Honor, goal setting, and energy conservation[a]

Running title: Honor, goal setting, and energy conservation

Botao Qin

Jinhe Center for Economic Research, Xi'an Jiaotong Universiy, China

Siyuan Xie

Jinhe Center for Economic Research, Xi'an Jiaotong Universiy, China

Chenyang Xu

Department of Economics, University of Massachusetts Lowell

[a] *Corresponding author:* Botao Qin, Jinhe Center for Economic Research, Xi'an Jiaotong University, No 28 West Xianning Road, Xi'an, Shaanxi China. 710049. bqinecon@mail.xjtu.edu.cn

HONOR, GOAL SETTING, AND ENERGY CONSERVATION

ABSTRACT. Non-monetary incentives are becoming increasingly popular in energy conservation. In light of this, we conducted a natural field experiment in student dormitories to assess the effect of honor-based incentives and goal setting on electricity saving and the intrinsic motivation to save energy. Using a difference-in-difference model, we found that honor-based incentives and goal setting reduced the dormitories' electricity consumption by 10.80% and 15.93%, respectively, compared to the control group. In addition, the study found that both honor-based incentives and goal setting, on average, did not crowd out the intrinsic motivation to save electricity in dormitories. The heterogeneity analysis showed that the more the dormitory values honor incentives, the more its intrinsic motivation was crowded in by honor incentives. We also found dormitory characteristics affect the crowding effect on intrinsic motivation.

Keywords: Honor; Goal setting; Electricity use; Crowding effect

JEL classification: C93; D10; Q41

Acknowledgment: Funding for the project has been provided by China's Ministry of Education Humanities and Social Science Research Youth Fund. Grant Number: 19YJC790104.

Conflict of interest: None

1. **Introduction**

Literature from both economics and psychology suggests that behavioral interventions can be powerful environmental instruments. Non-monetary measures are relatively inexpensive compared to, for example, subsidies and do not infringe on people's liberty of choice as much as, for example, taxes. Consequently, both academics and practitioners view behavioral interventions as potential cost-effective complements for the traditional price instruments (Andor and Fels, 2018; Allcott, 2015; Allcott and Mullainathan, 2010). Many studies have also documented the crowding effects of monetary instruments (see Rode et al. (2015) for a review), but less attention is paid to the crowding effects of non-monetary interventions. How does the intrinsic motivation and non-monetary incentives interact? This question is important, as the literature found that the crowding effects could be so large as to render the traditional price incentives counter-productive (Cardenas et al., 2000; Velez et al., 2010).

This paper takes up the tasks of examining both *the effectiveness and the crowding effects* of two types of non-monetary incentives in society—Honor and Goal setting—in inducing energy conservation. Honor is also a widely used incentive tool in many societies. For example, most countries do not pay blood donors for their blood donations because doing so would crowd out the civic spirit of voluntary blood donations (Titmuss, 1970). Rather, it is common practice to award blood donors with blood donation certificates or symbolic souvenirs. Similarly, in China, the government awards "civilized city" titles to cities that perform well in terms of economy, environmental performance, and governance. How effective, though, are honor-based incentives in environmental protection? And what impact do honor-based incentives have on people's intrinsic motivation to protect the environment? These are open questions that require more research.

Goal setting is often used as a commitment device to overcome present bias — people have a tendency to delay the present tasks later. Setting a personal goal also targets reference-dependent

preference: individuals evaluate their success or failure based on a predetermined level. This increases pressure by conditioning satisfaction on a desired level of performance. Some studies have found that setting a goal can affect households' electricity consumption behavior. Harding and Hsiaw (2014), for instance, studied an energy-saving project in Illinois, USA, and found that residents saved an average of 4% of their electricity use. The savings were heterogeneous, with households that set realistic goals saving more electricity than others.

