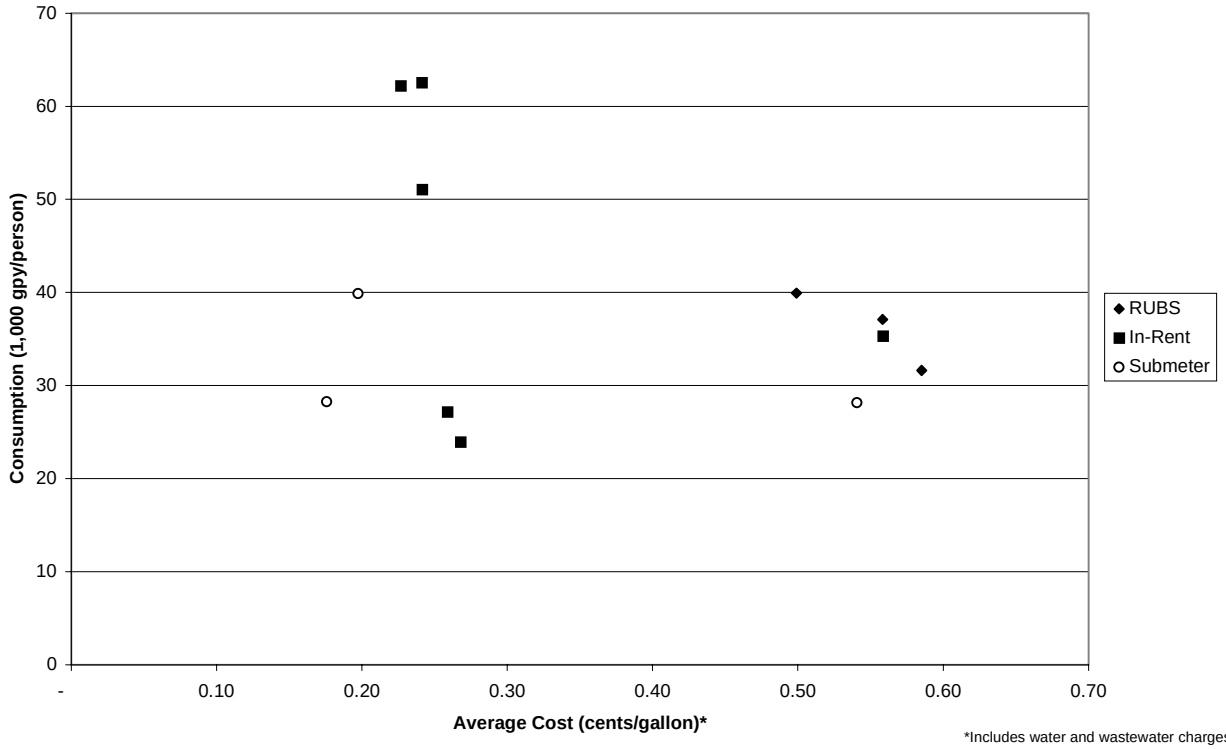
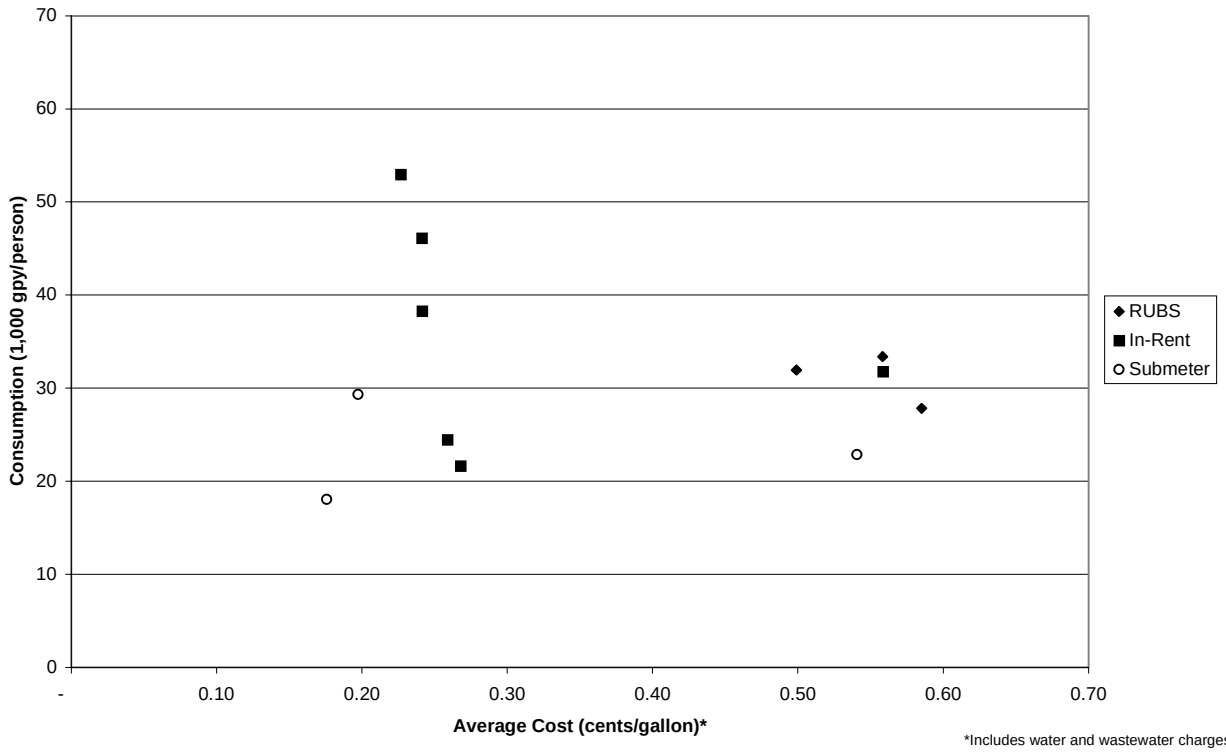


