

The Science, Policy and Governance of Smart and Sustainable Cities: Policy Design and Voluntary Compliance in Energy Programs

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Abstract: This paper is part of a larger project investigating the role of politics and policy design on suitability and energy transitions from the FSU participants in the Sustainable Healthy Cities Network. The City of Tallahassee FL is used as a test bed to examine how policy design is linked to individual behavior and outcomes. This specific piece examines voluntary compliance and explores actor motivations to comply with non-mandatory directives. We investigate the conditions and motivations shaping household-level decisions related to voluntary compliance within an energy audit (low-commitment) and a loan (high-commitment) program. We find evidence of different economic and social motivations at play, and discuss the research implications for policy design and implementation.

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Policy Design and Voluntary Compliance in Energy Programs

This paper presents a small initial project to investigate how politics and policy design related to individual and organization behaviors relevant to distributed and localized energy infrastructure transitions. From a policy perspective we examine how localized demand side policy interventions affect household (parcel) level energy use and program participation behaviors, accounting for socio-spatial contexts and the potential scalability of such interventions. The data for the larger project derive from a 10-year time-series panel data set for Tallahassee FL at the household/parcel level with more the 1M observations that is currently under development. The parcel level data base of all electrical utility customers in Tallahassee Florida includes information on consumption of energy and other utility services, housing characteristics, home value, spatial information such as vegetation cover and solar exposure, residents party affiliation, parcel level population estimates, census block demographics, and participation in specific demand-side distributed policy programs. The conclusion will address the implications of the findings at a multi-scale, multi-sector perspective linking to the overall work of the Sustainable Healthy Cities Network on the emergent infrastructure transitions that will reshape cities and urban regions.

Because of monitoring and enforcement costs and the adverse, unintended consequences associated with mandatory compliance, policymakers sometimes turn to alternatives to regulation that encourage actors to volunteer themselves to be regulated despite potential punishments for non-compliance. Even though such alternatives cannot mandate desired behavior, they can still alter the benefits and risks associated with complying (or failing to comply), and aid in the achievement of policy goals. In this chapter, we use the term “voluntary compliance” to describe this phenomenon.

Voluntary compliance is a special form of compliance whereby individual and organizational actors willingly choose to cooperate with an agreed upon set of rules, norms, and behavioral expectations that are not legally imposed upon them. *Non-compliance* is therefore deciding not to conform to such rules, norms, and expectations. Voluntary compliance occurs in two ways: the act of “opting-in,” which requires some form of upfront behavioral change or commitment, and the maintenance of association with sustained behavioral change requirements. While actors are subjected to tangible sanctions such as fines, lawsuits, or imprisonment when failing to comply with traditional regulation, the sanctions for actors in non-compliance with voluntary programs can include losing face and legitimacy, economic opportunities, and favorable future regulatory treatment.

Voluntary compliance is intended to reduce the monitoring and enforcement costs of regulation and encourage actors to mitigate activity that makes others worse off, which can produce positive externalities or benefits enjoyed by third parties. For example, policymakers often incentivize individuals and firms to participate in voluntary programs designed to promote pro-environmental behavior by providing technical assistance and financial incentives. However, individuals and firms also join voluntary programs for legitimacy purposes and sometimes symbolically cooperate with programmatic expectations in the absence of explicit sanctions (Delmas & Montes-Sancho, 2010; King & Lenox, 2000). Teasing out what motivates actors to comply voluntarily thus has important consequences for policy design and research.

Research questions

This paper explores two related questions: (1) Why do actors choose to cooperate in voluntary programs, and at different levels of commitment? (2) How do compliance decisions change based on the structure of the compliance scenario (i.e., the specific voluntary initiative)?

We tackle these questions by drawing on theories of individual motivation to empirically explain voluntary compliance decisions in two cases of environmental programs at the micro and meso levels.

