

Does City or State Make A Difference? The Effects of Policy Framing on Public Attitudes toward a Solar Energy Program

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Abstract:

Replacing fossil fuel with solar photovoltaic (PV) technology is critical to the transition to renewable energy and thus a key feature of the contentious and often confusing policy debates surrounding climate change. Governments can frame such environmental issues in various ways, but consensus is lacking on whether economic or environmental benefits most effectively encourage pro-environmental attitudes and behaviors, such as supporting PV technology. In this study, we introduce a moderator—psychological distance between citizens and policy outcomes—to elaborate this relation. Based on the federalism literature, we suggest that different levels of government, as the policy implementers, represent a sense of distance. The construal level theory (CLT) is adopted, and we hypothesize that the congruency between psychological distance and the construal level of policy outcomes will increase positive behavioral intentions to support solar PV installation. The results of survey experiments on Amazon Mechanical Turk (MTurk) offer partial support for our theoretical expectations and add new insights. Practical and theoretical implications are discussed.

Keywords: Construal level theory, Policy support, Willingness to pay, Solar Photovoltaic, Federalism

The transition in replacing fossil fuel with renewable energy occupies a prominent place on the climate policy agenda in the U.S. and around the globe (Feiock & Coutts 2013; Ramaswami et al 2017). However, the road to energy transformation in the U.S. has been quite bumpy, in part because it depends on altering individuals' behavior in participating in programs, investing in and using new technologies, and changing daily behaviors. One approach that is applied widely in efforts to change attitudes and encourage these actions is to inform citizens about the nature of the policy programs through particular policy frames (Skocpol, 1992; Levin, Schneider & Gaeth, 1998; Kallbekken & Salen, 2011). By framing policy issues in a particular way, a government can highlight the nature of a given policy program strategically to shape the public's perception of policy problems, direct resources available for political mobilization, and arrange the policy agenda for specific policy solutions (Mettler & Soss, 2004; Callaghan & Schnell, 2009; Mettler & SoRelle, 2014; Stokes & Warshaw, 2017). Consistent with this line of thought, framing can increase the public's support for the policy program, which in turn translates into their willingness to alter their behavioral intentions.

The nature of policy programs is multifaceted (Walker, Lee, James & Ho, 2018). Policy outcomes play a profound role in an individual's evaluation of policy programs' effectiveness and result in positive or negative attitudes toward governmental agencies or the programs themselves (Baron & Hershey, 1988; James & Olsen, 2017; Deslatte, 2019; Deslatte et al. 2019). A key question is whether economic (e.g., Spence, Leygue, Bedwell & O'Malley, 2014; Grillos, 2017) or environmental benefits (e.g., Bolderdijk et al., 2013; Raymond & Delshad, 2016) are the major determinants that persuade people to adopt pro-

environmental attitudes and behaviors. To date, previous studies have provided inconclusive and sometimes contradictory findings with respect to how the perception of economic or environmental benefits influences citizens' attitudes and behaviors.

This article seeks to fill this lacuna in efforts to influence citizens to take action to support energy transition. Specifically, we investigate the conditions under which a specific policy-outcome frame will lead the public to support a solar PV program and to be willing to pay for the system themselves. We argue that, within the U.S. federal system, a governmental agency at a specific hierarchical level could elicit a sense of proximity/distance from the citizen. Further, building on construal level theory (CLT), we expect that a positive attitude would be elicited when the process of abstraction (from an object's concrete to abstract construal) matches the psychological distance between citizens and officials. To investigate this proposition, a series of survey experiments are conducted through Amazon's Mechanical Turk (MTurk), and the empirical evidence offers partial support for the expectations we outline below. The theoretical and practical implications for policy framing to accelerate energy transition processes are then provided.

Policy Framing and Public Attitudes toward Sustainability

Extant research has demonstrated that policy framing plays an essential role in eliciting public support for diverse policy issues, such as climate change and energy (Chong & Druckman, 2007; Fletcher, 2009; Wiener & Koontz, 2010; Jones & Song, 2014). Policy frames could be either policy attributes or goals (Levin, Schneider & Gaeth, 1998). In this study, we focus on outcome framing for two reasons. First, outcome bias is prevalent (Baron

& Hershey, 1988). Previous studies on environmental policy have emphasized the importance of policy outcomes when the government intends to encourage pro-environmental attitudes and behaviors (for a review, see Drew & van den Bergh, 2016). Moreover, studies in public policy and management have revealed that the disclosure of policy outcome information, analogous to performance information, can affect public perceptions of agencies or programs (e.g., James & Van Ryzin, 2016, 2017; Nielsen & Moynihan, 2017; Deslatte, 2019). Hence, it is reasonable to examine the way different outcome framing affects perceptions of particular programs.

In environmental policy, it is inconclusive whether economic or environmental benefits elicit policy support more effectively. Some argue that individuals are willing to take actions when motivated by self-interest, such as acquiring economic benefits (Lindenberg & Steg, 2014; Spence et al., 2014) or facing lower financial barriers (Rabe, 2004; Lane & Potter, 2007; Caird, Roy & Herring, 2008; Lanzini & Thøgersen, 2014; Kachi, Bernauer & Gampfer, 2015; Grillos, 2017). Alternatively, recent studies have found that climate concerns and benefits could outweigh the monetary cost of mitigation actions (Tobler, Visschers & Siegrist, 2012; Bolderdijk et al., 2013; Steinhorst, Christian & Matthies, 2015; Raymond & Delshad, 2016). We seek to shed new light on these contradictory findings by introducing an important moderator—the psychological distance between citizens and policy programs.

Evaluation of policy outcomes is constructed socially, and the public's sense of distance from policy programs can affect their opinion of governmental performance. Experimental studies have found that public assessment of policy programs is contingent

upon party identity (e.g., James & Van Ryzin, 2017; Gromet, Kunreuther & Larrick, 2013), especially when the source of information is either in-party (socially closer) or out-party (socially distant) (e.g., Slothuus & De Vrees, 2010; Lyons & Jaeger, 2014). However, partisan-motivated reasoning could be tempered by various issues that affect an individual's interests directly or indirectly (Mullinix, 2016), suggesting that the sense of distance from policy programs might influence their evaluation.

Extending this work, we focus on the implementation level (whether city or state government) and the corresponding policy outcomes (whether it produces environmental or economic benefits). Later, we will advance our hypothesis by integrating federalism studies with a psychological theory—the construal level theory (CLT)—to examine how the relation between economic-environmental benefits' framing and the city/state level affect policy attitudes toward solar PV policy.

