To encourage more efficient water use, utilities conducting landscape audits—tailored, scientific reviews of a customer's outdoor water use—might suggest that the customer change watering habits, soil treatments, and/or plants.

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The institutional politics of water conservation

RECOGNIZING HOW INSTITUTIONAL STRUCTURES CHANNEL COOPERATION AND CONFLICT ALLOWS UTILITY MANAGERS TO DEVELOP EFFECTIVE POLITICAL STRATEGIES IN PURSUIT OF SOUND CONSERVATION POLICIES.

This article analyzes the influence of local governmental structures on the likelihood that utilities adopt one of two water conservation policies: conservation rates and landscape audits. Statistical analysis tests the effects of special-district versus general-purpose structures, ward-based versus at-large electoral structures, and mayor–council versus council–manager charter forms. The results demonstrate that government institutions influence adoption of conservation policies in predictable ways, even after accounting for climatic conditions and financial capacity. However, some institutional effects depend on relative resource scarcity: some institutions strongly influence policy outcomes under moderate or moist conditions, but not under relatively dry conditions. Other institutions affect policy adoptions under dry conditions, but not under moderate or moist conditions. These results offer important insights and strategic value for utility leaders considering conservation policies.

In the United States, water utility service is overwhelmingly a local government function. In 2008, nearly 80% of the US population received water service from a utility owned by a local government (USEPA, 2008). Though the politics of US water conservation are not exclusively local, they are inexorably local (Mullin, 2009; Annin, 2006). This article examines the structure of local institutions that govern water utilities and shows that these institutional structures shape the politics of water conservation in predicable ways. US local government structures vary widely in ways that make them more or less amenable to different kinds of conservation policies. Awareness of and sensitivity to these political dynamics can allow utility managers, elected officials, and other policymakers to anticipate potential opportunities for and barriers to conservation policies.

This article begins by outlining major policy options for local utilities seeking to encourage conservation, with a particular focus on landscape audits and conservation rates. A consideration of democratic governance follows, with a discussion of how the distribution of costs and benefits under different conservation policies affect their chances of being adoped under various institutional arrangements. Statistical analyses of more than 200 US water utilities show that governmental institutions affect adoption of landscape audit programs and conservation rate structures in different ways, even after accounting for climatic conditions and utilities' financial capacity. The article concludes with a summary of findings and provides lessons for utility leaders who are considering conservation programs.

The research in this article specifically focuses on utilities owned by municipal, county, or special district governments, not on investor-owned utilities; the politics of interest in this article are the politics of city halls and district board rooms. The politics of state utility commissions were not examined as part of this study. Further, this study focused on political institutions and did not address many other important variables that affect local politics, such as leadership, public opinion, and state or federal regulations.

CONSERVATION POLICIES

Utility leaders seeking to encourage their customers to conserve water have several potential policies at their disposal. Utilities can run public education campaigns to raise awareness of conservation. Regulatory policies such as irrigation restrictions and building standards can mandate more efficient water use. A variety of programs can promote efficient water consumption, including plumbing retrofits, appliance rebates, and landscape audits. Rate structures can be designed to provide financial incentives for water conservation.

Studies of these conservation policies have found that they are generally effective in reducing demand, that the benefits of most common conservation measures are greater than their costs, and that conservation rate structures are typically the most cost-effective means of encouraging conservation (Olmstead & Stavins, 2008; Maddaus & Maddaus, 2004; Platt & Delforge, 2001; Corral et al, 1999; Renwick & Archibald 1998; Whitcomb 1991). This list is not exhaustive; there are other ways to encourage conservation. But these are reasonably representative of the range of conservation mechanisms available to utilities.

Any cost-effective conservation policy provides benefits to all of a utility's customers inasmuch as conservation programs protect public resources like water supply or capital. However, different conservation policies distribute benefits and costs across the customer base in different ways, and so each approach creates patterns of political cooperation and conflict that help determine how likely a government is to adopt it. To illustrate these patterns of cooperation and conflict, consider two common conservation policies: landscape audits and conservation rates.

Landscape audits. Many utilities encourage conservation through programs that promote more efficient use of water. Efficiency-promotion programs are meant to get customers to use less water without sacrificing the benefits they enjoy from water consumption. Plumbing retrofits and rebates for efficient appliances and fixtures are typical efficiency-promotion policies. Seeking to promote conservation, many utilities provide landscape audits—which are tailored, scientific reviews of customers' outdoor water use—to identify ways that water might be used more efficiently with different irrigation practices, soil treatment, and/or vegetation (MAPC, 2006).

The benefits of efficiency-promotion policies are concentrated, inasmuch as they are enjoyed directly by the individual customers who receive the efficiency improvements. Customers who receive landscape audits will perceive tangible benefits from such a program in the form of more efficient water use and, presumably, lower bills. As direct beneficiaries of such programs, these customers are likely to support them. Landscape audits (and other efficiency programs such as plumbing retrofits or appliance rebates) can be costly for utilities to provide. (Utilities that provide landscape audits on a fee-for-service basis may recover some or all of the cost of providing them, but most landscape audit programs are offered free or at heavily subsidized rates.) However, the costs of landscape audits are dispersed across a utility's entire customer base. Therefore, although a landscape audit program might be costly, no individual customer of a medium-sized to large utility is likely to recognize a significant cost to such a policy. The cost of a landscape audit program might mean an increase of only a few cents per bill to most customers. For this reason, the vast majority of customers are not likely to perceive landscape audits and other efficiency-promotion programs

> US local government structures vary widely in ways that make them more or less amenable to different kinds of conservation policies.

as costly, and so such policies will generate little controversy.

Conservation rates. By contrast, conservation rates are intended to cause customers to perceive higher costs. At the most basic level, principles of price elasticity imply that any rate structure that imposes a marginal cost of consumption greater than zero encourages conservation. However, for purposes of this study, inclining-block and seasonal structures for single-family residential customers are considered conservation rates because they are designed with resource conservation in mind. Inclining-block rates raise the marginal cost of water consumption at progressively higher volumes, and seasonal rates raise the marginal cost of water during periods of relative resource scarcity. Once rare, conservation rates have become common over the past few decades. According to the 2006 Water and Wastewater Rate Survey (AWWA), 42.5% of surveyed public water utilities employed a conservation rate structure.