To identify the causal effects, we designed a field experiment at Xian Jiaotong University in China in the context of energy savings in student dorms. Students' energy consumption in tertiary institutions accounts for a large portion of national energy use (Zhou et al., 2021; Ding et al., 2018). Of all energy consumption in university buildings, dormitory electricity use accounts for a large proportion (Zhou et al., 2021). In addition, in Chinese schools, honors are frequently used to encourage people to achieve better grades, extra-curricular activities, etc. Goal setting is also often used in students' semester plans. These nonmonetary incentives are thus not unfamiliar to students and have the potential to be applied in energy conservation.

We randomly selected two treatment groups—one of which was asked to set goals and one that was presented with honor-based incentives—and a control group. After 16 weeks of experiments, using the difference-in-difference (DID) method, we found that, compared with the control group, the honor and goal-setting groups reduced their average electricity consumption by 10.80% and 15.93%, respectively. We did not observe a crowd-in/crowd-out effect on the intrinsic motivation of dormitory energy conservation.

Our paper differs from previous literature in nudging energy conservation in two ways. First, ours are among the first studies that examine honor-based incentives and goal setting on people's *intrinsic motivation* to conserve energy. Secondly, although previous literature such as Harding and Hsiaw (2014) and Lazaric and Toumi (2022) has tested the effect of goal setting on energy

conservation, the effect of honor-based incentives on energy conservation has rarely been studied with experiments.

The structure of the paper is organized as follows: in section two, we briefly review the literature and formulate the hypotheses; in sections three and four, we report the experimental design and results; and in section five, we conclude the paper.

2. **Literature review and hypotheses formulation**

People respond to non-monetary incentives, such as honor-based incentives, because they care about cultivating an image of themselves as civic-minded and responsible citizens (Benabou and Tirole, 2003; Bénabou and Tirole, 2006). Ariely et al. (2009), for instance, found that people behaved prosocially in a charity-giving field experiment in order to boost their public image. Similarly, Delmas and Lessem (2014) found that public information about dormitories' conservation rating combined with private information about electricity use and social norms reduced electricity consumption by 20% but that private information alone did not work. Several other studies found that people engage in more environmentally conscious behavior when their actions are being observed by others (Barclay and Barker, 2020; Griskevicius et al., 2010; Sexton and Sexton, 2014; Ernest-Jones et al., 2011). In addition, Kraft-Todd et al. (2015) reviewed evidence in the field and found that social interventions based on observability are highly effective in promoting cooperation. We can speculate, then, that honor-based incentives can reduce residents' electricity consumption, which leads us to propose our first hypothesis:

Hypothesis 1: Honor-based incentives can reduce the electricity consumption of dormitories.

Goal setting is a commonly used commitment tool to encourage energy saving. Review studies, such as those of Abrahamse and Steg (2013), Nisa et al. (2019), and Lokhorst et al. (2013), found commitment to be effective in promoting energy saving. However, Vesely et al. (2022) reviewed a

wide range of field experiments and concluded that the effects of commitment-based interventions in energy conservation are almost zero. In addition, evidence from Harding and Hsiaw (2014) and Lazaric and Toumi (2022) suggests that setting a goal, especially a realistic goal, can reduce the electricity consumption of residents. Based on this, we propose our second hypothesis:

Hypothesis 2: Goal setting can reduce electricity consumption in dormitories.

Previous studies have found that monetary incentives may crowd out people's intrinsic motivation (see Fehr and Falk (2002), Frey and Jegen (2001), and Bowles (2008) for a literature review). By contrast, non-monetary incentives, such as verbal and positive feedback, can crowd in people's intrinsic motivation. In addition, when incentives are perceived as supportive rather than controlling, they will crowd in people's intrinsic motivations (Deci, 1971; Deci et al., 1999; Lepper et al., 1973). Therefore, we propose the following hypotheses:

Hypothesis 3: Honor-based incentives can crowd in the intrinsic motivation to conserve energy in dormitories.

Hypothesis 4: Goal setting can crowd in the intrinsic motivation to conserve energy in dormitories.