City/State as Moderator

As noted previously, a policy program could be framed as either a higher-level abstract construal or a lower-level concrete construal. According to CLT, a higher level of construal focuses on an object's more primary and abstract property, while a lower level of construal relates to its relatively secondary and more concrete characteristics (Trope, Liberman & Wakslak, 2007; Trope & Liberman, 2010). Consider an environmentally friendly product that could be framed as either reducing adverse environmental effects (a higher level of construal) or saving an individual money (a lower level of construal). Positive judgments and behaviors derive from the congruence or “fit” between the levels of construal and

psychological distance, which is a subjective, egocentric perception based on either temporal, spatial, social, or hypothetical dimensions (Trope, Liberman & Wakslak, 2007; Trope & Liberman, 2010). Using a high-level construal could ensure a more accurate description of an object at a distance, since the contextual information is limited. So fit could elicit processing fluency (Lee & Aaker, 2004). In contrast, it becomes difficult to evaluate objects that include misfit information, such as assessing a product's economic appeals while thinking about life one year from tomorrow (Goldsmith, Newman & Dhar, 2016).

In addition, people would “feel right” about the means to the end when the fit between the construal level and psychological distance is maintained. When the means used to attain the goal are suitable for the orientation of activities, a value or “functional advantage” of goal pursuit could be derived (Fessel, 2011; Higgins, 2000). People would then recognize that certain actions would be more feasible and effective to achieve acclaimed goals in a specific circumstance (Henderson, Wakslak, Fujita & Rohrbach, 2011; White, Macdonnell & Dahl, 2011). This insight has been applied to individuals' judgments and behaviors, such as intentions to purchase eco-friendly products (Goldsmith et al, 2016), pro-environmental behavior and attitude (e.g., Brügger, Morton & Dessai, 2015; Chang, Zhang & Xie, 2015; Sacchi, Riva & Aceto, 2016), and decision-makers' evaluations (Burgoon, Henderson & Wakslak 2013).

In the U.S. federal system, we argue that different levels of government could entail a sense of distance between the government and citizens and, because of this perception, citizens would prefer a particular level of government to take the main responsibility to

achieve specific policy goals. Public perceptions of intergovernmental policy responsibility could root in part in the nature of policy problems (Konsiky, Milyo & Richardson, 2008; Schneider, Jacoby & Lewis, 2010). Individuals may think federally when considering the geographic scale of environmental problems, (Jacobs 2017; Konisky, 2010) or ensuring policy outcomes “close to the people” (Kelleher & Yackee, 2004). In addition, attitude toward politics, such as partisan identification or political trust, could likewise affect preferences on the assignment of policy responsibilities (Wolak & Palus, 2010; Connolly, Klostad, Uscinski, & West, 2019; Dinan & Heckelman, 2020; Wolak 2016). For instance, citizens are prone to defend state authorities against federal interventions, due to greater trust in the state government (Kam & Mikos, 2010). More importantly, citizens may prefer levels of governments of which they feel more in control. This occurs because more opportunities for civic engagement in a given jurisdictions are able to empower citizens (Craig, Niemi & Silver, 1990; Ostrom, Tiebout & Warren, 1961). Empowered citizens would then adopt a belief that “...individual political action does have or can have an influence upon the political process,” i.e., external political efficacy (Campbell, Gurin & Miller, 1954, pp.187). Higher external political efficacy suggests reduced power asymmetry and social distances between officials and citizens (Magee & Smith, 2013). As a result, we hypothesize:

H1: Citizens’ attitudes toward Solar PV policy and their willingness to pay to install solar PV will be influenced by psychological distances and economic/environmental benefits of the policy program.

H1a: Citizens exhibit a more support for the Solar PV policy and more willingness to pay to install the solar PV when the policy evaluation the state government publishes focuses on environmental relative to economic benefits.

H1b: Citizens exhibit a more support for the Solar PV policy and more willingness to pay intention to install solar PV when the policy evaluation the city government publishes focuses on economic relative to environmental benefits.

Experimental Design

To test these hypotheses, we designed a 2 X 2 factorial experiment with two factors: The implementing government and type of policy outcome. Experimental protocol is presented in Figure A1. The treatment is a constructed solar PV policy program, “Go to Solar,” based on the Department of Energy 2007 policy report (see Appendix for the complete text and wording). The sense of psychological distance is manipulated in two ways. First, the source of information indicates the level of government that is implementing the solar program. When it is the state government, our goal is to manipulate the perception that the policy program is distant from the respondents. In contrast, city government gives the perception of a proximate source. Secondly, the specific area the policy program affects is identified. If the information source is the state government, the influence will be framed as statewide. Otherwise, it will be citywide.

To evaluate the construal level’s effect, we vary the policy outcomes presented randomly as economic or environmental. With respect to economic benefits, we provide the information that each solar PV panel could save one family \$433 annually in energy expenses, and in the aggregate, a certain amount of money beneficial to the state/city ($\$433 \times 5000 \text{ households} = \$2,165,000$). Environmental benefits are the annual reduction in

CO₂ emissions and the aggregated reduction is described as equivalent to a corresponding number of tree seedlings grown in 10 years.¹

We have two dependent variables: Policy support and willingness to pay. The respondents' tendency to support the "Go to Solar" program is measured on a 7-point Likert scale that ranges from strongly support (7) to strongly oppose (1) (M=5.94, SD=1.12, Skewness=-1.33). Respondents are also asked to express their willingness to pay 100% of the expense to install the PV system themselves. If they are unwilling to do so, the following question asks the minimum amount of financial subsidy that would be sufficient for them to change their mind, with responses that range from "10%" to "not willing to change my mind even with more than a 51%" subsidy. Combining these two, the measure of willingness to pay ranges from 1 ("not willing to change my mind even with more than a 51%") to 7 (pay 100% by themselves) (M=5.04, SD=2.29; Skewness=-0.47). All of the measures are presented in Table A2 in the Appendix.