Exhibit TX-1A
Per Capita Consumption, by Billing Type and Cost



*Includes water and wastewater charges.

Exhibit TX-1B
Per Capita Consumption by Billing Type and Cost, Excluding Common Areas



*Includes water and wastewater charges.

Exhibit TX-2
Per Capita Consumption by Billing Type and Building Age

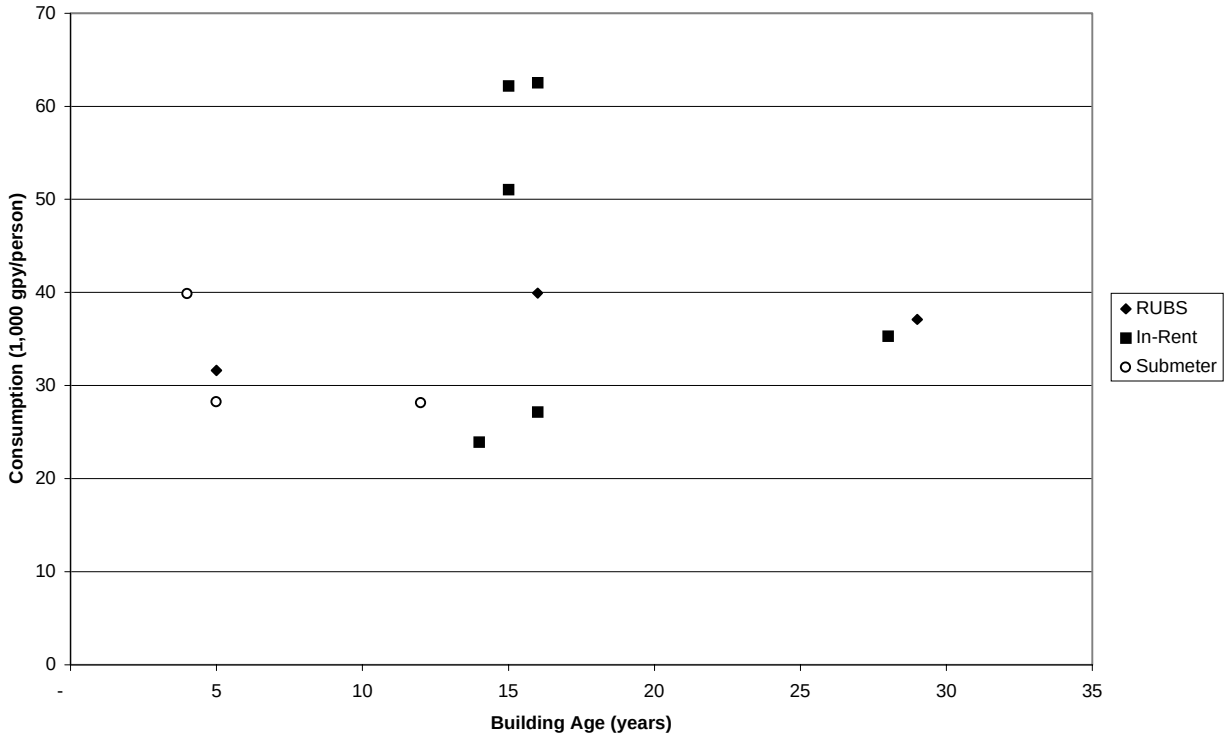
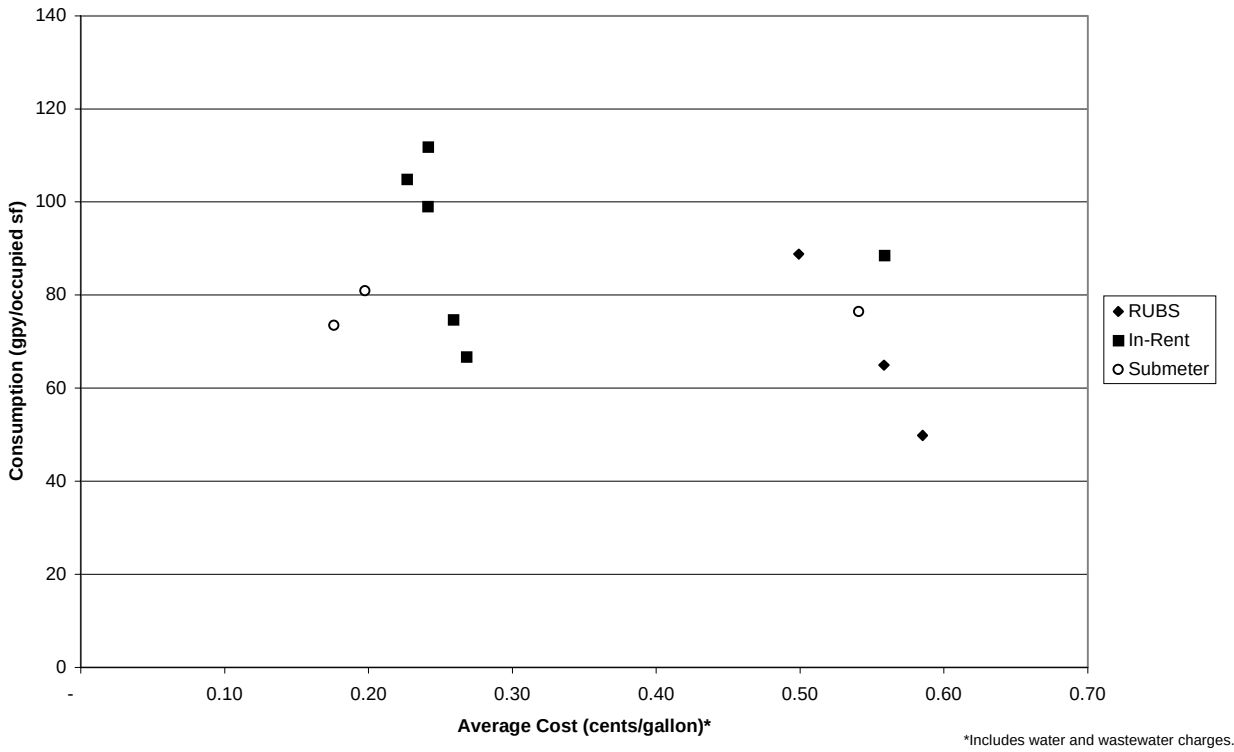
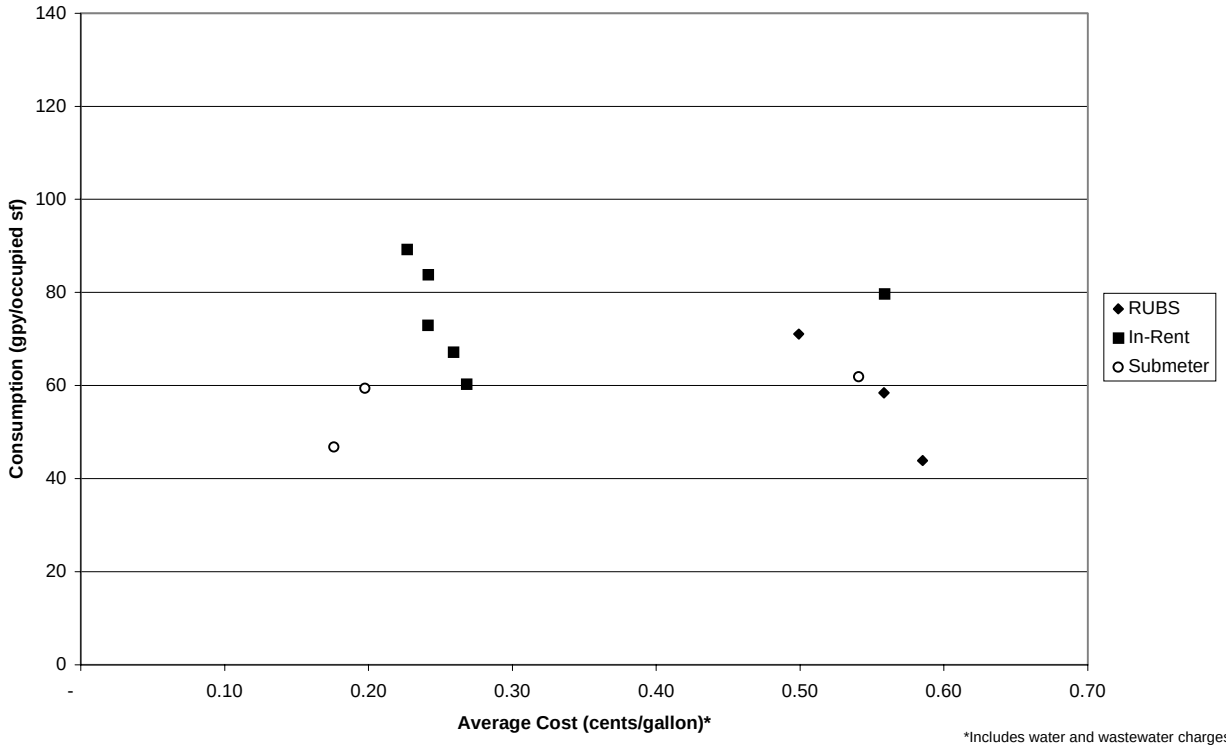


Exhibit TX-3A
Consumption per Square Foot, by Billing Type



*Includes water and wastewater charges.