3. **Design of Experiments**

We selected three student dormitory buildings at Xi'an Jiaotong University and used two of them as the control group and the third as the treatment group. The dormitories comprising the treatment group were randomly divided into the honor-based-incentives group and goal-setting group. We received permission from the university's logistics energy department to conduct the experiment and obtained electricity consumption data for the dormitories from them. The experiment lasted 16 weeks and was divided into three stages. The first four weeks comprised the first stage (the pre-treatment stage) and ran from October 1st to October 31st. The middle four weeks made up

the second stage (the treatment stage) and ran from November 1st to December 1st, during which time the dormitories received their respective treatments. The last eight weeks were the third stage (the post-treatment stage), for which we stopped the respective treatments. By employing this three-stage design, we were able to identify the effect of the corresponding treatment on the intrinsic motivation of dormitory electricity consumption. During week 5, we conducted a four-week "Dormitory Energy Saving" activity in selected dormitories and placed poster boards at the entrance of the dormitories. Then, on October 30th and 31st, we knocked door by door to inform the students of the activity and distribute different energy-saving leaflets to them. The contents of the flyer for the honor-based-incentives group and the goal-setting group were different, as shown in the appendix.

For the honor-based-incentives group, the experimenter informed each dormitory that, after the event, the top 20% of dormitories with outstanding electricity-saving performance would be issued honorary certificates and that this outcome would be publicized. For the goal-setting group, the experimenter set the electricity saving target at 15% of each dormitory's total electricity consumption in the first four weeks. The choice of this target was based on the research of Harding and Hsiaw (2014) and Lazaric and Toumi (2022)—that is, goals that are too high can be difficult to achieve, resulting in dormitories lacking sufficient motivation to save electricity, while targets that are too low will be too easy to reach and will therefore not help save electricity. The experimenter then informed all dormitories of their first-stage electricity consumption. For the goal-setting group, experimenters gave weekly feedback on the electricity consumption of each dormitory so that it could be compared with the electricity consumption in the first stage. At the end of the second stage, the experimenters informed each dormitory whether it had achieved the goal of saving electricity, with the dormitories that achieved their goals being awarded a USB flash drive engraved with "energy-saving dormitory". For the honor-based-incentives group, the experimenters announced the top 20% of dormitories with good energy-saving performance after the second stage and awarded them

honorary certificates. The third stage then ran from February 13th to April 14th. Due to the COVID-19 pandemic, students returned to their hometowns earlier than anticipated after the second stage, meaning the electricity consumption of the dormitories was close to zero. We therefore chose the new semester after students returned to campus as the third stage.

At the end of the third stage, the experimenters obtained weekly electricity consumption data from the three groups through the logistics energy department. In addition, the experimenters distributed corresponding questionnaires to each dormitory to collect data on their electricity use habits and electrical appliance usage. The timeline of the experiment is shown in the following table.

TABLE I. Experimental design

Group number	Intervention	First stage	Second stage and intervention	Third stage
G1	Honor	Week 1-4	Week 5-8	Week 9-16
G2	Goal setting	Week 1-4	Week 5-8	Week 9-16
G3	None	Week 1-4	None	Week 9-16

4. **Results**

4.1. *Summary statistics*

Table II lists the electricity consumption for each week of the first stage for the control and treatment groups, including the mean, median, and standard deviation, respectively. To test whether the initial allocation of the experiment was random, we used the Mann-Whitney test. Table III reports the results of pairwise comparisons between groups. From this, we can see that there are no significant differences between the groups' electricity consumption, which means we can assume that the control group and the treatment groups are randomly assigned.