In general, the respondents recruited from Amazon's MTurk (N=576) were attentive to our treatment.² Among them, 51% answer the two factual manipulation check questions corresponding to our two treatments correctly (see Table A4).³ Later, we ran both a *t*-test and the OLS model with the respondents who passed the FMC questions.⁴

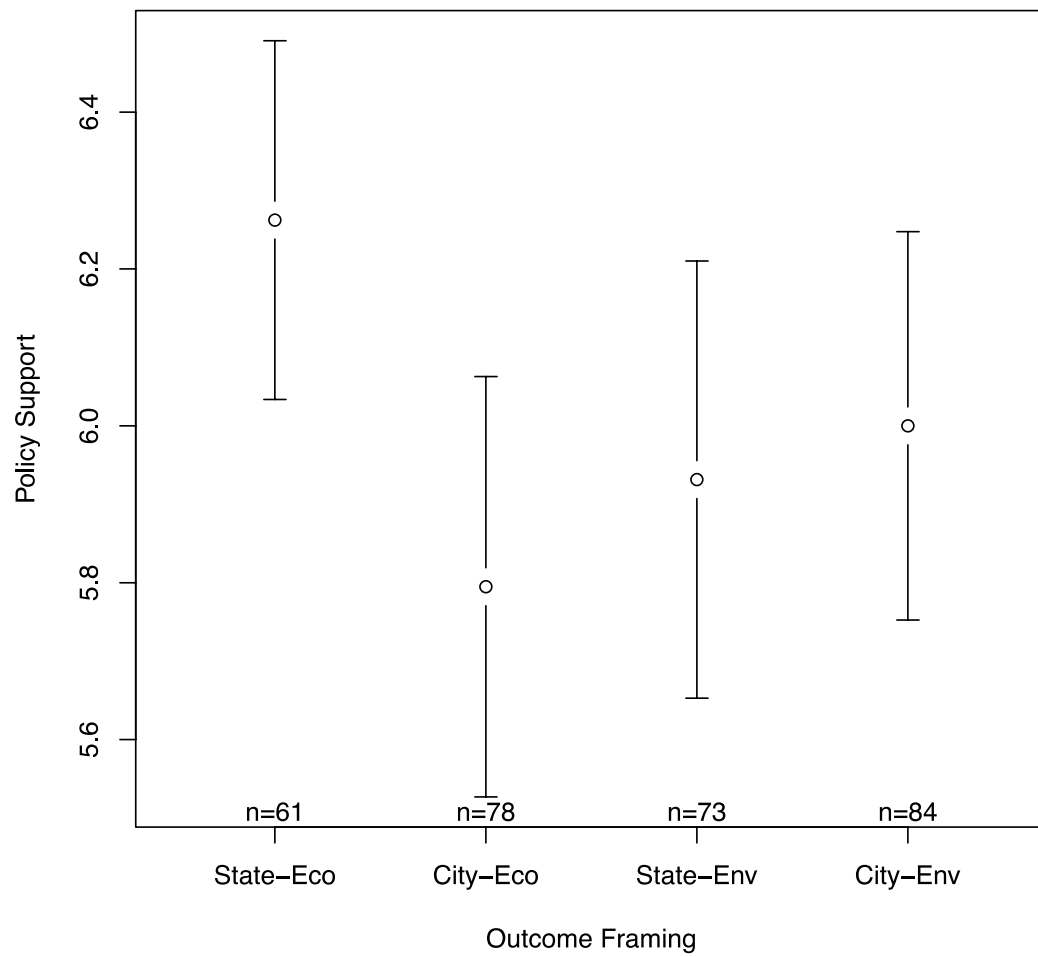
Results

Policy Support

Figure 1 presents the results of our hypothesis tests that congruence between outcomes' framing and psychological distances elicit a more policy support for the solar PV program. The result does not support our expectation that manipulated environmental (vs. economic) benefits at the state (vs. city) bolster policy support. In fact, the opposite is the case. The respondents expressed a greater level of policy support when offered statewide than citywide economic benefits ($t=2.65$, Effect size=0.44). Further, the respondents prefer state governments to implement the program, which could produce economic benefits relative to environmental benefits ($t=1.83$, Effect size=0.31). With respect to city governments, the respondents appear to support the solar PV program when it is intended to achieve environmental benefits, but the difference is not statistically significant.

Figure 1

Two-way interaction effect in the mean rating of policy support



Notes: Circles describe the mean of policy support and bars describe 95% confidence intervals.

We also run a series of regression analyses to test the hypothesis formally, and Table 1 reports parallel results.⁵ As noted, the implementing government and the type of benefits does not affect policy support solely, but jointly. Model 1 shows that the interaction effect is

statistically significant and positive, but the main effects are not statistically significant, as we anticipated. Even after including the demographic variables of political party, race, income, and U.S. residents in model 2, the results remain the same. Among the control variables, as one might expect, Democrats are more likely to support the solar PV program relative to independents.⁶

Table 1

OLS Model for policy support and willingness to pay for solar PV

	Policy Support		Willingness to pay	
	(1)	(2)	(3)	(4)
State	-0.068	-0.153	0.664*	0.303
	(0.179)	(0.179)	(0.375)	(0.372)
Economic	-0.205	-0.316*	0.792**	0.543
	(0.176)	(0.179)	(0.368)	(0.371)
State *	0.536**	0.680**	-0.964*	-0.560
Economic				

	(0.263)	(0.264)	(0.549)	(0.547)
Democrat		0.668***		0.427
		(0.168)		(0.349)
Republican		0.069		-0.120
		(0.186)		(0.385)
White		0.041		-1.110**
		(0.221)		(0.458)
Asian		-0.004		-0.094
		(0.286)		(0.592)
Income		-0.008		0.123
		(0.037)		(0.077)
USA		-0.111		-1.118***
Resident				
		(0.239)		(0.495)

Constant	6.000***	5.821***	4.131***	5.484***
	(0.122)	(0.357)	(0.256)	(0.739)
N	296	291	296	291
R ₂	0.021	0.100	0.018	0.106
Adjusted R ₂	0.011	0.071	0.008	0.077

Notes: 1. *<.1; **<.05; ***<.01; 2. Standard Deviations appear in the parentheses below the means.