We examine what drives voluntary compliance in residential energy programs offered to customers of a municipally owned utility in Tallahassee, Florida. Tallahassee is a mid-sized city that has repeatedly been ranked as having the best municipal utility in the United States. It offers a unique opportunity to investigate the programs of a city that is looked to nationally for best practices in demand-side energy management. These programs include low-interest loans, audits, and rebates, each offering a different financial incentive. However, participation may also be driven by social factors such as neighbors learning about, witnessing, and legitimizing behavioral change

These two study contexts provide an opportunity to understand the design, incentive structure, and motivational factors of voluntary compliance across different levels of scale and complexity, which allows for the development of more diverse and effective policy tools.

Theoretical approach

We identify the motivational factors of compliance in scenarios where there are no required mandates. Specific motivations that shape actors' choices to opt into situations where they face a wide array of adverse consequences for deviating from expected behavior. In some cases, these consequences will be similar to traditional regulation; however, the rules that make up a voluntary compliance scenario should have a direct effect on the decisions and behavior of actors. An implicit goal for most voluntary programs is to encourage norming of specific

behavior that creates peer pressure to conform. We elaborate on these rewards, punishments, and motivations below.

Motivational pathways of voluntary compliance

Previous research on voluntary programs suggests participant motivations include economic incentives such as reducing energy costs (Porter & van der Linde, 1995); forms of altruistic intent to further a collective benefit (Clark, Kotchen, & Moore, 2003); or pressure to maintain a reputation and achieve legitimacy or some social status benefit (Delmas & Montes-Sancho, 2010; King & Lenox, 2000). These explanations align with Sharp's (1978) use of *material*, *expressive*, and *solidary* motives to explain behavioral choices (Clark & Wilson, 1961). These motivational pathways can lead to participation in voluntary initiatives that require compliance to be effective.

Material motivations for opting into voluntary compliance include obtaining a pecuniary payoff and/or decreasing economic costs; for instance, using a deposit-refund system for recycling plastic containers, or preventing future costs such as regulation by complying voluntarily. Extant research suggests firms, for example, opt into environmental compliance scenarios for various material purposes.

Expressive motivations, or altruistic and "warm-glow" effects, are also thought to influence voluntary compliance. For example, there may be some personal or cultural belief that induces an actor to willingly comply in a voluntary rule setting. Empirical research in environmental economics and psychology finds evidence that altruistic attitudes of consumers increase the likelihood of participating in voluntary green energy programs (Clark, Kotchen, & Moore, 2003; Kotchen & Moore, 2007).

Finally, *solidary* motivations are believed to encourage voluntary compliance. These motives stem from pressure applied in peer groups that form an identity for the participant and deem what is socially legitimate. These include peer pressure and other social forces such as stakeholder expectations and reputational considerations.

Material, expressive, and solidary motives need not be independent, either. Research on voluntary compliance in environmental policy has tended to pit motivational theories against each other (e.g., Moon & de Leon, 2007), but it could be the case that these forces work together to explain voluntary compliance in various forms.

Residential compliance in energy programs

Energy programs for residential properties are typically voluntary in nature. But there is often some aspect of compliance required for participants to experience consumption reductions from programmatic activities. Previous research suggests that White, upper middle class, and more educated individuals have a higher likelihood of participating in these initiatives (Berry, 1990; Powers, Swan, & Lee, 1992). Beyond these findings there is limited understanding of why actors participate voluntarily at different levels of commitment.

Energy programs are usually offered by local governments and/or utilities. Their focus is to decrease peak demand and delay the need for generating additional capacity. They typically offer a wide array of programs that make up a demand-side management strategy, including, but not limited to, free energy audits, rebates for appliances, and low-interest loans for larger ticket items. Each program faces a different compliance scenario which may change the subset of participants willing to participate in the program.

Compliance situation context investigations

Degree and type of monitoring/enforcement

The monitoring and enforcement of residential energy programs is minimal but substantially different depending on the type of program. The audit program does not have a formal monitoring or enforcement mechanism. Once auditors enter the home, they begin their work—caulking windows, changing light bulbs, installing low-flow shower heads, adjusting thermostat settings, testing energy loss, etc. The only follow-up mechanism used is a phone call that the utility makes at random asking about the audit experience.