Figure 1 shows the changes in electricity consumption for all three groups at each stage. We can see that the electricity consumption trend of each group in the first stage was similar: as

TABLE II. Weekly electricity consumption of each group in the first stage (in kWh)

Group number	Week 1	Week 2	Week 3	Week 4
G1 (n=77)	23.1	19.6	17.5	16.2
	18.4	15.6	16.8	14.4
G2 (n=77)	23.9	20.6	18.5	17.1
	20.0	16.1	15.8	13.7
G3 (n=77)	23.0	19.5	17.9	16.2
	18.6	16.9	17.5	15.8

Notes: For each group, the upper and lower numbers are mean and median, respectively.

TABLE III. Mann-Whitney test results

	First week	Second week	Third week	Fourth week
G1 and G3	0.937	0.895	0.961	0.490
G2 and G3	0.518	0.643	0.987	0.702
G1 and G2	0.531	0.450	0.460	0.367

temperature increased after the first week, the electricity consumption of all the groups tended to decline. Then, in weeks 5 and 6 of the second stage, the electricity consumption of the control group began to rise, but the electricity consumption of the honor-based-incentives group and goal-setting group continued to decline. Relative to the control group, the honor-based-incentives and goal-setting groups both saw a decrease in electricity consumption, but by weeks 7 and 8, the trend of electricity consumption in each group became similar. Finally, in the third stage, the trend of electricity consumption across all the groups was similar, which suggests that, in the early stage of treatment, the treatments reduced energy consumption. However, this effect did not persist later in the treatment and, after the treatment, it was canceled out.

4.2. *Parallel trend test*

Before performing the DID, we had to first ensure that the electricity consumption of the treatment group and control group had a parallel trend. To do this, we used the following model for testing:

$$Y_{it} = \beta_0 + \sum_{j=2}^{4} \beta_{j1} * g_i * pre_{-j} + \sum_{j=1}^{3} \beta_{j2} * g_i * post_j + \beta_i * current_i + \epsilon_{ij} \tag{1}$$

where the variable pre_{-j} was the time dummy for the jth period before the treatment occurred, and pre_{-1} was the base period. $post_j$ was a dummy variable for the jth period after the treatment, and *current* was a dummy variable when the treatment occurred. g_i was a dummy variable for the treatment: if individual i was treated, the variable was 1, otherwise it was 0. The coefficient β_{j1} of the interaction term $g_i pre_{-j}$ reflected the pre-intervention difference between the treatment group and the control group. If β_{j1} was not significantly different from 0, it met the parallel trend assumption. Fig 2 shows the regression coefficient and 95% confidence interval of the parallel trend test. From this, we can see that before treatment there was no significant difference in the weekly electricity consumption across all three groups, meaning the parallel trend assumption was met.

4.3. *Average treatment effect and crowding effect*

We used the following DID model to analyze the treatment effect and crowding effect.

$$Y_{it} = \mu + \lambda_i + \beta_{n1} * week_{n2} * g_{i1} + \beta_{n2} * week_{n2} * g_{i2} + \beta_{m1} * week_{m3} * g_{i1} + \beta_{m2} * week_{m3} * g_{i2} + \beta_n * week_{n2} +$$