Willingness to Pay

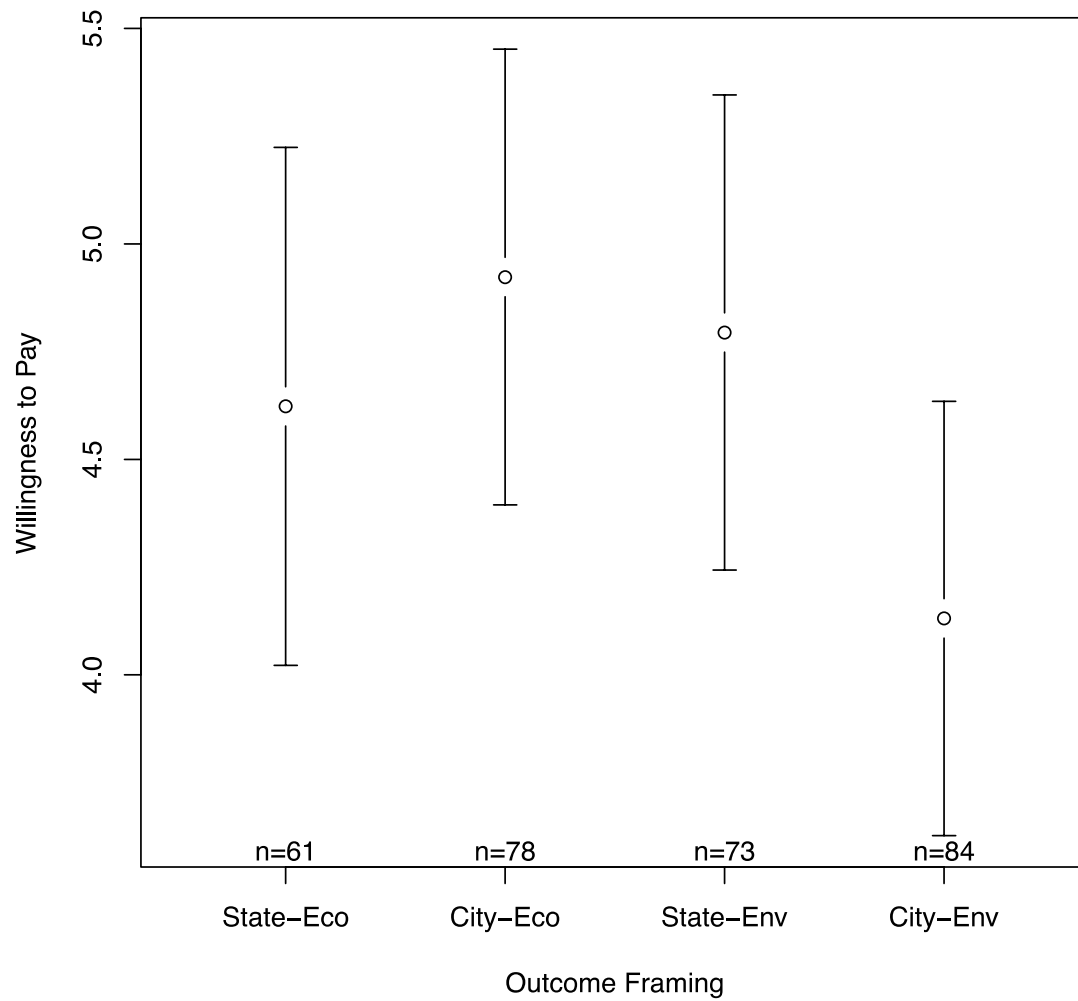
Figure 2 shows mixed evidence of the congruence hypothesis (H1a & H1b) that environmental (vs. economic) benefits at the state (vs. city) level would result in a greater willingness to pay for solar PV installation. As expected, respondents have more willingness to pay when the citywide economic rather than environmental benefits are highlighted ($t=2.16$, Effect size=0.34). On the other hand, relative to citywide environmental benefits, statewide environmental benefits seem to persuade respondents to be more willing to pay to install the solar PV system ($t=1.77$, Effect size=0.28).

Unlike the finding of the regression model on policy support, after demographic variables are included, the interaction effects between implementing governments and policy

benefits become insignificant (see Table 1). We also found that white and U.S. respondents tend to report less willingness to pay. Overall, the results support the interaction between construal level and psychological distance in willingness to pay, but only in part. It is worth noting that the effect size of our policy framing overall is relatively low and, given the relatively smaller sample size, the analysis may be underpowered.

Figure 2

Two-way interaction effect for the willingness to pay



Notes: Circles describe the mean of policy support and bars describe 95% confidence intervals.

Follow-up Experiments

Because the findings are not fully consistent with our theoretical expectations, two follow-up studies are conducted to provide further explanations.⁷ Some might argue that our first experiment frames the proposed solar program explicitly as a single action to mitigate

climate change. The promise of co-benefits in climate change policy could enhance the program's valence. If so, we expect that once climate change framing is removed, the respondents would prefer the program with environmental appeals rather than that with economic appeals.

The findings of the second experiment suggest the possibility that climate change framing could add value to the program with economic benefits. In the second experiment, we recruited 810 U.S. citizens from MTurks and asked them to report policy attitudes toward a solar PV program with either economic or environmental benefits. Table 2 shows that the solar PV program accompanied by environmental (vs. economic) benefits gains more support. Specifically, when respondents receive the treatment of economic benefits, policy support decreases by .62 units.⁹ However, respondents are indifferent to the specific level of government that should obtain these benefits. Considering willingness to pay for PV installation, the direction of the framing effects mains the same as the results of the first experiment. However, the differences are not statistically significant.

Table 2

OLS model for policy attitude toward Solar PV program (Experiment 2)

	Policy Support	Willingness to pay
	(1)	(2)

City	0.144	-0.149
	(0.261)	(0.291)
Economic benefit	-0.632**	-0.103
	(0.261)	(0.291)
City * Economic benefit	0.050	0.483
	(0.369)	(0.411)
Second Wave	0.276	0.149
	(0.190)	(0.212)
Republican	-1.386***	-0.500**
	(0.214)	(0.238)
Independent	-1.027***	-0.377
	(0.251)	(0.280)
Male	-0.333*	-0.087

	(0.189)	(0.211)
White	0.345	0.242
	(0.265)	(0.295)
Black	0.545	0.825*
	(0.445)	(0.495)
Education	-0.102	-0.070
	(0.100)	(0.111)
Constant	8.495***	4.513***
	(0.472)	(0.526)
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Observations	553	553
R ₂	0.120	0.019
Adjusted R ₂	0.104	0.001
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Notes: 1. *<.1; **<.05; ***<.01; 2. Standard errors appear in the parentheses below the coefficients.

Others might contend further that psychological distance of local government may not primarily be based on geographical one but social one. Hence, we decide to account for this variance by measuring political efficacy.¹⁰ Using treatments similar to those in Experiment 2, we again recruited 644 U.S. citizens from MTurk.¹¹ The results largely replicate the findings of Experiment 2 and confirm the moderating effect of political efficacy. Respondents seem to perceive distance across both levels of government. On average, local political efficacy is greater than that of the state across all groups (see Table 3). After including three-way interaction terms among implementers, policy benefits, and local political efficacy in the OLS model, the coefficient is negative and statistically significant in the case of policy support and willingness to pay. Specifically, when the respondents feel the local government is closer to them, their support for the city clean air program becomes stronger (see the right panel in Figure 3 (a)). However, this effect is not as intense for the state program. With respect to the job creation program, the state government gains more support from respondents with greater local political efficacy, and the slope of this effect is slight in the case of the city program. The results are comparable in the case of willingness to pay (see Figure 3 (b)). When the respondents' local political efficacy increases, the city (vs. state) clean air program increases their willingness to pay as well. In contrast, willingness to pay is more likely to be motivated because of the state (vs. city) job creation program. Largely, these findings indicate that when the respondents feel closer to the city government, they prefer the city (vs. state) program with environmental appeals and the state (vs. city) program with economic appeals.