The distribution of benefits and costs of conservation rates is exactly opposite of the distribution for landscape audits. In general, conservative customers (i.e., customers who use relatively little water, especially during periods of peak demand) benefit from conservation rate structures because their relatively low consumption does not cause them to pay the higher marginal costs imposed by conservation rate structures. In most utilities, average consumption is higher than median consumption, indicating that relatively conservative customers outnumber high-volume customers (Chestnutt et al, 1997). Thus the majority of customers will enjoy somewhat lower bills under conservation rate structures, but this benefit of conservation rates is dispersed among many customers. Meanwhile, the costs of conservation rate structures are borne by high-volume customers, whose consumption or demand patterns drive them into more expensive price ranges. In most utilities, these high-volume customers are relatively few, and so the costs of conservation rates are concentrated on a minority of customers.

A DEMOCRATIC PARADOX

Political support is essential to the success of any proposed conservation policy (Hall, 2009; AWWA, 2004). The patterns of costs and benefits created by landscape audits and conservation rates reveal a central paradox of US democracy: Democratic governments generally respond more to the demands of an active, vocal minority of citizens than to the interests of the less-active majority (Dahl, 1961). Basic principles of democratic government hold that governments should be responsive to citizens, even though the great majority of people are inattentive to and inactive on most public policy issues. However, small groups of people can become politically attentive when they recognize an opportunity to benefit from or they perceive a threat from some policy. Small groups of people can go from uninvolved to highly involved in politics when so aroused. In democratic governments, these intensely interested minorities usually prevail in the policy process (Kingdon 1984; Dahl, 1961). When a small group of people—perhaps even a single person—can bring a great deal of pressure to bear on policymakers, a minority can advance its own policy preferences even when they contravene the interests of a less-vocal majority.

Therefore, political cooperation, conflict, and outcomes follow the distribution of benefits and costs that different policies create. Policy proposals that concentrate benefits and costs tend to arouse intensely interested minorities of citizens who stand to gain or lose from those policies. Once aroused, these intense minorities become engaged in the political process and drive policy decisions. Meanwhile, proposed policies that would disperse relatively small benefits or costs across a large majority of people tend not to arouse intense interest, so people who stand to gain or lose only a little will remain politically inattentive and inactive.

Distribution of conservation policy costs and benefits. Table 1 summarizes the patterns of benefits and costs created by the two conservation policies examined in this study. The democratic paradox described here suggests that a proposal to perform landscape audits will not generate significant political controversy. The concentrated benefits offered by landscape audits will find easy supporters among those who would gain from them, whereas the widely dispersed costs of landscape audits are unlikely to incite opposition.

By contrast, conservation rates concentrate costs while dispersing benefits. Although most customers stand to gain from conservation rates, the gains to most individual customers are modest under typical conservation rate structures and so are unlikely to spur popular political support. Unlike landscape audits, conservation rates are intended to induce a voluntary change in behavior through using a price mechanism and so must concentrate costs sufficiently to prompt a high-volume customer to

Different conservation policies distribute benefits and costs across the customer base in different ways, and so each approach creates patterns of political cooperation and conflict that help determine how likely a government is to adopt it.

change his or her behavior. In this sense, a conservation rate structure must generate a modicum of customer discontent in order to be effective: a rate structure that doesn't cause customers to become upset is unlikely to reduce demand. As one industry veteran put it, when adopting a conservation rate structure, "If the phone doesn't ring, then you haven't done a thing" (Giardina, 2009). For this reason, political opposition is predictable when a utility considers conservation rates.

Of course, pointing out the obvious—that conservation rates are politically controversial and landscape audits are not—is neither profound nor useful. What remains unclear is why the political ease of efficiency promotion leads to landscape audit programs in some utilities but not in others and why political opposition to conservation rates prevails in some cases but not in others. This study looks to governance structure as one possible cause of these differences in political processes and policy outcomes.

Institutions and responsiveness. A striking variety of local governments own and/or operate more than 32,000 water utility systems in the United States (USEPA, 2008). These governments vary widely in size, scope of authority, and institutional structure. This study considers the effect of local governance institutions on the likelihood that a utility adopts landscape audits and conservation rates. According to a substantial body of past research, some local government institutions are more responsive than others to citizen demands.

Three institutional structures are analyzed in this study: (1) general-purpose versus special-district government, (2) ward-based versus at-large council elections, and (3) mayor–council versus council–manager charter form. On the basis of past research, general-purpose governments are thought to be more sensitive to citizen demands than are special district governments (Burns, 1994). Governments with legislative councils or boards that are elected by geographic districts or wards are generally considered more responsive to minority interests than those with boards elected at large. Legislative councils elected at large have been found to be more responsive to majority interests (Trounstine & Valdini, 2008; Leal et al, 2005; Bridges, 1997; Welch, 1990). Research on cities and counties indicates that governments operating under a mayor–council charter are more democratically responsive than are those operating under council–manager structures (Feiock et al, 2003; Clingermayer & Feiock, 2001). No part of this discussion is meant to suggest that any of these local government forms are somehow "undemocratic" or "nonresponsive," and there are many exceptional cases. However, a substantial body of research suggests that differences in institutional structure affect the representation of different interests in a community.

If the benefits and costs of different conservation policies mobilize support and opposition in the ways discussed here, then the more democratically responsive a government institution is, the more likely it is to adopt landscape audits and the less likely it is to adopt conservation rates. On the basis of existing research, ward-based elections and mayor–council charters are expected to increase the likelihood of landscape audits. Likewise, at-large elections and council–manager structures are expected to increase the likelihood of conservation rates. Mullin's (2007) study on the adoption of water conservation rates indicates that the relative democratic responsiveness of special districts and general purpose governments depends on the severity or salience of water conservation as a political issue. Mullin finds that special districts are more attentive to majority interests when policy problems are relatively mild. As the severity of a problem increases, general-purpose governments become more responsive to majority interests. In the case of water conservation policy, special-district governments might be expected to influence policy outcomes in different ways under different climatic and hydrologic conditions.

> A state or federal regulation requiring local utilities to conserve water might manifest itself in very different ways depending on the institutional structures that shape the local politics of water conservation.