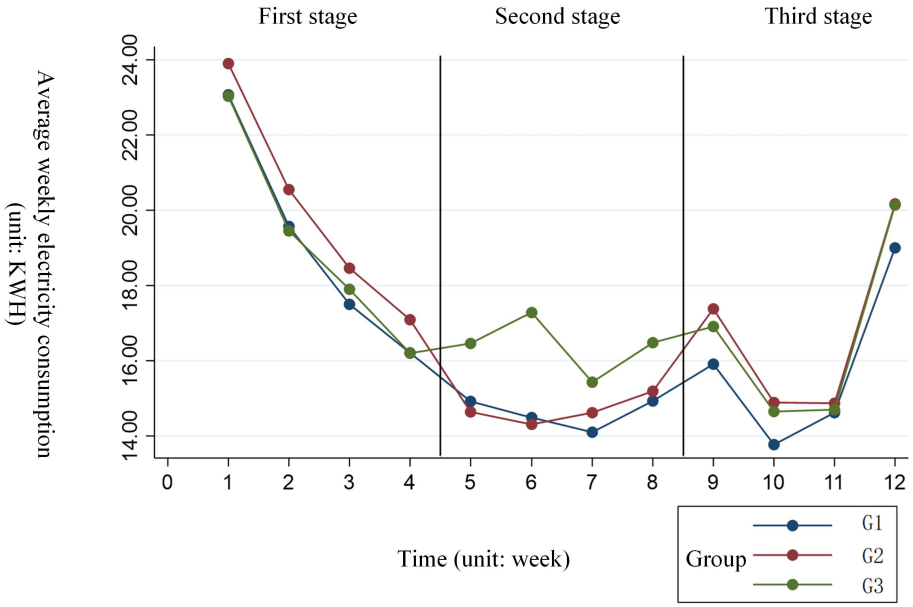

FIGURE 1. Average weekly electricity consumption of the treatment and control groups

$$\beta_m * week_{m3} + \beta_7 * g_{i1} + \beta_8 * g_{i2} + \epsilon_{it} \quad (2)$$

where $week_{n2}$ was the dummy variable for the week corresponding to the second stage (n=5,6,7,8), for example, if it was in week 5, then n=5, $week_{52} = 1$, otherwise 0. $week_{m3}$ was the dummy variable (m=9 to 16) for the week corresponding to the third stage, for example, if it was in week 9, then m=9, $week_{93} = 1$, otherwise 0. β_{n1} represented the average treatment effect of honor-based incentives on dormitory electricity consumption and β_{n2} represented the average treatment effect of goal setting on dormitory electricity consumption. Meanwhile, β_{m1} and β_{m2} represented the crowding effect of honor and goal setting on the intrinsic motivation of dormitory energy conservation. If the coefficient was positive (negative), it indicated that the treatment crowded out (in) the intrinsic motivation to save energy in dormitories. The estimated results of the DID model are shown in Tables IV and V.

As can be seen from the table above, the coefficients for the interaction terms $Week_{n2}g_{i1}$ and $Week_{n2}g_{i2}$ were negative for each week of the second stage. For the honor-based-incentives group, the treatment reduced the electricity consumption of the dormitory by 2.740 degrees in the sixth week—a decrease that was statistically significant at the level of 1%. The decrease was 15.86% compared with the electricity consumption of 17.28 degrees in the control group. Meanwhile,