Table 3

OLS model for policy attitude toward the solar PV program (Experiment 3)

	Policy Support		Willingness to pay	
	(1)	(2)	(3)	(4)
City	0.182	-0.177	0.111	-0.623
	(0.225)	(0.296)	(0.294)	(0.383)
Economic benefit	-0.743***	-0.991***	0.247	-0.398
	(0.232)	(0.304)	(0.303)	(0.393)
Local-State PE	0.137***	0.008	-0.044	-0.391**
	(0.050)	(0.105)	(0.065)	(0.136)
City * L-S PE Diff		0.264*		0.535***
		(0.141)		(0.182)
Eco benefit * L-S PE Diff		0.178		0.466**
		(0.143)		(0.186)

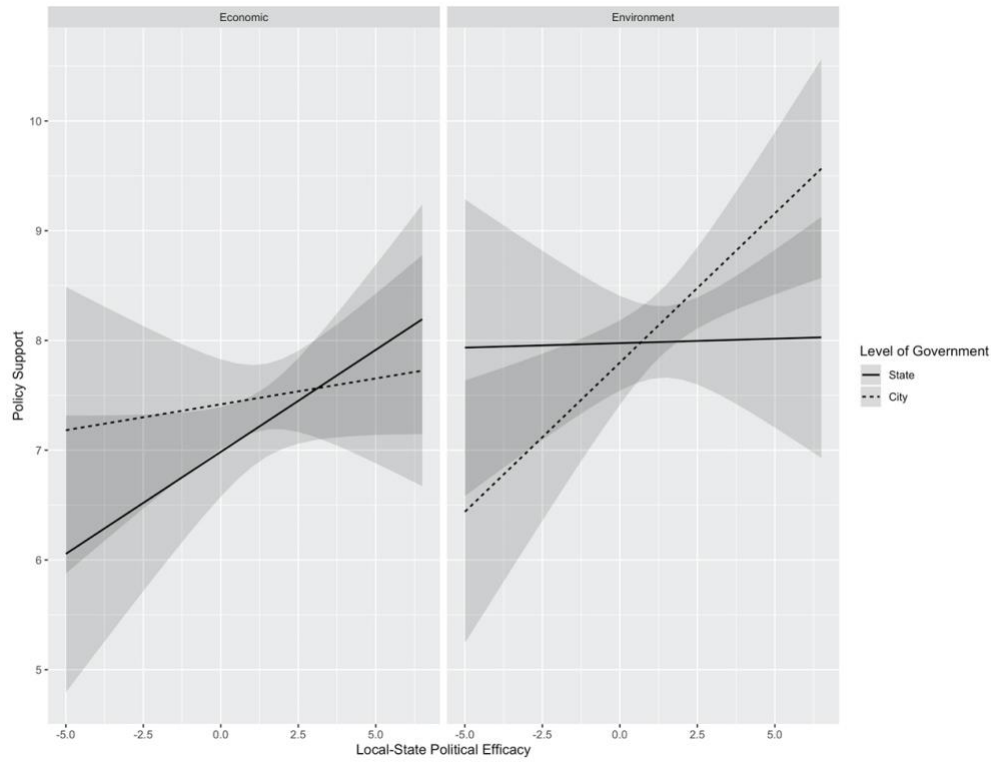
City * Eco benefit *L-S PE Diff		-0.403**		-0.679***
		(0.199)		(0.258)
Outcome expectancy	0.510***	0.511***	0.237***	0.236***
	(0.034)	(0.034)	(0.044)	(0.044)
Republican	-0.485**	-0.468**	0.041	0.057
	(0.193)	(0.193)	(0.252)	(0.250)
Independent	-0.589***	-0.610***	0.192	0.129
	(0.211)	(0.212)	(0.275)	(0.274)
Income	-0.022	-0.017	0.052	0.060
	(0.045)	(0.045)	(0.058)	(0.058)
Male	-0.021	-0.020	0.160	0.162
	(0.164)	(0.164)	(0.214)	(0.213)
White	0.592**	0.642***	0.348	0.422

	(0.240)	(0.241)	(0.312)	(0.312)
Black	0.591*	0.643*	0.258	0.290
	(0.331)	(0.333)	(0.431)	(0.431)
Education	0.050	0.037	0.020	-0.004
	(0.089)	(0.089)	(0.116)	(0.116)
Constant	4.124***	4.282***	2.166***	2.657***
	(0.472)	(0.492)	(0.615)	(0.638)
Observations	466	466	466	466
R ₂	0.382	0.388	0.073	0.092
Adjusted R ₂	0.365	0.367	0.048	0.062

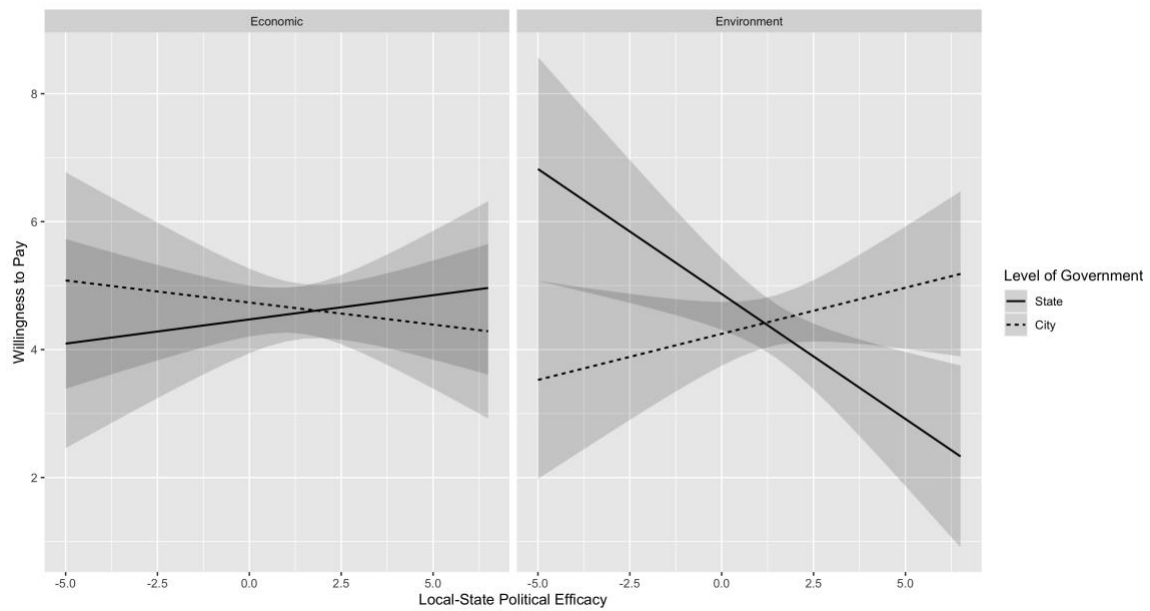
Note: 1. *<.1; **<.05; ***<.01; 2. Standard errors appear in the parentheses below the coefficients.

