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CLIMATE POLICY AND VOLUNTARY INITIATIVES:
AN EVALUATION OF THE CONNECTICUT CLEAN ENERGY COMMUNITIES PROGRAM

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ABSTRACT

Can simple government programs effectively promote voluntary initiatives to reduce greenhouse-gas emissions? This paper provides an evaluation of how the Connecticut Clean Energy Communities program affects household decisions to voluntarily purchase “green” electricity, which is electricity generated from renewable sources of energy. The results suggest that, within participating communities, subsidizing municipal solar panels as matching grants for reaching green-electricity enrollment targets increases the number of household purchases by 35 percent. The Clean Energy Communities program thus demonstrates how mostly symbolic incentives can mobilize voluntary initiatives within communities and promote demand for renewable energy.

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1. Introduction

Concern about climate change is having an increasing influence on how companies pursue corporate strategy and individuals make consumption choices. There exists a large and growing literature that seeks to explain why such voluntary initiatives occur and to evaluate their effectiveness. General areas of inquiry include corporate environmental management (e.g., Lyon and Maxwell 2004), voluntary programs (e.g., Morgenstern and Pizer 2007; Potoski and Prakash 2009), and environmentally friendly consumption (e.g., Kotchen 2005, 2006). Despite great enthusiasm for voluntary initiatives, economic theory casts serious doubt on whether they alone can meaningfully address the challenges of climate change. The incentive for free-riding is simply too strong when it comes to the voluntary provision of public goods—especially ones that are global in scale.

It would be a mistake, however, to ignore voluntary initiatives entirely in the pursuit of climate policy based on more centralized instruments. When individual nations, states, and municipalities seek to reduce greenhouse-gas emissions, they are volunteering to incur their own costs in the interest of global, public benefits. But even outside of regulatory frameworks, voluntary initiatives warrant attention. Real and substantial expenditures are being made in the interest of climate-related corporate strategy, voluntary programs, and “green” goods and services. We should thus seek to maximize the potential benefit of these activities. What is more, and perhaps less recognized, is that voluntary initiatives are effective at increasing awareness, education, and opportunities for leadership. Apart from their potential to reduce emissions, voluntary initiatives are important because of their influence on public support for climate policy more generally.

This paper considers a question that has received little attention in the literature: Can simple and relatively low-cost government programs effectively promote voluntary initiatives? In particular, what follows is an evaluation of how the Connecticut Clean Energy Communities (CCEC) program affects whether households voluntarily switch to an electricity provider with generation capacity that comes entirely from renewable sources of energy. The results suggest

that within participating communities, offering symbolic rewards—i.e., municipal solar panels or some other clean-energy technology—upon reaching green-electricity enrollment targets increases the number of household purchases by 35 percent. In effect, the CCEC program is responsible for 7,020 additional households having purchased green electricity. The reduction in greenhouse-gas emissions due to these additional purchases comes from a modest and mostly symbolic subsidy. The CCEC program can thus serve as model for how basic incentive programs can mobilize voluntary initiatives within communities, promote demand for renewable energy, and reduce greenhouse-gas emissions. While a growing body of research investigates how “green nudges” can change individual behavior as it relates to the environment, the present paper evaluates effectiveness of a green nudge applied at the community level.

2. Background

The Connecticut State Legislature established the Connecticut Clean Energy Fund (hereafter CTFund) in 2000 in order to stimulate supply and demand of renewable sources of energy within the state. Three CTFund programs are of interest here. The first is a program targeted at the household level, while the second two are targeted at the municipality level.

CTCleanEnergyOptions (Options Program): As part of Connecticut’s Climate Change Action Plan, the Options Program was established in 2005 as a mechanism for electricity customers to purchase green electricity from their utility company. All customers of Connecticut’s two major utility companies are eligible, and they are able to choose from two different green-electricity suppliers, Sterling Planet and Community Energy. The two suppliers offer electricity that comes from a similar mix of wind and small-scale hydro sources, and they charge slightly different prices at 1.19¢ and 1.3¢ per kWh, respectively. Residential customers can purchase the green options at either 50- or 100-percent levels of their actual electricity demand. Participation at the 100-percent level for a household that consumes the average amount of electricity in Connecticut (750 kWh/month) costs either \$8.93 or \$9.75 per month. As of

December 2009, a total of 22,776 Connecticut households were Options Program participants, with 83 percent participating at the 100-percent level.¹