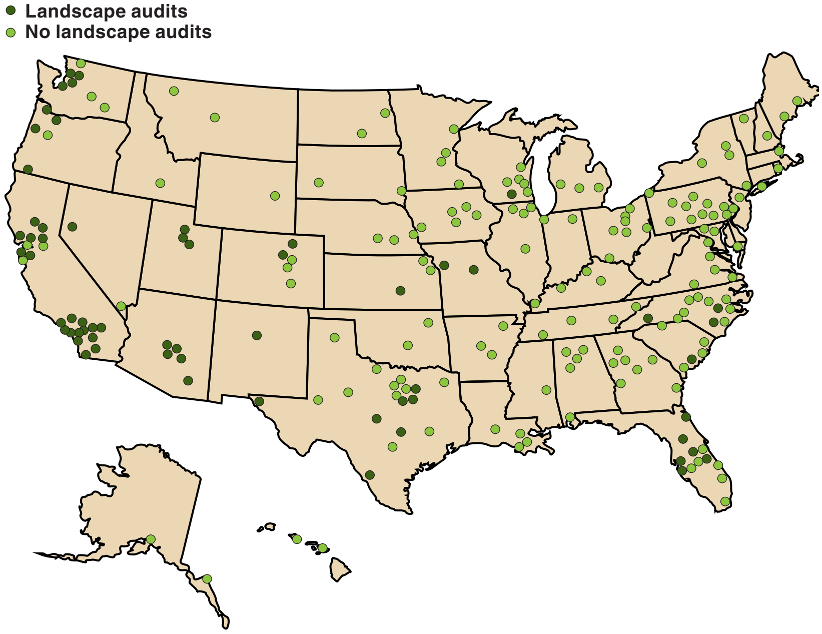
EMPIRICAL ANALYSIS

This study uses a series of logistic regression models to test the relationship between local governance structure and the adoption of two different conservation policies. In this analysis, landscape audits and conservation rates are simply binaries: Either a utility has the policy in

TABLE 1 Benefits and costs of selected conservation policies

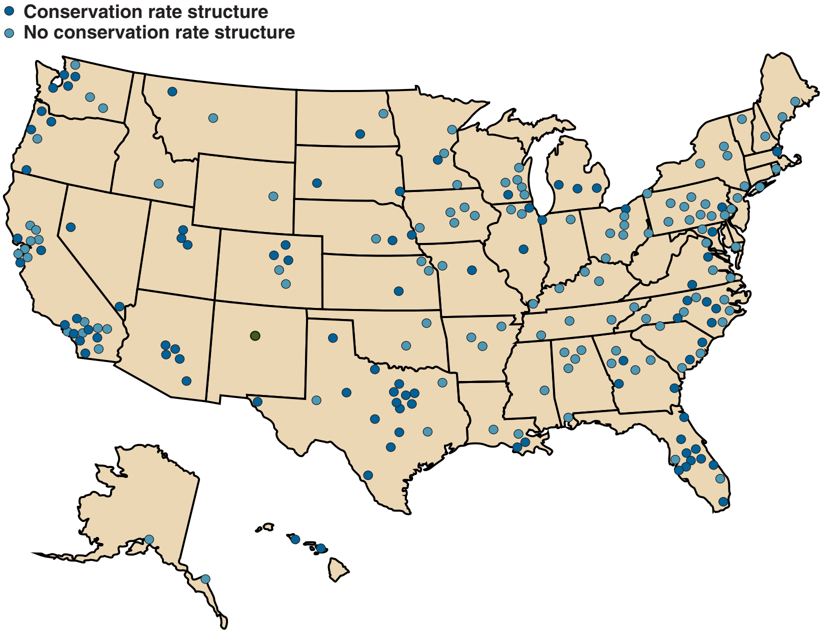
Parameter	Landscape Audits	Conservation Rates
Benefits	Concentrated	Dispersed
Costs	Dispersed	Concentrated

FIGURE 1 Landscape audit policy for sampled water utilities



Source: AWWA, 2006

FIGURE 2 Residential rate structure for sampled water utilities



Source: AWWA, 2006

place (coded 1) or it does not (coded 0). Utilities may adopt either policy or both together, so separate models analyze each policy in turn. With a logistic regression analysis it is possible to measure the independent effects of different institutional variables on the likelihood that a utility has adopted either policy while controlling for variation in environmental conditions and financial capacity. Although statistical analysis of observational data can never "prove" causality, a finding that variation in governance structure is associated with variation in the likelihood of different policies is a strong indication that governance structures can affect the politics of water conservation.

Governance institutions. Three governance institutions are analyzed here, each with a simple binary dummy variable.

- Utilities whose legislative boards are chosen through ward-based elections are coded 1, with at-large elections coded 0.
- Special-district governments are coded 1, general-purpose governments (cities and counties) are coded 0.
- In a separate analysis of city and county governments only (without special districts), council–manager charter form is coded 1, and mayor–council form is coded 0.

Controls for environmental conditions. Climatic conditions, customer demand patterns and supply sources are likely to drive conservation policies, and so a valid analysis of political institutions must account for these factors (Mullin, 2007; Hewitt, 2000). The current analysis uses three metrics to control for the effect of these environmental conditions. The climatic moisture index (I_m) developed by Willmott and Feddema (1992) is the main measure of water resource scarcity. The I_m integrates precipitation, temperature, and sunlight with the land's water retention capacity and evapotranspiration potential. In this way the –1.0 to +1.0 I_m "reflects the relationships between climate and the availability of moisture at the earth's surface" (Willmott & Feddema, 1992). An I_m value of 0 reflects a climate in which available water and climatic demand for water are exactly equal. Negative values of I_m indicate relatively little available moisture, and positive values of I_m indicate relatively more available moisture. To put I_m in terms more meaningful for readers familiar with US geography, the I_m value for Missoula, Mont., is +0.07, which is approximately the average for the data analyzed in this study. With an I_m of –0.29, Cheyenne, Wyo., is about one standard deviation below average. Roswell, N.M.'s, value of –0.65 is two standard deviations below average. Syracuse, N.Y.'s, I_m is about one standard deviation above average at +0.42. Juneau, Alaska's, +0.72 is two standard deviations above average. Of course, the I_m does not account for every potentially relevant climatic condition. Abundance or scarcity of water from seasonal snowpack is not necessarily captured by the I_m if water is transmitted a significant distance from sources to customers. Supply interruptions or fluctuations in climatic conditions might cause localized or temporary drought conditions, and water quality concerns might drive water scarcity. The I_m does not capture such conditions.

In addition to the direct effects of climatic moisture, the models described here analyze the interactions of climate with institutional structure. These interactive variables demonstrate whether institutions affect conservation policy in different ways under different climatic conditions (discussed later). Interactive variables that generated statistically significant effects are given in this article.

The models discussed here also control for percent of supply drawn from groundwater sources and peak-to-average demand ratio. The control for groundwater supply is included because groundwater supplies are often more vulnerable to scarcity than are surface water sources. The peak-to-average demand ratio recognizes that utilities' conservation needs are often driven by peak demands rather than simply by volume. A utility with a high peak-to-average demand ratio might be more likely to adopt landscape audits or conservation rates.