Figure 3

Three-way interaction effect on policy support and willingness to pay



(a) Policy support



(b) Willingness to pay

Discussion and Implications

It has been long debated whether economic or environmental benefits are more effective in eliciting pro-environmental attitudes and behaviors. To shed light on the inconsistent findings in previous research, this article examines the effectiveness of policy outcome framing with respect to solar PV installation in the context of American federalism. We suggest that individuals use specific levels of construal when the economic/environmental benefits the solar PV system offers are highlighted. Further, people demonstrate policy support and willingness to pay by associating the policy benefits with a specific level of government as an appropriate implementer that is psychologically farther or closer to them.

Our experimental results suggest a more nuanced story regarding the effect of policy framing on public attitudes toward environmental policy. In general, outcome framing seems to change support for a solar PV program while having more mixed effects on willingness to pay. When the solar PV program is framed with co-benefits for reducing climate change impacts, policy support could be induced by presenting statewide (vs. citywide) economic benefits. Once the climate change framing is removed, environmental (vs. economic) benefits are more likely to influence policy support, regardless of which level of government implements the program. On the other hand, our findings also indicate that the willingness to pay to install a solar PV system seems to be elicited by presenting citywide (vs. statewide) economic benefits with climate change framing. However, this effect is insignificant when demographic variables are included in the regression model. Furthermore, without climate change framing, there is no significant difference in the influence of city/state framing on

willingness to pay. Taken together, these findings suggest that outcome framing can shape public attitudes toward environmental policy programs to different degrees, depending on policy context.

It seems that the public appears to care less about the distribution of intergovernmental policy responsibilities as long as the desired outcomes are outlined and achieved. Nevertheless, it is worth noting that the effect of such outcome-determined mindsets may not be overwhelming. There are heterogeneities within the treatment groups. Existing scholarship has demonstrated that political trust could motivate citizens' "safeguards of federalism" in the Federal-state relation (Kam & Mikos, 2007). Here, we expand this argument to the state-local relation by measuring local political efficacy. Our results suggest that when the respondents believe local political efficacy is high, the city program that promises to deliver environmental benefits, and the state program that offers economic benefits, would be perceived as the preferable option. Specifically, citywide (vs. statewide) environmental benefits are more likely to encourage a willingness to pay on the part of people with higher local political efficacy. Taken together, although citizens may be ill-informed about the legal and administrative principles of governance arrangement, they appear to acquire a pragmatic understanding about the federalist system in their own ways and accordingly, choose appropriate implementers to serve their interests.

Finally, this article illustrates the value of the application of construal level theory to federalism studies. As we demonstrated, the psychological distance between government and citizens is important in the distribution of policy authorities across levels of government, and local political efficacy is by no means the only measure. Future work could continue to

explore the way different dimensions of psychological distance affect policy attitudes. Further, the message of policy outcomes in our experiments is more general. It may be the case that national and local officials could acquire more policy support by providing case-specific or general statistical statements on policy programs. Finally, the determinants of behavioral intention could differ from those of real behavioral change, so more work should be performed to unveil the motivation underlying energy transition.

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Notes

1. This number is calculated based on the DOE greenhouse gas equivalent calculator: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.
2. The survey was conducted via Qualtrics in March 2019. Only MTurkers with a higher reputation (over 95% Approval Rate) are recruited, and are paid \$1 after they finish the survey. After excluding responses from the same IP address, we have 576 observations. Demographic variables appear to be balanced across treatment groups, except for income level, political party, and race (see Table A3 in Appendix).

3. Although each treatment group has different correction rates, the Chi-squared test shows no significant difference in the distribution of the rate across groups ($\chi^2_{(4)} = 4.40, p > .1$).
4. Following some scholars' suggestions (Angrist, 2006; Aronow, Baron, & Pinson, 2019; Gerber & Green, 2012), we also employ the instrumental variables method and analyze the full samples. By and large, the findings are quite similar (see Table SA4 in the Supplement).
5. Given this dependent variable's skewness, we also run the ordered logit model for both policy support and willingness to pay to check the result's robustness (see Table SA3 in the Supplementary information). Largely, the results are identical.
6. Some may have a concern that political party affiliation affects the assignment of intergovernmental policy responsibilities and attitudes toward environmental policy. Hence, we conduct a subgroup analysis, and the results are relatively similar to the overall pattern (see Table SA1 and SA2 in the Supplement).
7. Arguably, the solar PV program is targeted to reduce adverse environmental effects. That said, one might argue that if economic benefits are perceived to be the primary feature, policy support would be greater in the case of the statewide (vs. citywide) programs. The results of a pre-test (N=223 U.S. participants from Amazon's MTurk) support that economic benefits tend to be a concrete (feasible), but secondary feature of the program, while environmental benefits are primary, but abstract (See Supplement B).
8. In this experiment, we employ two-wave data collection processes, because after collecting the first wave sample, we realize that we may not have sufficient statistical power. It appears that the results of the two-wave sample may not exert great effects on our result, given the insignificant coefficient of the dummy variable for two-wave

respondents in the regression analysis (see Table 2). Detailed information is reported in Supplement C.