Connecticut Clean Energy Communities (CCEC): In order to stimulate demand for green electricity, the CTFund simultaneously established the CCEC program to incentivize purchases through the Options Program. Qualifying municipalities receive free photovoltaic panels or some other clean-energy technology in proportion to the number of Options Program purchases. The clean-energy technologies are installed at highly visible, public locations within a municipality, including town halls, schools, fire stations, and police stations. The number of free installations is based on the number of designated points earned. Initially, residential sign-ups at the 50- and 100-percent levels counted as half a point and one point, respectively, but a sign-up at any level began counting as one point beginning in November 2008. In order for a municipality to qualify for the CCEC program, however, it must first meet a threshold of either 100 points or a 10-percent participation rate, in addition to having made a commitment to the 20% by 2010 Clean Energy Campaign.²

20% by 2010 Clean Energy Campaign (20by2010): Created by the non-profit marketing organization SmartPower, the 20by2010 campaign began in 2003 and thus predates the other programs. Now administered by the CTFund, 20by2010 challenges communities to purchase 20 percent of their energy from renewable sources by 2010. Participation requires that municipalities pass a resolution or issue an official proclamation committing to the challenge. In return, CTFund and SmartPower provide consultation services that can help municipalities reach the goal. Services include information about technology and cost options, media events, task-force formation, and educational materials for use in schools. The 20by2010 program is entirely voluntary, and there is no consequence for failing to meet its goal.

¹ The Options Program is also available to commercial customers, but this paper restricts attention to residential households. See CTFund (2010) for complete details.

² Qualification also depends on a few other criteria, including municipal government purchases of clean energy and participation in the U.S. Environmental Protection Agency's Community Energy Challenge. In practice, however, the other criteria are generally not binding constraints and have also changed somewhat through time. While the program description here is simplified to focus on factors influencing residential participation, interested readers should refer to CTFund (2010) for complete details about qualification criteria and point conversions.

Figure 1 illustrates the status of all 169 Connecticut municipalities with respect to enrollment in the CCEC program and 20by2010 campaign as of December 2009. Recall that all CCEC municipalities must also be participants in the 20by2010 campaign. Three municipalities are ineligible because electrical service is supplied by a municipal provider rather than one of the two possible utility companies, United Illuminating and Connecticut Light and Power.

3. Data

Data were obtained from the CTFund and were prepared with assistance from NMR Group Inc., the consulting firm that provides ongoing monitoring and evaluation support for administering the CCEC program. The key variables are illustrated graphically in Figure 2. The upward sloping line indicates the total number of residential households participating in the Options Program by month from June 2005 through December 2009. While only quarterly data is available for 2005, all subsequent observations are monthly counts. The counts sum households participating at the 50- and 100-percent levels through both Sterling Planet and Community Energy.³ Overall participation increased substantially from 3,383 to 22,776 households. Figure 2 also illustrates the percent of eligible municipalities enrolled in the 20by2010 and CCEC programs in each month, and these enrollments have increased substantially over time as well. Participation in the 20by2010 campaign increased from 8 to 57 percent, while participation in the CCEC program increased from 2 to 25 percent. The next section considers how a municipality's enrollment in these programs affects household purchases of green electricity through the Options Program.

Table 1 reports descriptive statistics for additional variables at the municipality level that were obtained from the Connecticut Economic Resource Center (CERC) for 2009. Among all municipalities, the mean number of households is 7,699, the mean of median household income is \$81,239, and the mean percentage of individuals with at least a bachelor's degree is 47

³ While future research will investigate differences in participation levels and choices among providers, all types are combined in this paper to focus simply on overall participation rates.

percent.⁴ Moreover, based on municipality data for December 2009, the mean participation rate of households in the Options Program is 2.7 percent. Table 1 also reports descriptive statistics separately for municipalities enrolled in the CCEC program, the 20by2010 campaign only, and neither of the two programs. Partitions are based on a municipality's status as of December 2009. Differences in the means reveal that municipalities with more involvement in CTFund programs are larger, have greater incomes, and are more highly educated. Household participation rates in the Options Program are also positively related to involvement in the CTFund's community programs: 4.9 percent for CCEC municipalities, 3.7 percent for 20by2010 only municipalities, and 1.5 percent for municipalities enrolled in neither program.