The loan program, however, has a more formal monitoring mechanism that ensures the city's limited budget to make loans is being utilized efficiently and appropriately. This mechanism includes a receipt provision—the customer must provide a copy of the receipt for the purchase of the high energy efficient material the loan was approved to purchase. This program also has random follow-up inspections after installation, as auditors revisit the home to ensure the installation was completed properly by contractors.

Design of specific rules

The rules of both programs are designed with material incentives in mind. In the audit program, participation is free and incentivized through potential energy savings from participation. The audit is also used as an entry-level program, as participants are told about the loan program during the audit itself. Typically, before a customer can participate in the loan program, they need to have an audit conducted. The audit program has minimal requirements; it only asks for the participant to be present during the time of the audit. There are no sanctions in place. The customer can fail to present for an audit and request a follow-up appointment without fear of sanction. They also have no sanctions in place if the participant were to remove low-flow shower heads or new lightbulbs.

The low-interest loan program similarly operates on a material incentive—the utility offers an interest rate lower than market value but requires the purchase of higher-rated energy efficient materials (e.g., appliances). This helps the customer obtain material gains in two ways: (1) reduced long-run interest costs, and (2) energy savings. Sanctions, such as withholding electricity or adjusting payment plans, are only put in place if the customer fails to repay their loan, does not allow for follow-up inspection, or purchases equipment failing to meet energy efficiency standards. However, the loan program requires a financial commitment from the homeowner in the form of interest payments.

Capacity, relative to required behavior change

Lack of knowledge and incentives are common barriers to enhance residential energy efficiency. Many households do not have adequate knowledge and information about how to increase energy savings in the home. And even when households understand the value of energy savings, they may not have the immediate financial capacity to change their behavior. The audit and loan programs educate households about energy savings and help them overcome financial burdens associated with behavioral change. Leaning on the experience and knowledge of utility experts allows utility customers to make more informed decisions regarding their energy-related behavior. It also ensures that they are informed prior to enrolling into a situation of voluntary compliance.

Individual psychological factors

Voluntary compliance, like traditional compliance, requires an understanding of the individual psychological factors that come into play. Above, we discussed the three primary motives that can shape decisions of voluntary participation, however no single motivating factor is dominant and they may rely on other important factors such as trust. In residential energy

programs, the decision to opt-in might be motivated by a material rationale (e.g., reduced monthly energy bills, decreased costs of new appliances through incentives, etc.). However, there may also be a solidary motive at play, particularly in how information diffuses in groups. Consider the installation of residential solar panels: one neighbor in a cul de sac places solar panels on the roof using the loan program, which provides information to another neighbor who in turn makes a similar decision. These neighbors begin to build a new identity in their neighborhood and share information with other neighbors, which further encourages participation and compliance in the loan program.

In addition, the need for trust with the organization that is establishing and managing the program is important. Actors generally receive information about energy efficiency from three sources: government agencies offering the program or policy, private companies selling the equipment, and personal relationships. However, previous research suggests that more trustworthy information about energy conservation is derived primarily from acquaintances and non-experts (Darley, 1978; Leonard-Barton, 1981; Stern, 1992).

Actors are psychologically complex. In the audit program, energy auditors change light bulbs and showerheads, caulk windows, alter thermostats, and discuss other programs to help customers save money. Here there is a strong material incentive for cost minimization that encourages participant compliance (e.g., keeping new light bulbs and showerheads in place). However, anecdotal evidence from discussions with utility representatives reveals that some audit participants remove light bulbs and showerheads almost immediately after their audit. Thus, understanding the motives and psychological factors affecting voluntary compliance choices are important for informing program design and implementation.