9. Similarly, this mean difference between groups shows that the respondents are more likely to support a solar PV program that could improve air quality, rather than one that increases job opportunities ($M_{Env/city}=8.02$, $M_{Eco/City}=7.25$, $t=-2.93$; $M_{Env/state}=7.80$, $M_{Eco/state}=7.20$, $t=-2.16$; see Table SC 11 in the Supplement).
10. We gauge political efficacy by asking two questions: The extent to which “each level of government cares what people like you think” and the extent to which “ordinary citizens like you can do a lot to influence the governments at different levels” (See Table SD2 in the Supplement). The Cronbach’s alpha yields a reliability coefficient of 0.83 for the responses to state political efficacy and 0.86 for those to local political efficacy. Hence, we average the responses to these two questions. Taking the difference between local and state political efficacy, we are able to detect political efficacy’s moderating effect.

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Appendix

Figure A1

Experimental Protocol

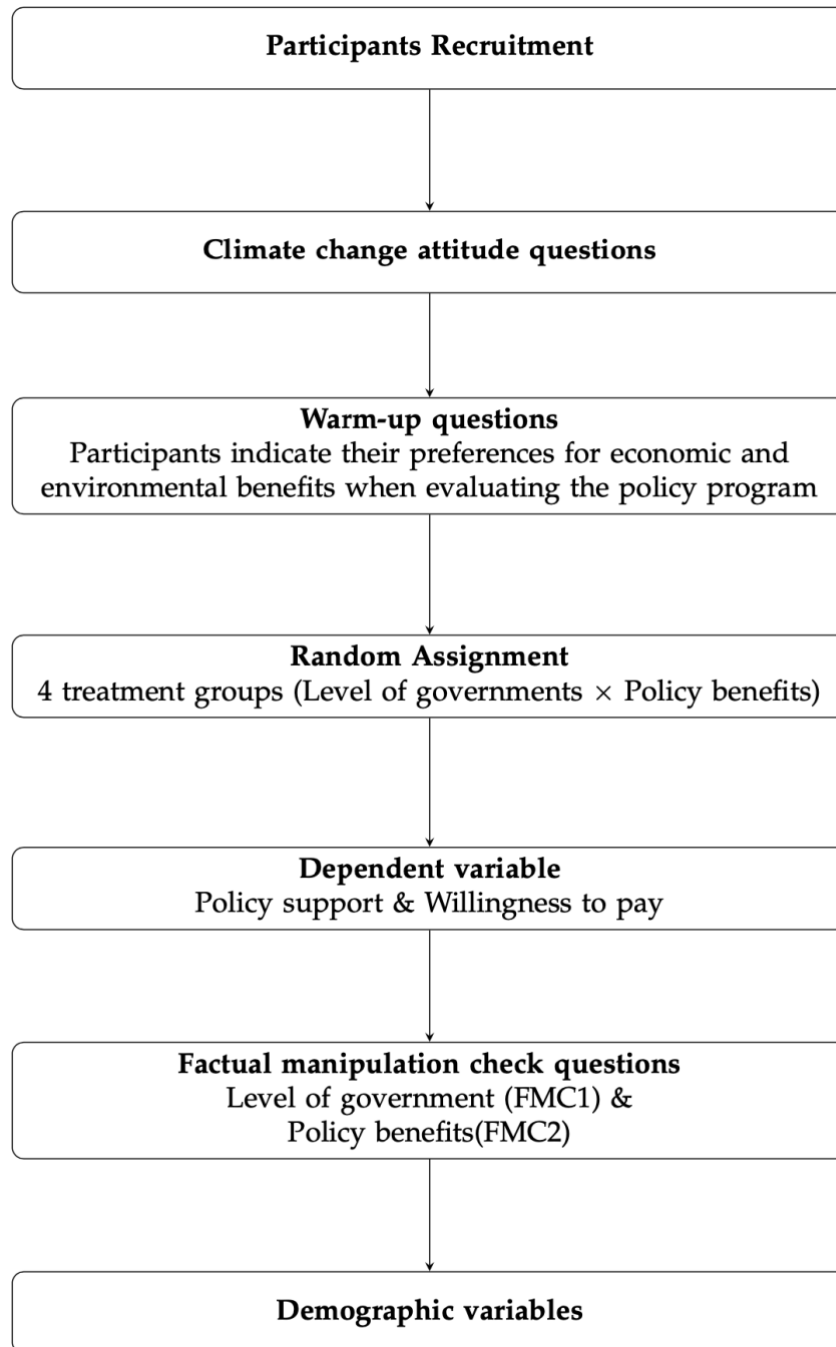


Table A1 Treatments

1. Local Economic framing

The City mayor of one of your neighboring city published one solar policy evaluation report. Please read it carefully and answer the following questions:

Policy Background

To address the negative impacts of carbon emission, such as air pollution, sea level rise, flooding, the city government has launched a voluntary program, “Go to Solar”. This program aims to increase the rate of photovoltaic (PV) installations to build energy-efficient homes.

Policy Program

Within the City, there are 5,000 voluntary households participating in the pilot program. Each household installs 40 photovoltaic panels in a 4.1-kW power system.

Policy Benefits

The city-wide impacts of “Go to Solar” program are positive and promising.

! Each PV system provides a household around 6,400 kWh of electricity per year.

! Each PV system saves a family \$433 a year on their energy bills.

! In aggregate, the installation of the PV system **directs more than \$2,165,000 dollars into city economy annually.**

2. Regional economic framing

The State governor of one of your neighboring state published one solar policy evaluation report. Please read it carefully and answer the following questions:

Policy Background

To address the negative impacts of carbon emission, such as air pollution, sea level rise, flooding, the city government has launched a voluntary program, “Go to Solar”. This program aims to increase the rate of photovoltaic (PV) installations to build energy-efficient homes.

Policy Program

Within the City, there are 5,000 voluntary households participating in the pilot program. Each household installs 40 photovoltaic panels in a 4.1-kW power system.

Policy Benefits

The city-wide impacts of “Go to Solar” program are positive and promising.
1 Each PV system provides a household around 6,400 kWh of electricity per year.

1 Each PV system saves a family \$433 a year on their energy bills.

1 In aggregate, the installation of the PV system **directs more than \$2,165,000 dollars into State economy annually.**

3. Local Environmental framing

The City mayor of one of your neighboring city published one solar policy evaluation report. Please read it carefully and answer the following questions:

Policy Background

To address the negative impacts of carbon emission, such as air pollution, sea level rise, flooding, the state government has launched a voluntary program, “Go to Solar”. This program aims to increase the rate of photovoltaic (PV) installations to build energy-efficient homes.

Policy Program

Within the State, there are 5,000 voluntary households participating in the pilot program. Each household installs 40 photovoltaic panels in a 4.1-kW power system.