4. Analysis

Existing studies use household surveys to investigate variables that explain the decision to participate in price-premium, green-electricity programs (e.g., Clark *et al.* 2003; Kotchen and Moore 2007). The closest thing possible with the Connecticut data is to use municipality characteristics to explain differences in municipality Options Program participation rates. Table 2 reports the results of two regression models in which the dependent variable is the natural log of a municipality's Options Program participation rate in December 2009. Model (a) includes number of households, income, and education as explanatory variables. Municipalities that are larger have lower participation rates, more highly educated municipalities have higher participation rates, and municipalities with greater income have lower participation rates.⁵ One-thousand additional households in a municipality is associated with a 3-percent decrease in the participation rate. A 10-percent increase in the proportion of residents with at least a college degree is associated with a 6-percent increase in the participation rate. Finally, after controlling

⁴ It is worth noting that household income and educational attainment in Connecticut differs substantially from the rest of the nation, where comparable figures are just over \$50,000 for median household income and just under 0.30 for the proportion of the population with at least a college degree.

⁵ Though the model is not reported here in the interest of brevity, it is worth mentioning that income has the opposite sign in a model that does not include education as an explanatory variable. This underscores the importance of controlling for education when estimating the effect of income on purchases of green electricity. Even allowing for nonlinearities, similar results are found on the linear term if income is included as a quadratic.

for education, a \$1,000 increase in median income is associated with a 1.6-percent decrease in the participation rate.

Model (b) includes two additional dummy variables for whether in December 2009 the municipality is enrolled in the CCEC program or the 20by2010 campaign. These variables are included in the model because they are expected to affect participation rates, meaning that excluding them renders the model susceptible to omitted variable bias. Hence the important thing to note is that the coefficients on number of households, income, and education do not change substantially. While one might be tempted to interpret the new coefficients as estimates of the program effects on household participation rates, this should be done with caution for at least two reasons. First, the variables account for enrollments in December 2009, but municipalities up until that point had been enrolled for different periods of time, as can be seen in Figure 2. Second, the CCEC variable is susceptible to some degree of endogeneity because threshold participation rates must be met before a municipality is able to qualify. Despite these caveats, the estimates imply that compared to municipalities enrolled in neither program, those in only 20by2010 have 40 percent higher participation rates on average; and those in CCEC have participation rates that are 90 percent higher, where 50 percent of the difference is due to CCEC enrollment over and above the effect of 20by2010. Turning now to an alternative empirical strategy, these differences are shown to be overestimates of the actual program effects.

A more reliable evaluation of the 20by2010 and CCEC programs is possible using the complete panel of data on participation rates in the Options Program for each municipality from June 2005 through December 2009. Consider a model of the form

$$(1) \quad \ln(\textit{participation_rate}_{it}) = \alpha 20by2010_{it} + \beta CCEC_{it} + \mu_i + \nu_t + \varepsilon_{it}$$

where i indexes municipalities, t indexes each month-year, μ_i is a unique intercept for each municipality, ν_t is a unique intercept for each month-year, and ε_{it} is an error term. Advantages of specification (1) are that it controls for changes in participation rates through time that are

common to all municipalities and for unobserved time-invariant heterogeneity among municipalities (e.g., differences in size, education, and income).⁶ Coefficients on the program variables estimate differences in the average household participation rate when a municipality is enrolled in different CTFund programs. Identification comes entirely from changes within a municipality, which are then averaged across municipalities. The estimate of α captures how participation rates differ during periods when municipalities are enrolled in the 20by2010 program compared to no program, and the estimate of β captures the additional effect of periods when municipalities are enrolled in the CCEC program. The sum $\alpha + \beta$ captures the overall CCEC effect on participation rates because CCEC requires enrollment in the 20by2010 campaign.

Model (a) in Table 3 reports the fixed effects estimates of equation (1) with standard errors clustered at the municipality level to account for serial correlation. The effect of the 20by2010 program is positive but not statistically different from zero. The effect of the CCEC program is positive and has a high degree of statistical significance: within municipalities, CCEC enrollment is associated with a 39 percent higher participation rate compared to 20by2010 enrollment alone. The overall difference in participation rates associated with CCEC enrollment compared to no program enrollment (i.e., the estimate of $\alpha + \beta$) is 41 percent.

A potential concern with the preceding estimate of the CCEC effect on participation rates is still endogeneity due to the participation threshold for enrollment. Municipalities with more participants in the Options Program are more likely to qualify for CCEC enrollment, and this relationship could lead to an overestimate of β . To address this concern, a useful feature of the data is that qualifying municipalities do not always enroll in the CCEC program. In fact, enrollment occurs in only 62 percent of the periods when municipalities satisfy the qualification threshold. As an alternate specification, model (b) in Table 3 includes an additional dummy variable to control for the average difference in participation rates due to satisfying the

⁶ Models were also estimated for which the dependent variable is simply the participation rate rather than its natural log. Only the results of specification (1) are reported because they fit the data better and are easier to interpret; however, the sign and significance of all coefficients are robust to both specifications.

qualification threshold, which is distinct from CCEC enrollment. While the coefficients of interest do not change substantially, they do have lower magnitudes. The 20by2010 effect remains statistically indistinguishable from zero, and the additional CCEC effect reduces to 35 percent. Combining the two coefficients in this model, the overall difference in participation rates associated with CCEC enrollment, compared to no program enrollment, is 37 percent.