Controls for financial capacity. Conservation policies require varying degrees of organizational and financial capacity. Landscape audits and similar efficiency promotion programs can be labor-intensive, and some kinds of conservation rate structures can increase utilities' revenue volatility (MAPC, 2006; Raftelis, 2005). Larger agencies might be more likely to adopt conservation policies than their smaller counterparts, and so the models shown here therefore control for utility size measured as the natural log of customer connections to the utility. The log transformation is consistent with the nonlinear nature of utilities' organizational capacity: Differences in utility size should matter less at the high end of the distribution than at the low end. For example, the "real-world" difference between a utility with 500 connections and one with 5,000 connections is expected to be greater than the difference between a utility with 200,000 connections and one with 204,500 connections. Financial capacity is also included in the models, measured as net income per customer account.

Data. The main source of data for this empirical analysis is the 2006 Water and Wastewater Rate Survey conducted by Raftelis Financial Consultants and published by AWWA. This published dataset provided information on utilities' rate structures and nonrate conservation programs, including landscape audits. Figures 1 and 2 show the sampled utilities included in this study and the geographic distribution of landscape audits and conservation rates. Not surprisingly, both conservation policies are most common in the relatively warm and/or dry regions of the United States. Data on utility size, percent groundwater supply, demand pattern, and net income were also drawn from the AWWA survey. The subjects of this study are water utilities owned by local governments, so

TABLE 2 Descriptive statistics of forms of government structure

Political Institutions	Percentages*
Electoral structure	
Ward/district-based	27.8
At large	72.2
Authority	
Special district	23.4
General-purpose government	76.6
Charter form (general-purpose government only)	
Mayor–council	43.5
Council–manager	56.6

Climatic and Institutional Variables	Sample Minimum	Sample Maximum	Sample Mean	Standard Deviation
Moisture index	–0.91	0.72	0.07	0.36
Groundwater supply—%	0.00	100.00	30.99	40.90
Peak-to-average-demand ratio	1.07	3.71	1.64	0.45
Customer connections	4,789	828,060	82,950	112,817
Net income per account—$	–809.56	758.64	64.97	137.89

n—number
n = 214 utilities included in study

*Percentages may not equal 100.00 as a result of rounding.

investor-owned and wastewater-only utilities were dropped from the sample, leaving 214 utilities for the study. The analyses given here do not account for any potential sample or nonresponse bias caused by the methods that were used to gather the data. Also, the current analysis does not include data on local water quality conditions, population growth rates, or state policies that might encourage or discourage different conservation policies.

The models in this study use the average annual moisture index values for each of the selected utilities' locations as published by Willmott and Matsuura (2001). (Willmott and Matsuura's 2001 archive of the Willmott-Feddema Climatic Moisture Index is available from the Center for Climatic Research at the University of Delaware: http://climate.geog.udel.edu/~climate/.) Data on governance structure were drawn primarily from the 2006 Municipal Yearbook published by the International City/County Management Association (ICMA, 2006). Table 2 shows a summary of the data.

As the bivariate correlation matrix in Table 3 shows, the tested governance structures are largely uncorrelated with most of the control variables. However, special-district form and ward-based elections are moderately correlated with the moisture index, and the council–manager form is strongly and negatively correlated with climatic moisture. It is likely that these bivariate correlations reflect the nonrandom geographic distribution of governance structures in the United States (Mullin, 2009; Bridges, 1997). These correlations raise the specter of multicollinearity that might cause the statistical models to generate unreliable coefficients and standard errors. Fortunately, diagnostic tests of the logistic regressions used here revealed that all models' multicollinearity were well within generally accepted tolerances. The models' mean variance inflation factors (VIF) ranged from 1.17 to 1.30, and no variable generates a VIF greater than 1.56. (As a general rule of thumb, VIF values greater than 10.00 indicate a potential problem with multicollinearity in a logistic regression model [Cohen et al, 2003]). There is little reason to think that multicollinearity skewed the models' results in any significant way.

RESULTS

Table 4 shows the coefficients and standard errors generated by two regression models predicting the likelihood of adopting a landscape audit program: one for all sampled utilities, and another for general-purpose governments only. Table 5 shows the corresponding results for the models predicting conservation rates. Environmental conditions, financial capacity, and governance institutions all proved to be statistically and substantively significant predictors of conservation policy adoption in these models.

Environmental conditions. The three environmental variables tested in these models affected the likelihood of both conservation policies strongly and in the expected ways. The climatic moisture index strongly predicts adoption of both landscape audits and conservation rates in all

TABLE 3 Bivariate correlation matrix*

Parameter	Landscape Audits	Conservation Rates	Moisture Index	Groundwater Supply—%	Peak-to-Average-Demand Ratio	Log Customer Accounts	Net Income per Account	Special District	Ward-based Elections
Conservation rates	0.38 (0.00)								
Moisture index	–0.49 (0.00)	–0.32 (0.00)							
Groundwater supply—%	0.08 (0.24)	–0.07 (0.29)		–0.13 (0.05)					
Peak-to-average-demand ratio	0.08 (0.28)	0.10 (0.16)	–0.18 (0.01)	0.09 (0.22)					
Log customer accounts	0.18 (0.01)	0.27 (0.00)	–0.09 (0.19)	–0.15 (0.03)	–0.19 (0.01)				
Net income per account	0.10 (0.16)	0.14 (0.04)	–0.02 (0.14)	–0.04 (0.59)	–0.05 (0.44)	0.05 (0.51)			
Special-district Form	0.01 (0.94)	–0.05 (0.46)	0.14 (0.04)	–0.22 (0.00)	–0.08 (0.25)	–0.00 (0.96)	0.03 (0.62)		
Ward-based elections	–0.11 (0.11)	–0.11 (0.10)	0.13 (0.07)	0.04 (0.61)	0.01 (0.86)	0.08 (0.28)	0.00 (0.99)	0.18 (0.01)	
Council–manager form	0.29 (0.00)	0.26 (0.00)	–0.37 (0.00)	0.01 (0.94)	0.16 (0.05)	–0.07 (0.39)	–0.01 (0.92)	0.00 (0.00)	–0.48 (0.00)

n—number
n = 214 utilities included in study

*Cells contain Pearson correlation coefficients; *p* values are in parentheses.

four models. As moisture increases, the likelihood of these conservation policies falls. Percent groundwater supply and peak-to-average ratio positively predict both conservation policies, with particularly significant effects for conservation rates. The greater a utility's reliance on groundwater sources and the higher its peaking pattern, the more likely it is to adopt landscape audits and/or conservation rates. Interpreting logistic regression results in a useful way requires translating the coefficients that they generate into more intuitively meaningful likelihoods.