Exhibit TX-3B
Consumption per Square Foot, Excluding Common Areas, by Billing Type



*Includes water and wastewater charges.

Exhibit TX-4A
Comparative Consumption by Paired Properties
(% Difference from In-Rent Control Property)

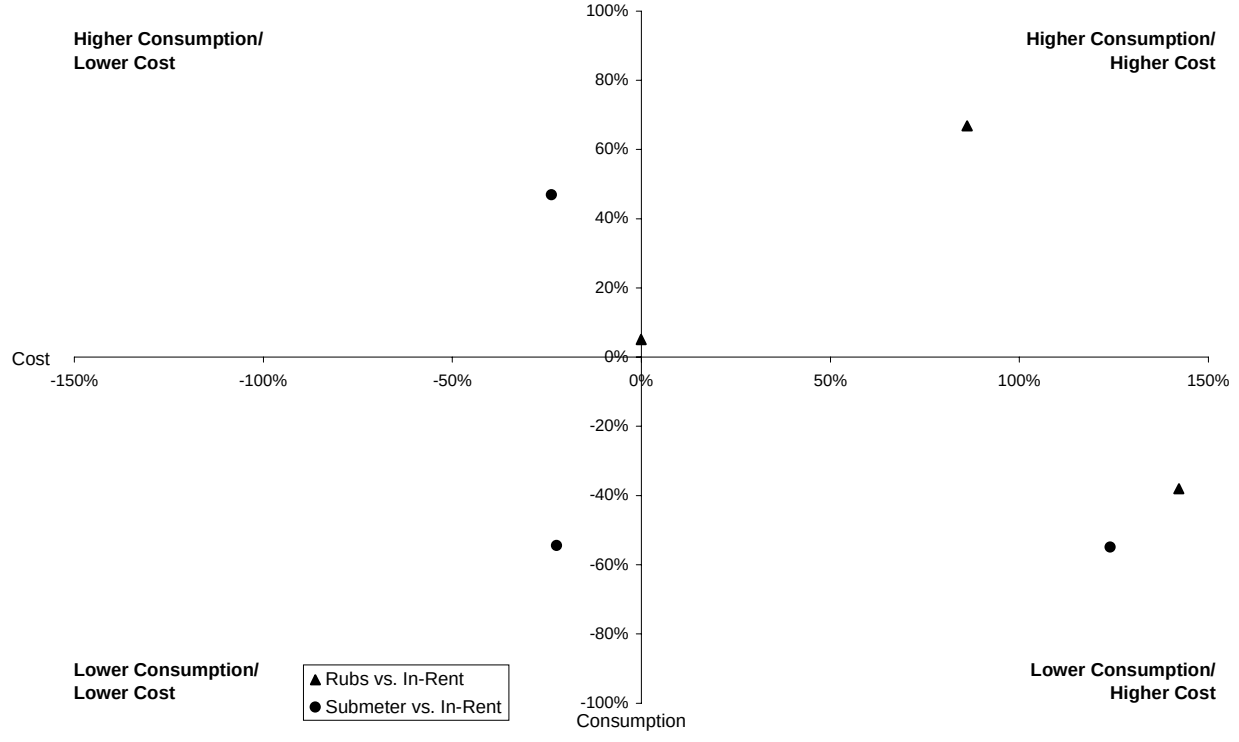


Exhibit TX-4B
Comparative Consumption by Paired Properties, Excluding Common Areas
(% Difference from In-Rent Control Property)