5. Conclusion

Can symbolic rewards in the form of publically displayed solar panels in municipalities increase the number of households that purchase price-premium, green electricity? Or more generally, can community level “green nudges” affect individual behavior? The CCEC program provides evidence that they can: within municipalities that choose to enroll, household participation rates in the Options Program increase 35 percent. Therefore, based on the observed mean participation rate of 4.9 percent among CCEC communities, 1.27 percent is due to the CCEC program. Within these municipalities, the CCEC program is thus responsible for 7,020 additional household participants in the Options Program, which translates into 31 percent of all household participants state-wide in December 2009. Counting all residential Options Program participants in the state, assuming average electricity consumption, and using the observed proportion of 50- and 100-percent sign-ups, the estimated reduction in carbon dioxide emissions is 74,528 metric tonnes. Of this total, 31 percent, or 23,104 metric tonnes, is due to the CCEC program having awarded a total solar capacity of 259 kW in participating municipalities. Assuming Connecticut would have subsidized installation of these solar panels anyway, the CCEC program provides a model for how simple matching grants can promote voluntary initiatives related to climate change. Whether such initiatives will continue to be as effective after passage of more centralized climate policies—that is, whether voluntary and mandatory initiatives are complements or substitutes—is an important question for future research.

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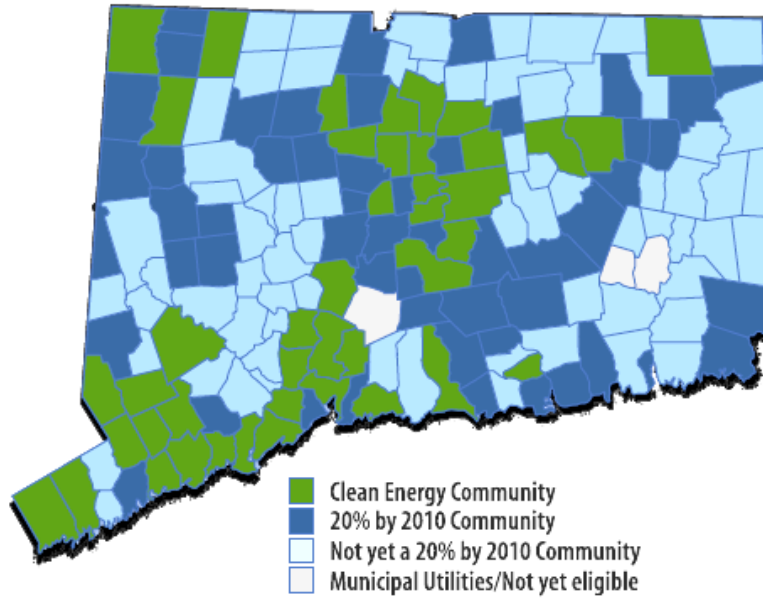


Figure 1: Most recent program participation among Connecticut municipalities (Recall that CCEC requires 20by2010. Source of figure: CTFund 2010)