Figure 3 shows the estimated likelihoods of adopting landscape audits across a wide range of climatic moisture conditions, with all other variables held at their means. Figure 4 shows similar estimated likelihoods for conservation rates. The downward sloping lines in Figures 3 and 4 illustrate the effect of climatic moisture on the likelihood of utilities adopting conservation policies. In a relatively dry climate with a climatic moisture index one standard deviation below average ($I_m = -0.29$, as in Cheyenne), a utility is 0.303 likely to adopt landscape audits and 0.600 likely to adopt conservation rates with all other variables at their average values. Under relatively moist conditions with a climatic moisture index one standard deviation above average ($I_m = +0.42$, as in Syracuse) a utility's likelihood of adopting landscape audits and conservation rates are just 0.081 and 0.194, respectively.

None of these findings is surprising, but these modeled effects of scarcity offer a sense of how much environmental conditions matter for the conservation policies of interest and provide important statistical controls for the governance institutions at the heart of this inquiry.

Financial capacity. All four statistical models show utility size to be a highly significant, positive predictor of both conservation policies. With all else held equal, the more customers a utility has, the more likely it is to have landscape audits and/or conservation rates. This result also is unsurprising, because larger utilities are likely to have greater organizational capacity to implement such programs. A utility's net income per account has no statistically or substantively significant effect on the likelihood of landscape audits. However, higher net income per account significantly increases the likelihood that a utility will adopt conservation rates. These results are consistent with the nature of price-based conservation programs—inclined-block rate structures can increase revenue volatility in utilities, and so utilities may require greater financial strength to make conservation rate structures work (Chesnutt et al, 1996). Meanwhile, seasonal rates can reduce revenue volatility and increase overall financial strength (Chesnutt et al, 1996). Either way, financial strength is expected to be correlated with adoption of conservation rates, and statistical analysis bears out that expectation.

Governance institutions. All three of the governance institutions examined in this study were significant predictors of the conservation policies analyzed here. Various tests of the models' fit and power indicate that models including governance structure variables were better overall predictors of policy adoption than were models that included only environmental and financial capacity data. However, institutional structure affected the likelihood of landscape audits and conservation rates in different ways. Further, the effects of some of these governance institutions varied

TABLE 4 Utility adoption of landscape audit program

Logistic Regression	Coefficient (Standard Error)	
Variable	**All Utilities**	**Cities and Counties Only**
Moisture index	–2.223* (0.634)	–1.759* (0.673)
Groundwater supply	0.008 (0.005)	0.010† (0.006)
Peak-to-average-demand ratio	0.640 (0.466)	0.413 (0.530)
Log customer connections	0.850* (0.245)	1.153* (0.298)
Net income per account	0.003 (0.002)	0.002 (0.002)
Special-district form	0.414 (0.780)	
Special-district form × moisture index interaction	–4.418† (2.498)	
Ward-based elections	–0.546 (0.572)	–0.502 (0.915)
Ward-based elections × moisture index interaction	–4.046† (2.178)	–7.820‡ (3.438)
Council–manager form		1.161† (0.631)
Intercept	–11.726* (3.149)	–15.476* (3.909)
Log likelihood	–74.34	–60.20
Likelihood ratio x^2	72.98	58.15
$p > x^2$	0.00	0.00
Percent cases correctly predicted—%	81.15	79.47
Number	191	151

*Statistically significant with > 99% confidence
†Statistically significant with > 90% confidence
‡Statistically significant with > 95% confidence

TABLE 5 Utility adoption of conservation rates

Logistic Regression Variable	Coefficient (Standard Error) All Utilities	Cities and Counties Only
Moisture index	–2.557* (0.616)	–2.283* (0.682)
Groundwater supply—%	0.007 (0.005)	0.011† (0.005)
Peak-to-average-demand ratio	0.657‡ (0.392)	0.782‡ (0.475)
Log customer connections	0.825* (0.199)	1.220* (0.272)
Net income per account	0.003† (0.001)	0.004† (0.002)
Special-district form	–0.012 (0.463)	
Special-district form × moisture index interaction	2.637† (1.244)	
Ward-based elections	–0.784‡ (0.415)	–1.016‡ (0.616)
Council–manager form		1.041† (0.554)
Intercept	–10.533* (2.506)	–15.874* (3.554)
Log likelihood	–101.22	–69.88
Likelihood ratio x^2	55.90	66.06
$p > x^2$	0.00	0.00
Cases correctly predicted—%	72.77	76.16
Number	191	151

*Statistically significant with > 99% confidence
†Statistically significant with > 95% confidence
‡Statistically significant with > 90% confidence

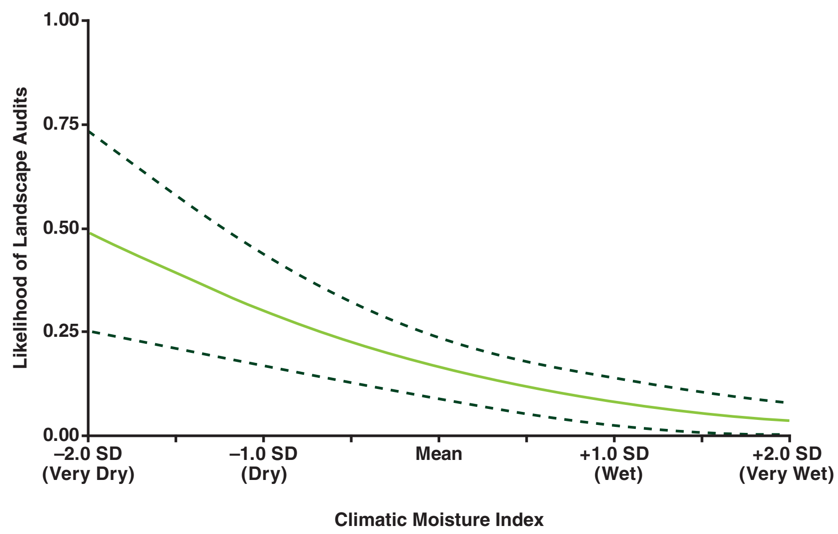
depending on the relative climatic moisture of the utility's location.