Policy Benefits The state-wide impacts of “Go to Solar” program are positive and promising.

1 Each PV system provides a household around 6,400 kWh of electricity per year.

1 Each PV system reduces around 4-5 metric tons CO₂ emission per year.

1 In aggregate, the installation of PV system **leads to a City-wide reduction of around 25,000 metric tons annual CO₂ emission reduction, equivalent to 413,380 tree seedlings grown for 10 years.**

4. Regional environmental framing

The State governor of one of your neighboring state published one solar policy evaluation report. Please read it carefully and answer the following questions:

Policy Background

To address the negative impacts of carbon emission, such as air pollution, sea level rise, flooding, the state government has launched a voluntary program, “Go to Solar”. This program aims to increase the rate of photovoltaic (PV) installations to build energy-efficient homes.

Policy Program

Within the State, there are 5,000 voluntary households participating in the pilot program. Each household installs 40 photovoltaic panels in a 4.1-kW power system.

Policy Benefits

The state-wide impacts of “Go to Solar” program are positive and promising.

l Each PV system provides a household around 6,400 kWh of electricity per year.

l Each PV system reduces around 4-5 metric tons CO₂ emission per year.

l In aggregate, the installation of PV system **leads to a state-wide reduction of around 25,000 metric tons annual CO₂ emission reduction, equivalent to 413,380 tree seedlings grown for 10 years.**

Note: Technical terms and details are retrieved from DOE 2007 Policy report —“High-Performance Home Technologies: Solar Thermal & Photovoltaic System”.

Table A2 Variable Descriptions

Variables	Description
<i>Dependent Variable</i>	
Policy Support	What is your opinion of the government implementing this "Go to Solar" program in your area? (7-point Likert Scale)
Willingness to pay	Would you be willing to pay 100% of the expenses by yourself to install the PV system in your residential house if you are a house owner? (1-Yes; 0-No) (If No) What would be the minimum amount of financial subsidy that would be sufficient for you to install solar panels to your home if you are a house owner? (6-point Likert Scale)

<i>Factual Manipulation Check</i>	
Level of government	Which government published the solar policy evolution report?

Policy outcome	What kinds of policy benefits does the evaluation report focus on?
<i>Demographic characters</i>	
Gender	Categorical variable indicating if the respondent is male or female.
Income	Ordinal variable indicating respondent's annual income
Age	Continuous variable indicating respondent's age
Education	Variable indicating if the education level of respondent
Race	Categorical variable indicating if the respondent's race
Environmental preference	How important is a healthy environment to you for living in a city? (0-10 scale)
Economic preference	How important is a strong economic to you for living in a city? (0-10 scale)
Concern about climate change	In your opinion, how serious are the current impacts of global warming on your community? (7-point Likert Scale)
Political Ideology	0-10 scale indicating respondent's political ideology (from liberal to conservative)
Party Identity	Categorical variable indicating if the respondent is Democrat, Independent, or Republican
USA residents	Dummy variable indicating if the respondent lives in a state in the USA or not

Table A3: Descriptive statistics and randomization check test

	N	Mean	St. Dev.	Randomization check	
				<i>f</i>	<i>p</i> -value
Ideology (Liber)	576	6.502	2.840	0.904	0.439
Climate change concern	576	3.705	1.076	0.731	0.534
Economic preference	576	7.965	1.804	0.523	0.666
Environment preference	576	8.167	1.834	1.925	0.124
Env- Eco prefer	576	0.201	1.813	1.879	0.132
Age	576	2.970	1.645	1.923	0.125
Education	576	3.649	0.821	1.929	0.124
Income	576	3.917	1.753	2.760	0.042
				<i>Chi2</i>	<i>p</i> -value
USA Resident	576	0.821	0.384	3.939	0.268
<i>Gender</i>					
Female	576	0.401	0.491	5.594	0.133
Male	576	0.594	0.492	5.812	0.121
Others	576	0.005	0.072	--	--
<i>Race</i>					

White	570	0.668	0.471	9.780	0.021
Asian	570	0.218	0.413	7.426	0.059
Black	570	0.079	0.270	4.308	0.230
Others	570	0.035	0.184	--	--
<i>Party ID</i>					
Republicans	569	0.302	0.460	12.022	0.007
Democrats	569	0.452	0.498	7.416	0.060
Independent	569	0.227	0.419	1.912	0.591
Others	569	0.019	0.138	3.769	0.288

Table A4: Factual Manipulation Check

	FMC1 Correct		FMC2 Correct		All Correct		All Failed		Total
	N.	%	N.	%	N.	%	N.	%	Obs.
State, Eco	92	64.336	92	64.336	61	42.657	20	14.00	143
City, Eco	119	75.316	95	60.127	78	49.367	22	13.92	158
State, Env	89	65.926	106	78.519	73	54.074	13	9.63	135
City, Env	113	80.714	101	72.143	84	60.000	10	7.14	140
Total	413	71.701	394	68.403	296	51.389	65	11.284	576

Supplement

Supplement A: Experiment 1

Table SA1: Party ID subgroup analysis for policy support

Table SA2: Party ID subgroup analysis for willingness to pay

Table SA3: Ordered Logit Model for policy attitude toward the Solar PV program

Table SA4: Instrumental variable Method: Using treatment assignment as IV

Supplement B Follow-up Studies: Pre-test experiment

Table SB1: Treatment

Table SB2: Variable Descriptions

Table SB3: Importance and feasibility of policy outcomes of solar PV installation

Table SB4: Paired T-test for the priority of policy outcomes as the reason for supporting solar policies

Table SB5: Paired T-test for policy outcomes more likely to be obtained

Table SB6: Assignment of policy responsibility to the state and city government

Table SB7: Assignment of policy responsibility to the state and city government

Supplement C Follow-up studies: Experiments 2

Table SC1: Treatments

Table SC2: Variable descriptions

Table SC3: Descriptive statistics and randomization check

Table SC4: Factual Manipulation Check

Table SC5: Descriptive statistics and randomization check of the first wave data

Table SC6: Factual Manipulation Check of the first wave data

Table SC7: Policy Attitude of the first wave data

Table SC8: Descriptive statistics and randomization check of the second wave data

Table SC9: Factual Manipulation Check of the second wave data

Table SC10: Policy Attitude of the second wave data

Table SC11: Policy Attitude of the first and second wave data

Supplement D Follow-up studies: Experiments 3

Table SD1: Treatments

Table SD2: Variable descriptions

Table SD3: Descriptive statistics and Randomization check

Table SD4: Factual Manipulation Check