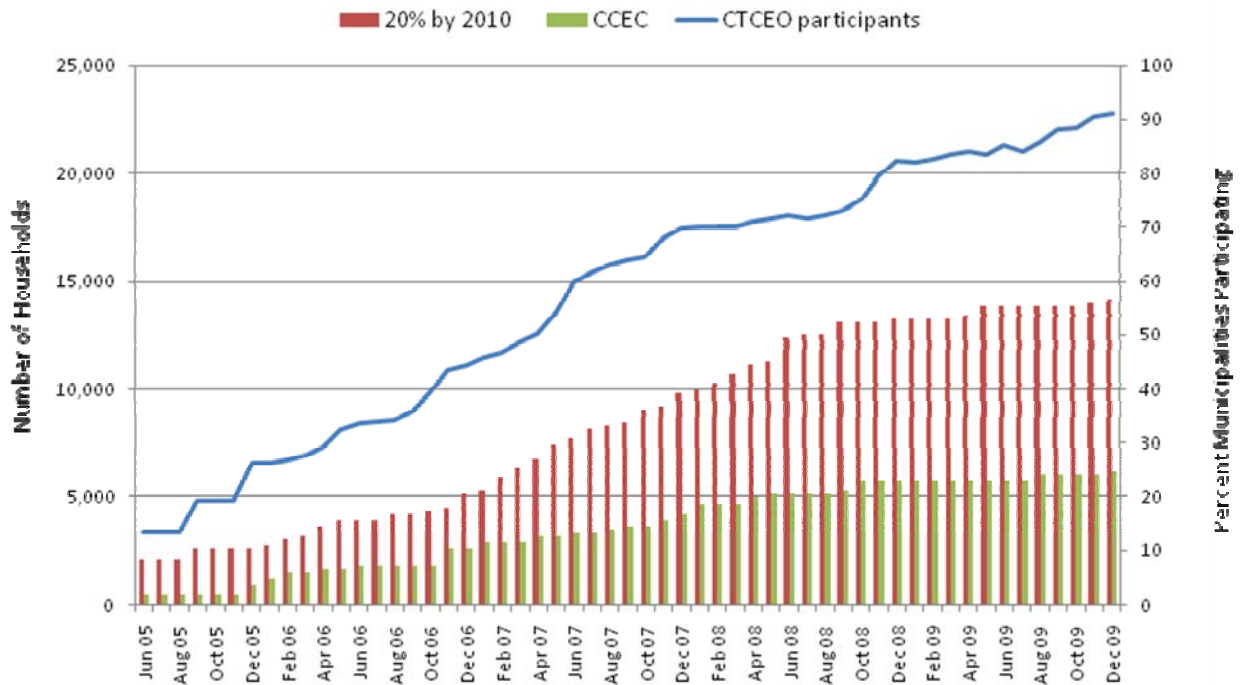


Figure 2: Household and municipality participation in Connecticut green-electricity programs

Table 1: Descriptive statistics among different sets of municipalities in 2009

	Set of municipalities with status as of December 2009			
	All municipalities (Obs. = 166)	Neither program (Obs. = 72)	20by2010 (Obs. = 94)	CCEC (Obs. = 41)
Number of households in municipality	7,699 (9,302)	4,857 (5,924)	9,876 (10,756)	13,482 (13,346)
Median household income (\$2009s)	81,239 (26,254)	79,221 (23,514)	82,784 (28,200)	90,617 (37,131)
Proportion individuals with bachelor's degree or more	0.468 (0.145)	0.421 (0.138)	0.503 (0.141)	0.564 (0.151)
Options Program participation rate in December 2009	0.027 (0.036)	0.015 (0.012)	0.037 (0.044)	0.049 (0.058)

Notes: All municipalities are those eligible for the CCEC program. Statistics reported are means (standard deviations) of the variables. Municipalities listed a CCEC participants are a subset of those reported as 20by2010 participants.

Table 2: Linear regression models of household Options Program participation rates by municipality in 2009

	Model	
	(a)	(b)
Number of households in municipality (1,000s)	-0.030* (0.005)	-0.045* (0.004)
Median household income (\$10,000s)	-0.163* (0.029)	-0.124* (0.025)
Proportion individuals with bachelor's degree or more	6.040* (0.503)	4.348* (0.477)
Dummy for 20% by 2010 participant	--	0.403* (0.088)
Dummy for CCEC participant	--	0.505* (0.109)
Constant	-5.278* (0.163)	-5.038* (0.149)
<i>R</i> -Squared (adjusted)	0.590	0.703

Notes: The dependent variable is the natural log of the municipality participation rate. All models include 166 observations. Standard errors are reported in parentheses. An asterisk indicates statistical significance at the 99-percent level.

Table 3: Fixed effects estimates of program evaluation models

	Model	
	(a)	(b)
Dummy for 20% by 2010 participation (α)	0.026 (0.039)	0.019 (0.040)
Dummy for CCEC participation (β)	0.387* (0.088)	0.350* (0.089)
Dummy for satisfying CCEC qualification threshold	--	0.054 (0.042)
Month-year dummies	Yes	Yes
Observations	8,460	8,460
Municipalities	166	166
R-squared (overall)	0.318	0.319
Estimate of $\alpha + \beta$	0.413* (0.103)	0.369* (0.104)

Notes: The dependent variable is the natural log of the municipality participation rate. Reported in parentheses are standard errors clustered at the municipality level. An asterisk indicates statistical significance at the 99-percent level.