Beginning with electoral structure (Figures 5 and 6), utilities with ward-based elections were significantly less likely than those with at-large elections to adopt conservation rates. The gap between the two lines in Figure 6 represents the effect of electoral structure on the likelihood of conservation rates. Across the range of values shown in Figure 6 (based on the model analyzing all utilities), a utility with officials elected at large is on average 14.0% more likely to have conservation rates than a utility with district- or ward-based elections, with all other variables held at their averages. High-volume customers are not uniformly scattered throughout a utility's service area; rather, they are likely to be geographically concentrated into specific neighborhoods. Because ward-based legislative boards respond to the interests of the geographic areas they represent, ward-based legislators are less likely to support conservation rates that they perceive as harmful to their constituents. Legislators elected at large are less likely to respond to the geographically concentrated minority of high-volume customers and so are more likely to adopt majority-friendly conservation rates.

Electoral structure also affects the likelihood of landscape audits, but in a way markedly different from its effect on conservation rates. The direct statistical effect of ward-based elections is relatively mild (Table 3). However, the interactive effect of ward-based elections and the moisture index is very strongly negative. This "conditional effect" is illustrated by the two lines in Figure 5—utilities with ward-based elections are much more likely to adopt landscape audits than are utilities with at-large elections under conditions of very low moisture. With a moisture index two standard deviations below average (a very dry I_m = –0.65, as in Roswell, N.M.), a utility with district- or ward-based elections is about 0.914 likely to have a landscape audit program, with all other variables held at their averages. Under identical climatic and financial conditions, a utility with at-large elections is just 0.570 likely to offer landscape audits. But the effect of electoral structure diminishes as climatic moisture approaches average. In fact, the small gap between the lines in Figure 5 as the value of the moisture index increases shows that the marginal effect of electoral structure under moderate-to-very moist conditions is slight. Put simply, ward-based electoral structure increases the likelihood of a landscape-audit program, but only under very dry conditions. This result suggests that, under very dry conditions, geographically concentrated groups of high-volume customers are motivated to pursue benefits from their local governments in the form of landscape-audit services. A ward-based legislative body is more likely than one elected at large to respond to such an aroused minority interest.

The special-district form of government showed similar conditional effects for both policies. The direct effect of special-district form is small and statistically insignificant in both models, but the interaction of special-district form with the moisture index shows that the special-district form of government has a very strong positive effect on the likelihood of landscape audits under relatively dry conditions. For example, under relatively dry conditions one standard deviation above average moisture (I_m = –0.29, as in Cheyenne), a utility is 0.716 likely to offer landscape audits if it is governed by a special district, but only 0.315 likely to do so if it is governed by a city or county. However, under moderate-to-moist conditions, there is hardly any difference in likelihood of landscape audits between special-district and general-purpose governments. Meanwhile, the special-district form has a mirror-image effect on the likelihood of conservation rates. Under relatively moist conditions, utilities operated by special districts are more likely to adopt conservation rates than those run by cities and counties. For example, with climatic moisture one standard deviation above average (I_m = +0.42, as in Syracuse), a utility is more than twice as likely to adopt conservation rates if it is governed by a special district than if it is governed by a city or county (likelihood 0.401 and 0.181, respectively, with all other variables held at their averages). However, under average climatic conditions the differences between special districts and general-purpose governments virtually disappear (likelihood 0.394 and 0.356, respectively). Essentially the effect of the special-district form on the likelihood of landscape audits is strongly positive where the climate is dry, but disappears under moderate climatic conditions. Likewise, the effect of the special-district form on likelihood of conservation rates is strong where the climate is moist, but disappears under moderate climatic conditions. Because conservation rates generally benefit the majority of customers and landscape audits benefit a minority of customers, these results are consistent with Mullin's (2009) argument that general-purpose governments serve majority interests under more severe conditions, whereas special districts serve majority interests under less severe conditions. These interaction variables should be interpreted with some caution, however, because the sample analyzed here includes only 50 special districts.

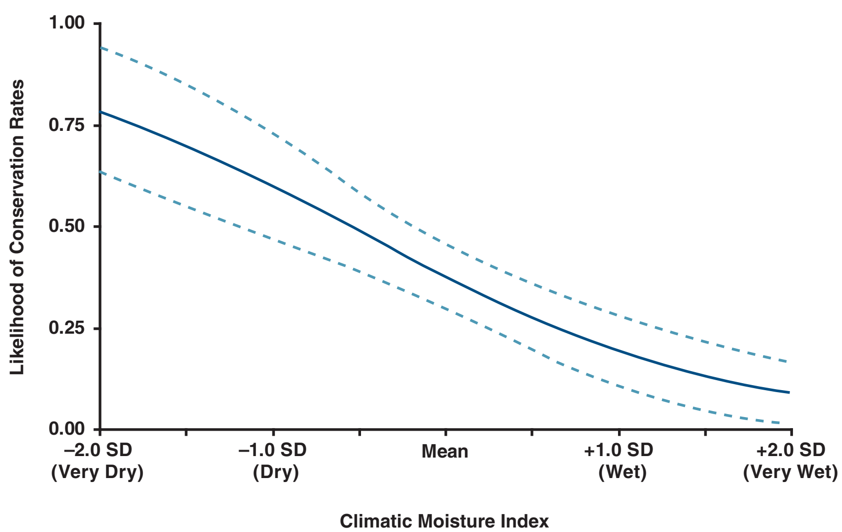
FIGURE 3 Modeled likelihood of landscape audits



SD—standard deviation

Solid line represents the estimated likelihood that a utility has a landscape audit program in place, with other variables assumed at their average values. Figure is based on estimates generated by the model of all utilities (Table 4). Dotted lines show the 95% confidence interval for the estimate.