Methods

To explore the choice to participate quantitatively, we use data on programmatic participation and residential energy consumption from the City of Tallahassee Utilities. We also draw data from the 2010 US Census at the block level to incorporate the characteristics of individuals living within these homes. These data were merged with Leon County property tax appraisal data to describe the housing stock characteristics of the homes in question. Here we compare these characteristics across programs to understand the differences in decisions to opt into compliance scenarios by utility customers living in owner-occupied homes. While these data are available for the entire population, we selected a sample of 443 households that maintains the population level participation rates of loans and audit programs.

The dependent variable—the choice to not participate, participate in the audit program only, or participate in the loan and audit program—is built from understanding the *degree and type of monitoring/enforcement* as well as the *design of specific rules*. These contextual characteristics helped identify that participating in loan and audit signified a higher-level commitment to energy savings relative to participating in the audit only. The *individual psychological factors* related to participation and the *capacity, relative to required behavior change* are used to inform the independent variables. These contexts suggest what types of information are required to understand individual compliance decisions.

Table 1 summarizes the differences between household-level characteristics between the groups that comply with their energy auditors' request that they participate in the low-interest loan program after receiving an audit, compared to those who receive an audit but do not opt into the loan program. Participation rates across the city are 7% in the audit program, and roughly 1% in the loan program, suggesting many audit participants do not proceed to the loan program.

Larger, older, and more expensive homes tend to have owners who comply with the auditor's request for participation in the loan program and demonstrate higher levels of commitment to energy savings.

Table 1. Differences in characteristics of loan participants versus audit-only participants

Characteristics	Loan participants	Audit-only participants	Difference
Mean value of home	\$160,047	\$155,169	\$ 4,878
Age of home	35.2 years	31.1 years	4.1 years
Home size (sq. ft.)	1926.0	1825.8	100.2
Educational level†	14.9 years	14.6 years	0.3 years
Number of occupants†	2.39	2.21	0.18
Minority (%)†	25.7%	31.1%	-5.4%

Note: † data measured at the Census block level.

The following analysis examines differences in characteristics between those choosing not to participate in any program (non-participants), those opting into only the audit program (low-compliance context), and those opting into the audit and loan program (higher-compliance context). We utilize a multinomial logit model to compare both options, (1) audit participation only and (2) loan and audit participation, to the base outcome (0) of no participation. We can thus interpret the differences between those who choose to participate at a level of compliance and those who choose not to participate at all.

Proxy variables, measured at the census block level, are included for factors identified as important in the literature: percentage of racial minorities, median income, and percentage with a bachelor's degree (Berry, 1990; Powers, Swan, & Lee, 1992). Other variables inform participation decisions: high bill complaints (a dummy variable equal to 1 if a customer filed a complaint), household energy use (lagged one year), and the percentage of renters in the area. We added measures for home characteristics, including home market value and age (and a squared term to capture possible curvilinear effects associated with home age). We also controlled for years, as external economic climates may shape participation decisions, as well as summer and winter months to capture seasonal effects associated with participation.

Findings

Table 2 reports the multinomial logistic regression results, which suggest clear differences between non-participants, audit-only participants, and loan-and-audit participants. Compared to the non-participants, those opting into the audit program are likely to participate if they live in areas with older homes. This finding appears to align with material motives. For instance, older homes tend to have greater energy loss, and audits can determine where residents can improve energy savings. Residents in older homes thus likely have a strong material

motivation to participate in the audit program and presumably lower their energy bills. However, as indicated by the statistically significant squared term, this effect diminishes as the age of the home increases.