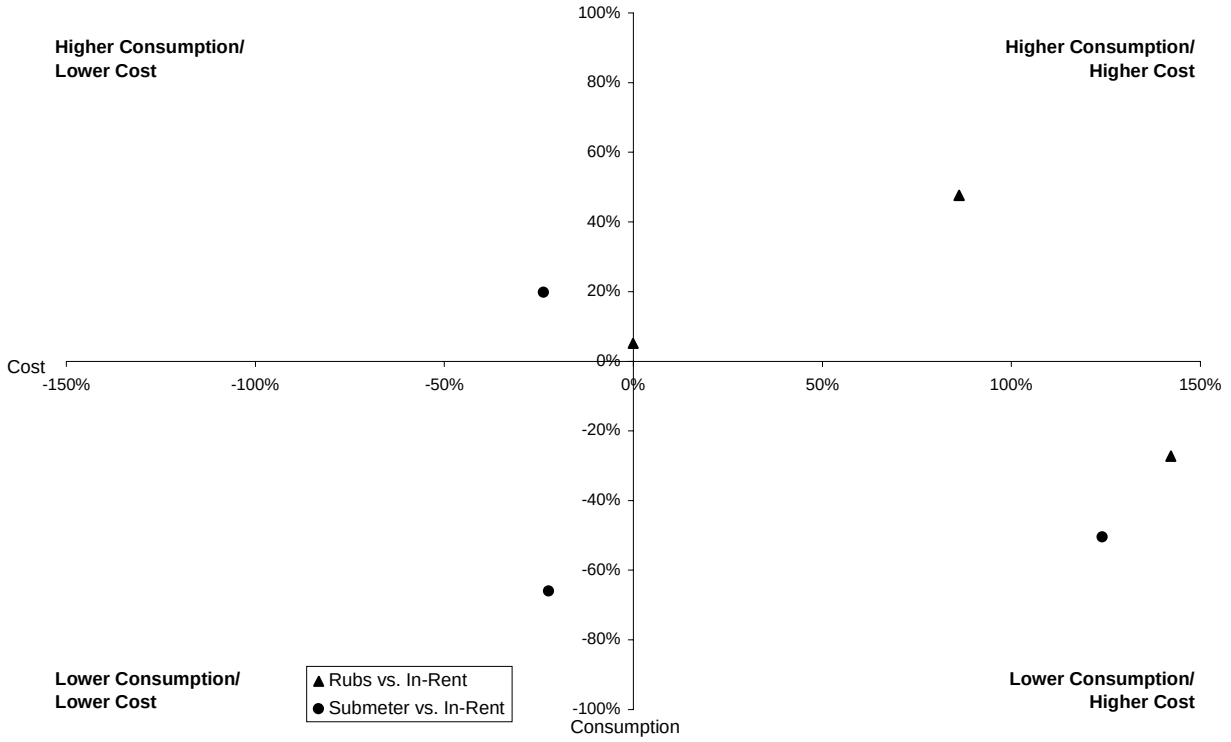


Exhibit TX-5
Change in Per Capita Consumption over Time
(% Change Over Period of Available Data)