FIGURE 4 Modeled likelihood of conservation rates

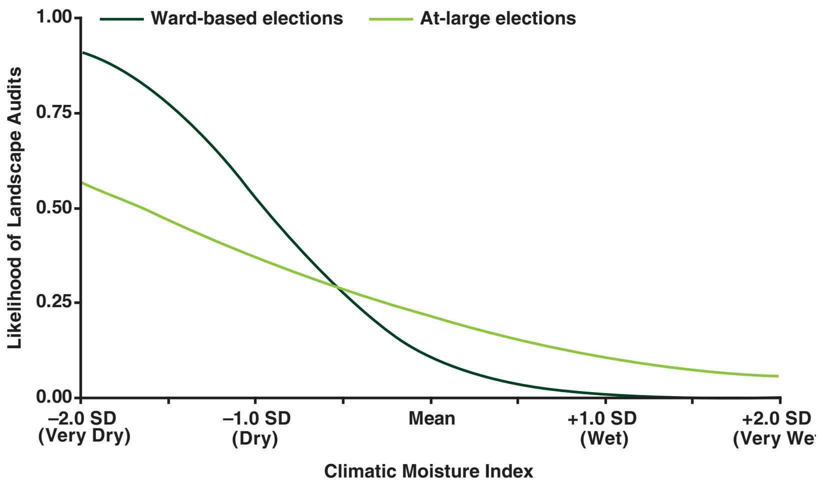


SD—standard deviation

Solid line represents the estimated likelihood that a utility has a landscape audit program in place, with other variables assumed at their average values. Figure is based on estimates generated by the model of all utilities (Table 4). Dotted lines show the 95% confidence interval for the estimate.

Turning to general-purpose governments only (cities and counties, no special district utilities), regression analysis shows that council–manager charter structures significantly increase the likelihood of adoption of both conservation policies examined here. The gaps between the lines in Figures 5 and 6 represent the difference between governments with council–manager and mayor–council charters under varying moisture conditions. As Figures 7 and 8 indicate, utilities with council–manager charters are more likely to adopt landscape audits and conservation rates than are utilities with mayor–council charters across the entire range of climatic moisture. Over the range evaluated in Figures 7 and 8, utili-

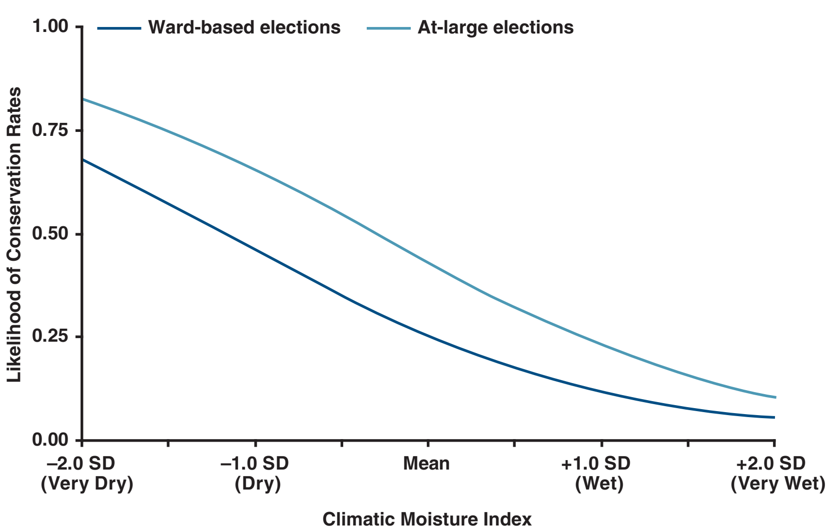
FIGURE 5 Modeled likelihood of landscape audits by electoral structure



SD—standard deviation

Lines represent the estimated likelihood that a utility has a landscape audit program in place, with other variables assumed at their average values. Figure is based on estimates generated by the model of all utilities (Table 5).

FIGURE 6 Modeled likelihood of conservation rates by electoral structure



SD—standard deviation

Lines represent the estimated likelihood that a utility has a conservation rate structure in place, with other variables assumed at their average values. Figure is based on estimates generated by the model of all utilities (Table 5).

ties with council–manager charters are 0.150 more likely than those with mayor–council structures to offer landscape audits, and 0.192 more likely to adopt conservation rates (again with other variables at their averages). This result may indicate that council–manager systems allow utility leaders to be more assertive about water conservation as a general issue than are mayor–council systems. The effect of council–manager form appears to decrease very slightly as moisture rises. The statistical tests interacting council–manager with the moisture index generated no statistically significant effects on either landscape audits or conservation rates, and so the interaction term was dropped from these analyses.

DISCUSSION

Table 6 summarizes the results of the analysis for each of the conservation policies. These analytical results demonstrate that different types of government institution structures influence the politics of water conservation. To summarize these statistical results in practical terms, all else being equal, the political prospects of landscape audits are poor under council–manager structures and good under mayor–council structures. Special districts are politically friendlier to landscape audits under dry climatic conditions, but are no different from cities and counties under moderate-to-moist conditions. Similarly, landscape audits will fare better politically in utilities whose officials are elected by wards than in utilities with at-large elections, but only under very dry climatic conditions.

These governance structures affect the political prospects of conservation rates in distinctly different ways. All else being equal, conservation rates fare well under at-large electoral structures and council–manager charters, but face greater political obstacles under ward-based elections and mayor–council charters. Conservation rates also fare better in special districts than they do in cities and counties, but only under moist conditions.

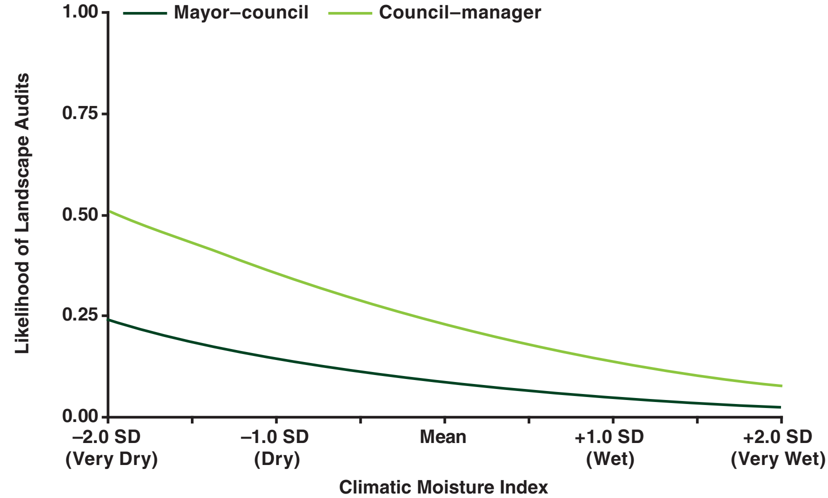
These results illustrate a paradox of democratic government in the United States. The benefits of landscape audits and similar efficiency-promotion programs are concentrated on a minority of high-volume customers, whereas these programs' costs are dispersed across a relatively conservative majority. Conversely, the benefits of conservation rates are widely dispersed and disproportionately enjoyed by the majority of conservative customers, whereas a minority of high-volume customers bears the costs of conservation rates.