Table 2. Mlogit examining levels of compliance relative to baseline of non-participation

Variables	(1) Audit participation only	(2) Loan and audit participation
Percent renters	-0.003	-0.016
Home age	0.030***	0.062
Home age ²	-0.0004***	-0.0003
Market value	-5.09e-07	3.40e-06
Base square feet	0.00007	-0.002***
2006	-3.678***	-18.49***
2007	-2.126***	-3.530***
2008	-1.078***	-2.162***
2009	-0.363***	-1.234**
2010	-0.102***	0.038
Winter	-0.083***	0.061
Summer	-0.037***	0.006
Percent minority	0.005**	-0.002
Percent bachelor's	0.013***	0.030
Median income	-5.56e-06	0.00004***
E-bill	-0.108	0.367
High bill complaint	0.158	-16.99***
Lagged energy use	0.00006	0.0004
Constant	-2.68***	-8.14***
Observations	175,375	
Groups	443	
Prob > chi ²	0.0000	

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Other significant predictors align more with solidary motives. Those living in areas with higher levels of education are more likely to participate in the audit program, which is consistent with previous research. Surprisingly, however, the model suggests households in neighborhoods with a greater percentage of racial minorities tend to participate more in the audit program. This

may indicate a peer effect within Black/African American and other minority neighborhoods in Tallahassee. While minorities in urban areas have been traditionally disadvantaged in accessing opportunities (Loury, 1977), minority groups are also known to cultivate strong social institutions (e.g., churches, civic groups, etc.) that promote opportunities for individual and communal advancement (Putnam, 1993). Moreover, since the trustworthiness of information is thought to be higher from acquaintances, it may be less surprising that minority neighborhoods in Tallahassee participate more in the audit program, controlling for income and other relevant factors, assuming such neighborhoods have developed stronger social networks.

We see different trends when comparing non-participants to those participating in loan programs. Loan participants tend to live in smaller homes (controlling for home value and age), higher income areas, and in households that did not file a high bill complaint. Calling the utility with a high bill complaint is negatively associated with higher levels of compliance. This is likely because high bill complaints usually intend to reduce energy bills and not reflect interests in making energy efficiency investments. The results also suggest that those with higher median incomes tend to participate in programs with higher compliance requirements. This is likely because of the financial costs associated with participation in the loan program, which means they may be more willing to commit to energy efficiency if they have the economic means to do so.

Summary

In the case of residential energy programs, we see the importance of household characteristics and policy design in shaping voluntary compliance. The compliance context reveals some of the underlying motivations and design mechanisms that might influence voluntary compliance decisions, such as financial incentives (material), neighbor effects

(solidary), and costs of compliance. From the statistical model, we find support for these material and solidary motivations and observe significant differences in the characteristics of households choosing to comply with voluntary programs that have different costs of compliance. These findings demonstrate the practical value of having more targeted marketing, using motivational ploys to encourage participation in these programs. Specifically we find that material motives such as cost savings to older homes and making public presentations in the neighborhoods should encourage participation in the audit program; and finding ways to reduce compliance costs for lower-income households in the loan program would encourage participation as they appear more resistant to the higher level costs. One question that remains is whether this multifaceted motivational structure of voluntary compliance holds at the meso and macro levels.

Conclusion

In this chapter, we discussed the concept of voluntary compliance and examined how different motivations shape voluntary compliance decisions in household compliance with residential energy programs. Much is still to be discovered about the relationship between motivations and willingness to comply with voluntary directives, it offers a useful methodological approach for pairing a detailed descriptive investigation with a quantitative analysis that explains voluntary compliance at multiple levels of scale.

We found evidence of a relationship between the degree of voluntary compliance and motivational factors, especially for material incentives. This suggests the compliance scenario and the design of specific rules matters in shaping individual voluntary compliance decisions. While more investigation is needed, these findings may have important implications for understanding how voluntary compliance differs between individual and organizational actors.

Our analysis is limited in its consideration of expressive motives, as well as in its use of proxy measures for material and solidary motives and reliance on cross-sectional data.

Investigating these motivations in a more robust way in the future requires additional research designs, such as surveys or experiments, that can more precisely measure and compare alternative motivations across different compliance scenarios, ideally over time.

Our findings also speak to the importance of policy design and implementation in voluntary compliance. Policymakers might benefit from research on how motivations shape compliance decisions, because they can choose designs that better elicit responses from individuals and firms that might participate in voluntary programs. Understanding the differences between compliers and non-compliers could inform strategies to encourage participation in voluntary programs.

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