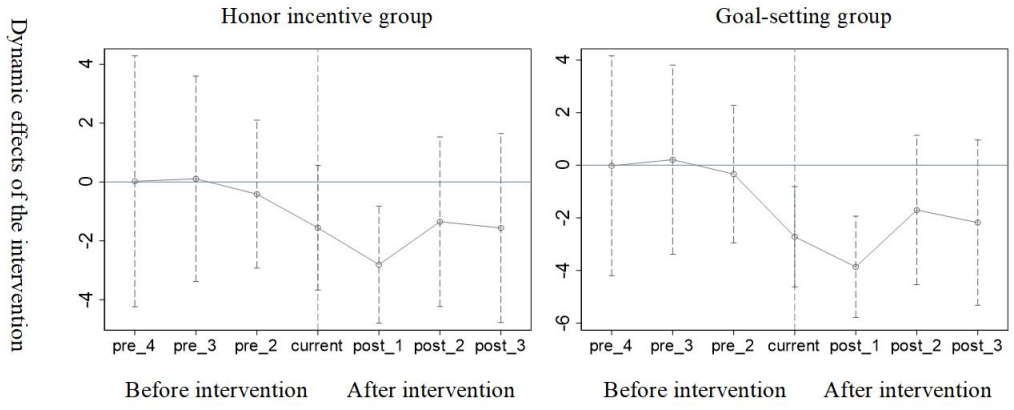

FIGURE 2. Parallel trend test coefficient and confidence interval

TABLE IV. Estimation results of the second-stage DID random-effects model

Interaction terms	Week 5	Week 6	Week 7	Week 8
$Week_{n2} * g_{i1}$	-1.487	-2.740***	-1.279	-1.492
	(1.193)	(0.908)	(1.331)	(1.295)
$Week_{n2} * g_{i2}$	-2.681**	-3.827***	-1.666	-2.144
	(1.185)	(0.938)	(1.302)	(1.353)
$Week_{n2}$	-2.680***	-1.859***	-3.710***	-2.667***
	(1.028)	(0.665)	(1.041)	(1.068)
Obs.	3696	3696	3696	3696
Number of dormitory	231	231	231	231

Notes: Robust standard errors are in parentheses. $*p < 0.1; * * p < 0.05; * * *p < 0.01$.

for the goal-setting group, there was a decrease in electricity consumption by 2.681 and 3.827 kWh in weeks 5 and 6, respectively, which were statistically significant at the level of 1% and 5%, respectively. Relative to the electricity consumption of the control group at 16.46 and 17.28 degrees in weeks 5 and 6, the decreases were 16.29% and 22.15%, respectively. In addition, the Wald test was performed on the regression coefficients of $Week_{n2}g_{i1}$ and $Week_{n2}g_{i2}$ in week 6 and indicated no significant difference ($\chi^2 = 1.44, p = 0.2307$). Thus, in the second week after treatment, the effects of honor-based incentives and goal setting were found to be similar. In the last two weeks after the implementation of the honor-based incentives, the electricity consumption of the dormitory decreased by 1.279 and 1.492 kWh, respectively, but these drops were not statistically significant; meanwhile, in the last two weeks after the implementation of the goal setting, the electricity consumption of the dormitory decreased by 1.666 and 2.144 kWh, respectively, but again the drops were not statistically significant. In addition, we also changed the model settings to determine progress according to each stage, rather than according to weeks. We found that, in the second stage, the honor-based incentives group reduced its electricity usage by an average of 1.750 kWh, while the goal-setting group reduced its usage by 2.580 kWh. Thus, the average treatment effects of honor-based incentives and goal setting were 10.80% and 15.93%, respectively, which supports hypotheses 1 and 2, which state that honor-based incentives and goal setting can

reduce dormitory electricity consumption. Furthermore, Allcott (2011) found that regularly sending home energy reports with social comparison information helped to reduce household electricity use by an average of 2.0%. Moreover, Magali and Doctori (2010) conducted a meta-analysis to assess the impact of different types of information interventions on energy-saving behavior. They found that the average treatment effect of information-based strategies was 7.4%, while for high-quality experiments, the treatment effect was only 2%. Therefore, the honor-based incentives and goal setting in this study exhibit a greater treatment effect on electricity saving than that seen in previous studies.

TABLE V. Third-stage DID random-effects model estimation results

Interaction terms	Week 9	Week 10	Week 11	Week 12
$Week_{m3} * g_{i1}$	-0.94	-0.821	-0.021	-1.088
	(1.536)	(1.372)	(1.299)	(2.478)
$Week_{m3} * g_{i2}$	-0.385	-0.62	-0.688	-0.831
	(1.981)	(1.640)	(1.350)	(2.836)
$Week_{m3}$	-2.236*	-4.493***	-4.446***	1.002
	(1.255)	(1.139)	(1.010)	(1.988)
Obs.	3696	3696	3696	3696
Dormitory number	231	231	231	231

Notes: Robust standard errors are in parentheses. $*p < 0.1; **p < 0.05; ***p < 0.01$

Table V shows that in the weeks of the third stage, the coefficients of the interaction terms $Week_{m3}g_{i1}$ and $Week_{m3}g_{i2}$ were negative but not statistically significant. We therefore reject hypotheses 3 and 4 as we have no evidence to support the crowding effect of honor-based incentives and goal setting on the intrinsic motivation to save energy in dormitories.