If democratic institutions translate interests of the majority into policies, then more democratically responsive institutions would be expected to eschew landscape audits and embrace conservation rates. However, analysis of utilities' actual policies indicates otherwise. Some governmental structures typically considered "responsive" (e.g., ward-based elections) are more likely to adopt landscape audits and less likely to adopt conservation rates. Yet the impact of some political institutions—the special-district form in particular—on conservation policies apparently is contingent on climatic conditions, a finding consistent with past research (Mullin, 2007). Curiously, the council–manager charter form has a positive effect on the likelihood of both landscape audits and conservation.

Cautions. It is important to observe that there is nothing inherently democratic or undemocratic about any of the governance structures analyzed here. US local governments display an extraordinary variety of local electoral arrangements, governance structures, and charter forms, all of which can rightfully be described as "democratic." Moreover, neither landscape audits nor conservation rates are necessarily good or bad approaches to conservation. Several other factors, including many not analyzed in this study, may determine which water conservation policies are best for a given utility.

It is also important to bear in mind that the structure of governmental institutions shapes but does not determine what kinds of conservation policies a utility will adopt. No institutional structure or combination of structures will entirely ensure that a utility will use landscape audits, conservation rates, or any other conservation policy. Utility leaders interested in conservation should not allow institutional conditions to constrain their choice of policy options. However, the results of this analysis show that governance structures clearly influence the politics of water conservation in predictable ways.

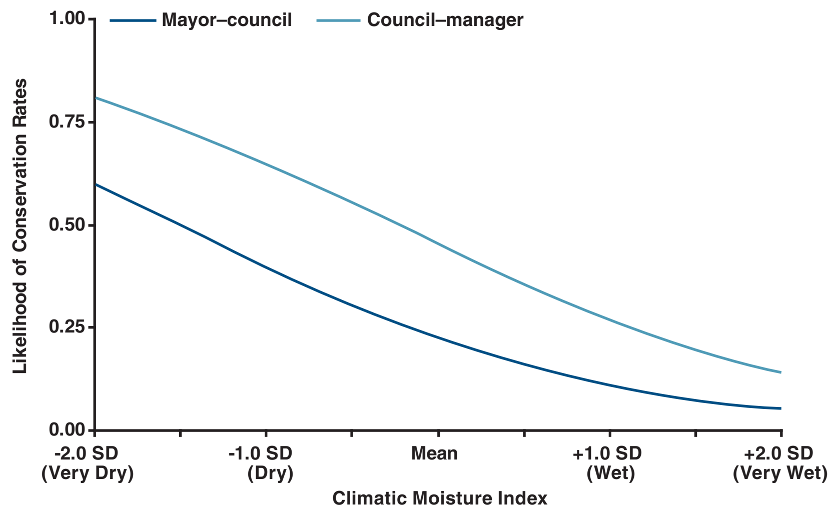
FIGURE 7 Modeled likelihood of landscape audits by charter form



SD—standard deviation

Lines represent the estimated likelihood that a utility has a landscape audit program in place, with other variables assumed at their average values. Figure is based on estimates generated by the model of city and county utilities (Table 4).

FIGURE 8 Modeled likelihood of conservation rates by charter form



SD—standard deviation

Lines represent the estimated likelihood that a utility has a conservation rate structure in place, with other variables assumed at their average values. Figure is based on estimates generated by the model of all utilities (Table 5).

Practical lessons. Many utility professionals are reflexively uncomfortable with the word "politics." But as an industry that is overwhelmingly owned and operated by public agencies, water utilities are inevitably political, especially when it comes to conservation (Annin, 2006; Mullin, 2009; Postel, 1999). Consequently, effective leadership in water utilities requires a degree of political savvy. Knowing that governance structures influence policy outcomes allows utility leaders to foresee political opportunities and obstacles in their pursuit of effective conserva-

TABLE 6 Summary of modeled effects

Variables	Likelihood of Landscape Audits	Likelihood of Conservation Rates
Environmental conditions		
Climatic moisture	Less likely as moisture increases	Less likely as moisture increases
Groundwater supply	More likely with greater reliance on groundwater	More likely with greater reliance on groundwater
Peak demand	No significant effect	More likely as peak demand increases
Financial capacity		
Utility size	More likely as size increases	More likely as size increases
Net income	No significant effect	More likely as income increases
Governance institutions		
Special district	More likely (under dry conditions)	More likely (under wet conditions)
General government	Less likely (under dry conditions)	Less likely (under wet conditions)
Ward-based elections	More likely (under dry conditions)	Less likely
At-large elections	Less likely (under dry conditions)	More likely
Mayor–council charter	Less likely	Less likely
Council–manager charter	More likely	More likely

tion policies. This knowledge is valuable, because in the real world of utility management, a conservation policy is only as good as its viability in the political process. Practical lessons for utility managers, elected officials, and state and federal regulators follow from these findings.

Utility managers and conservation specialists should recognize the patterns of benefits and costs created by different approaches to conservation. By identifying the distribution of costs and benefits of conservation policies, utility managers can anticipate that some policies are likely to arouse intense minority interests in support of or in opposition to a conservation policy. Managers also can anticipate the ways in which their utilities' governance institutions might mute or amplify different interests in the political process. Utility managers may anticipate a relatively smooth political process for adoption of conservation policies in which governance structures are conducive to them. However, some governance structures can also stymie efforts to adopt certain conservation policies. "If you have a tough governance model and you want conservation rates or other controversial policies, then you'd better figure out a good political strategy," observed Denver Water Finance Director David LaFrance (2009). For example, a utility manager looking to introduce conservation rates in a city utility with ward-based elections and a mayor–council charter may anticipate significant opposition. In anticipation, managers might prepare analyses that demonstrate the distribution of benefits and costs under conservation rates, in addition to the more familiar analyses of revenue and conservation effects.

> Conservation policies require varying degrees of organizational and financial capacity.

Elected officials should recognize that the governance institutions in which they serve tend to mobilize and demobilize different interests. Elected officials must respond to citizens who are active in the political process but should also bear in mind and advocate for the less-intense majority of citizens who are less active but nonetheless have a real interest in the water conservation decisions that their utilities make.

Finally, state and federal regulators should recognize that local utilities operate under a wide diversity of governance structures and that these institutions are likely to affect the ways that regulations are translated into utility policies. A state or federal regulation requiring local utilities to conserve water might manifest itself in very different ways, depending on the institutional structures that shape the local politics of water conservation. Anticipating the impact of local governance structures on policy outcomes can help state and federal regulators craft more effective conservation policies.

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