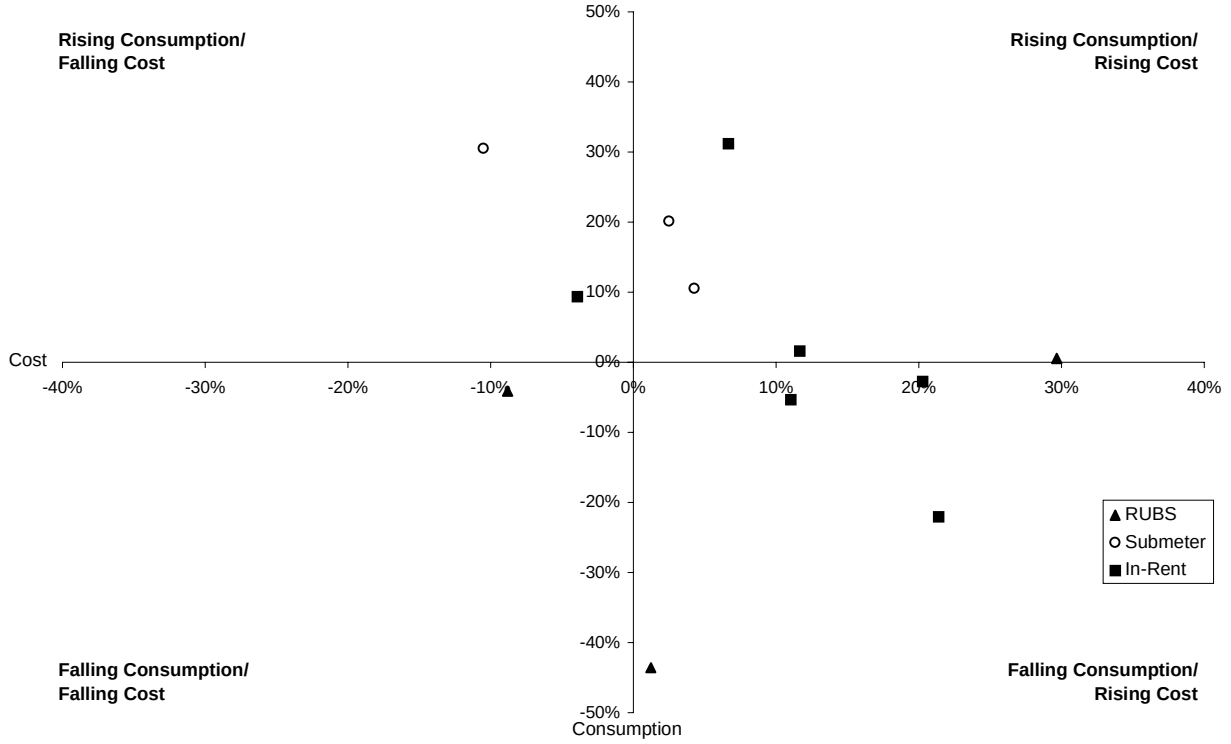
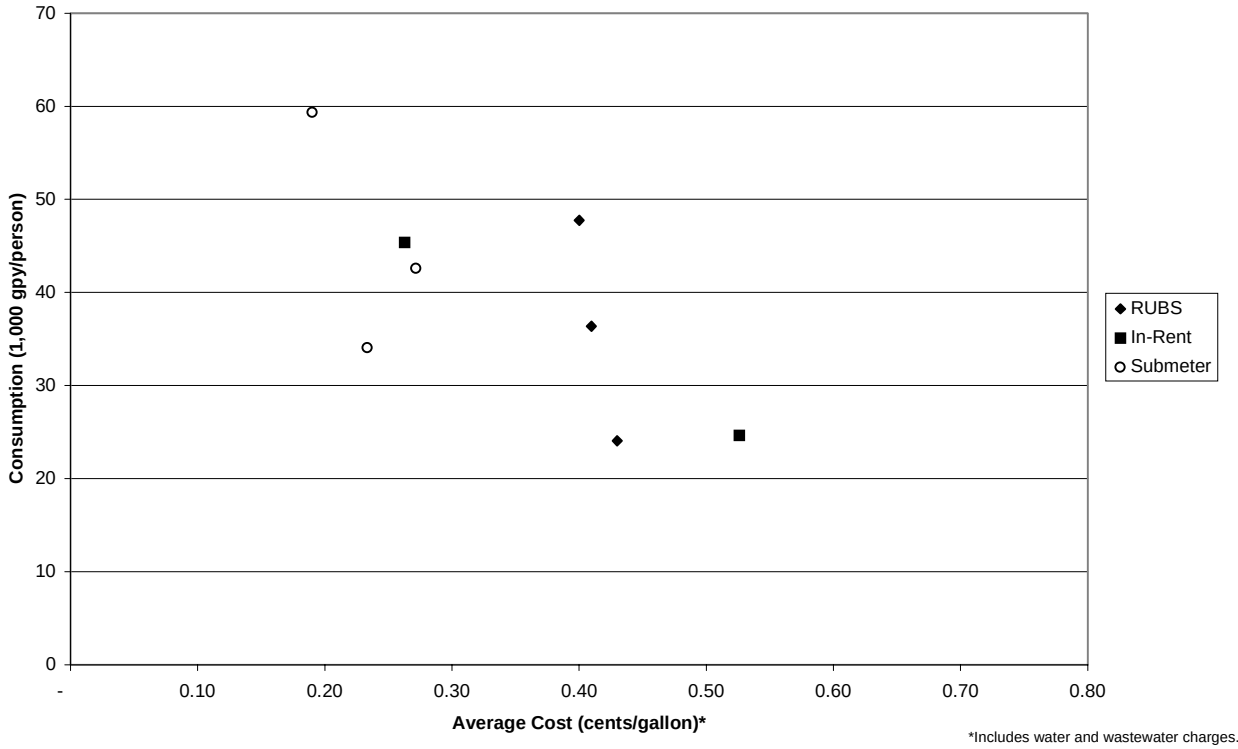
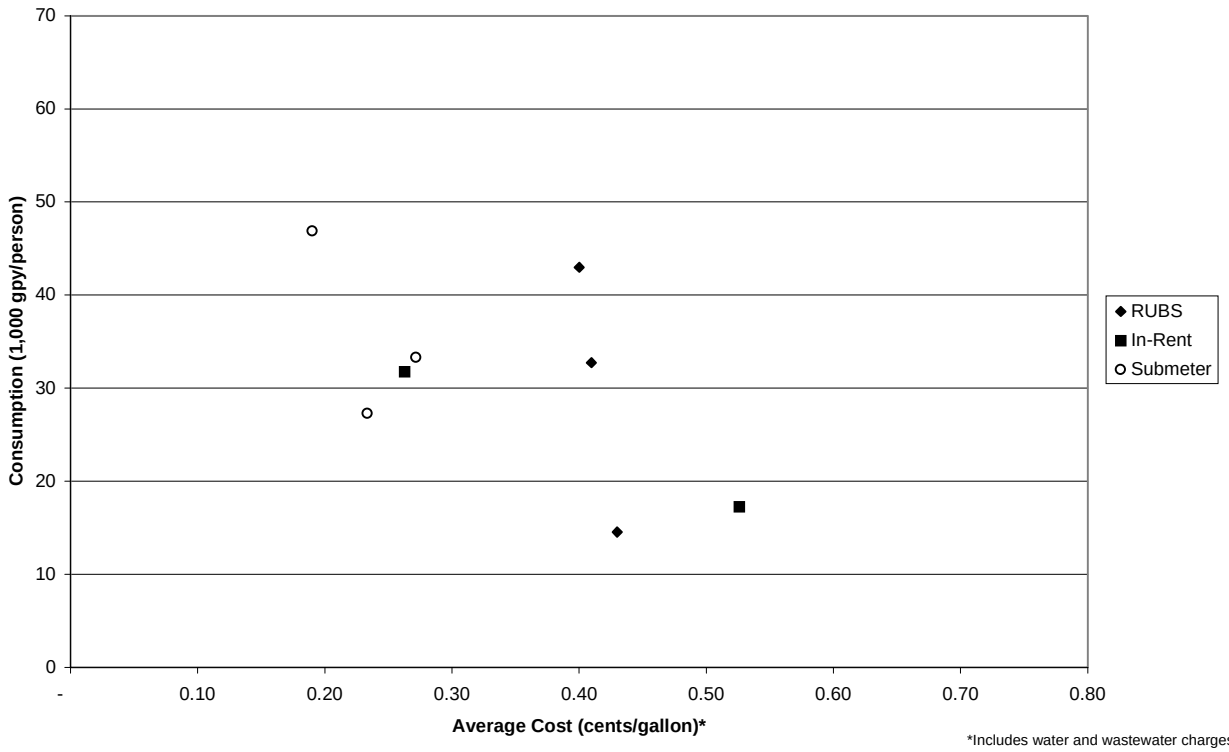


Exhibit CA-1A
Per Capita Consumption, by Billing Type and Cost



*Includes water and wastewater charges.

Exhibit CA-1B
Per Capita Consumption by Billing Type and Cost, Excluding Common Areas



*Includes water and wastewater charges.

Exhibit CA-2
Per Capita Consumption by Billing Type and Building Age

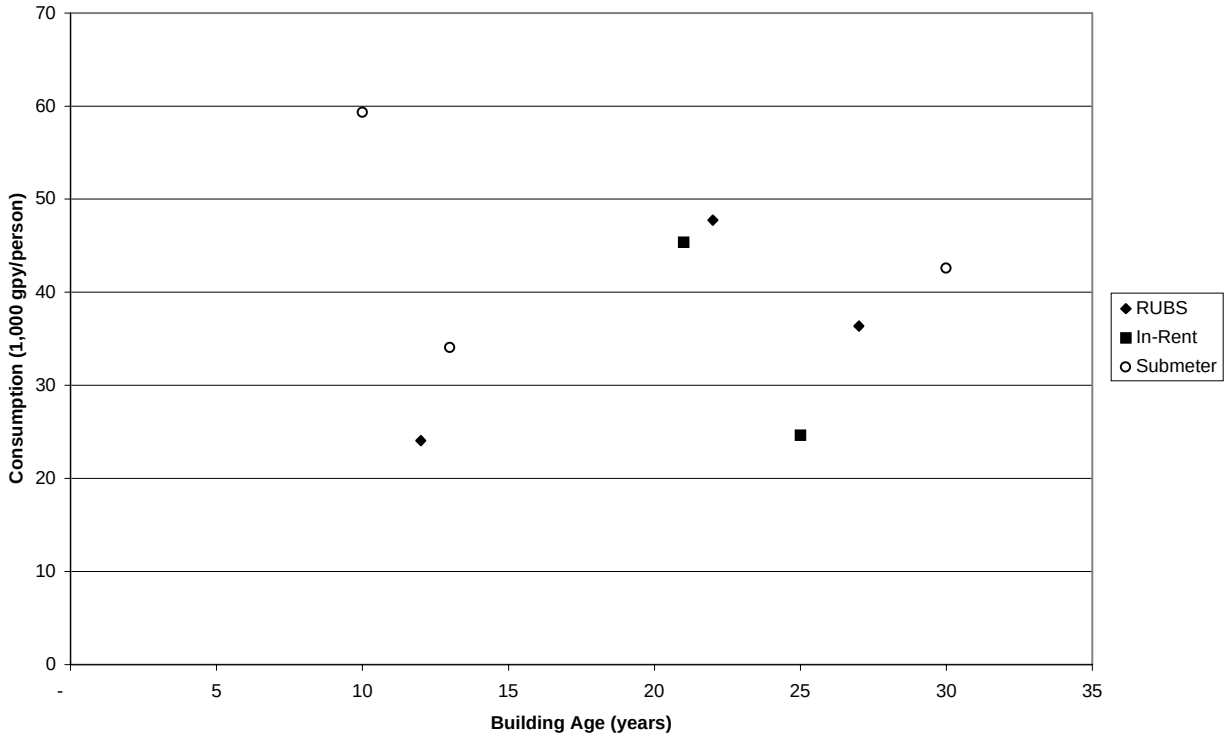
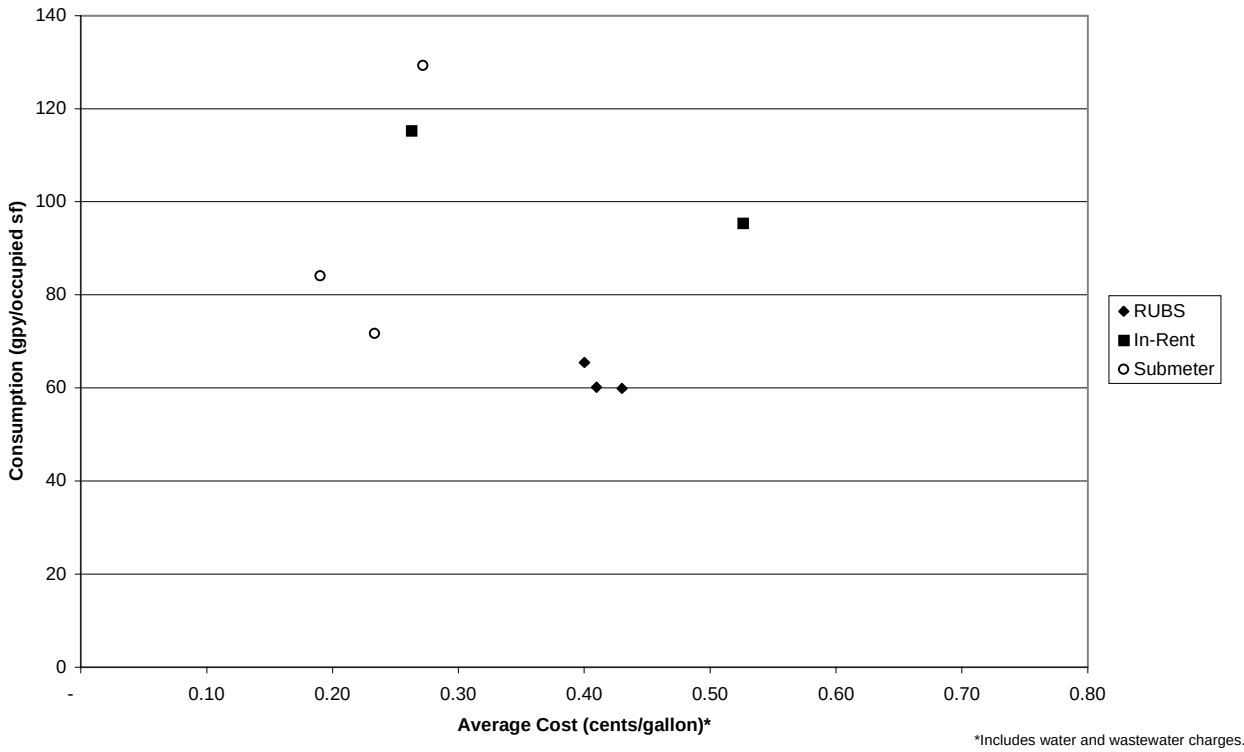
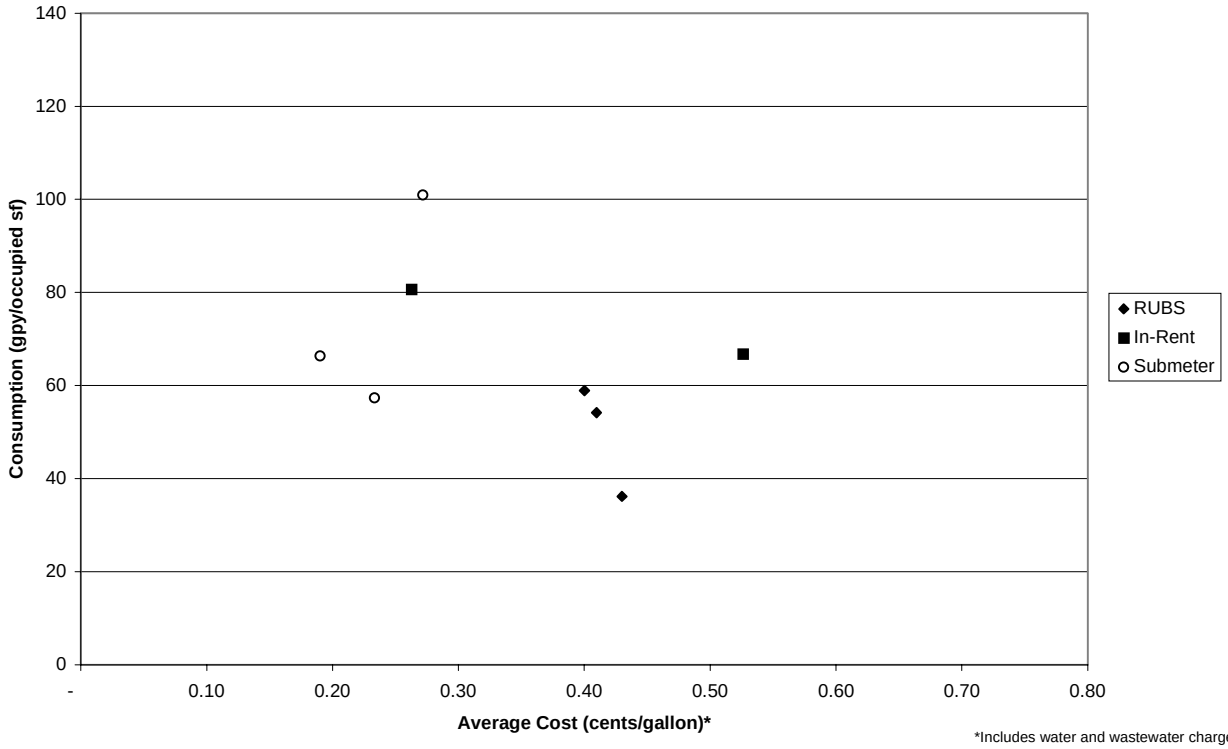


Exhibit CA-3A
Consumption per Square Foot, by Billing Type



*Includes water and wastewater charges.

Exhibit CA-3B
Consumption per Square Foot, Excluding Common Areas, by Billing Type



*Includes water and wastewater charges.

Exhibit CA-4
Change in Per Capita Consumption over Time
(% Change Over Period of Available Data)