4.4. *Heterogeneous treatment effect and crowding effect*

After the experiment, we collected the characteristics and electricity use habits of each dormitory through an online questionnaire. We also collected the average temperature for each week of the experiment. In addition, for the dormitories of the honor incentive group and the control group, we distributed a questionnaire about the attitude towards honor; For dormitories in the goal-setting

group, we distributed questionnaires about their views on setting goals. These questionnaires all included 5 questions, each with three options, representing negative, moderate, and positive, to which we assigned scores 0, 1, and 2, respectively. The total score of the five questions represented each dormitory's perception of honor and goal setting. The higher the score, the more honor and goal-setting the dormitory values. Table VI reports descriptive statistics on dormitory characteristics and electricity use habits.

TABLE VI. Summary statistics of dormitory characteristics

Variables	Mean	Standard deviation	Maximum	Minimum	Sample size
Number of permanent residents	2.791	0.418	3	1	220
The total number of high-power electrical appliances	2.205	1.635	6	0	220
Total number of computers and tablets	4	1.023	6	0	220
Number of days using air conditioner per month	10.76	6.688	26	0	220
Whether to turn off the lights when no one is around	0.682	0.466	1	0	220
Whether to turn off the air conditioner when sleeping at night	0.655	0.476	1	0	220
Average weekly temperature (Celsius)	11.45	3.704	17.8	3.9	16
Attitude towards goals and feedback	7.519	2.711	10	0	77
The degree of importance attached to honor	7.175	2.471	10	2	143

To explore the heterogeneity of honor incentives, we modified the previous DID model to include variables about the importance of honors.

$$Y_{it} = \mu + \lambda_i + \beta_1 pre_{i2} g_{i1} + \beta_2 post_{i3} g_{i1} + \beta_3 pre_{i2} + \beta_4 post_{i3} + \beta_5 g_{i1} + \beta_6 Honor_i + \beta_7 Honor_i g_{i1} + \beta_8 Honor_i pre_{i2} + \beta_9 Honor_i post_{i3} + \beta_{10} Honor_i pre_{i2} g_{i1} + \beta_{11} Honor_i post_{i3} g_{i1} + \epsilon_{it} \quad (3)$$

where $Honor_i$ is the total demeaned score of the dormitory i for the importance of honors. The coefficients β_{10} and β_{11} of the triple interaction term indicate the influence of the dormitory's value on honor on the treatment effect of honor incentive, and the influence on the crowding effect of

intrinsic motivation of energy saving, respectively. The estimated results of the equation 3 are shown in table VII. The coefficient of the triple interaction term $Honor_i pre_{i2} g_{i1}$ is -2.245, and it is statistically significant at the 1% significance level. Therefore, the more the dormitory values honor, the better the electricity-saving effect of honor incentives. The coefficient for the triple interaction term $Honor_i post_{i3} g_{i1}$ is -2.351 and is statistically significant at the 1% significance level. Therefore, the value of honor in the dormitory will enhance the crowding effect of honor incentives on the intrinsic motivation of electricity saving.

TABLE VII. Estimation of heterogeneity of honor incentives

Variables	Average treatment effect
$Honor_i pre_{i2} g_{i1}$	-2.245***
	0.294
$Honor_i post_{i3} g_{i1}$	-2.351***
	(0.398)
$Honor_i$	-0.498
	(0.418)
$Honor_i g_{i1}$	2.484***
	(0.637)
$Honor_i pre_{i2}$	0.898***
	(0.218)
$Honor_i post_{i3}$	0.885***
	(0.280)
$pre_{i2} g_{i1}$	-1.447
	(0.888)
$post_{i3} g_{i1}$	-0.346
	(1.076)
pre_{i2}	-2.638***
	(0.774)
$post_{i3}$	-1.954**
	(0.854)
g_{i1}	-1.203
	(1.584)
Constant	19.709***
	(1.152)
Observations	2288
Number of dormitories	143

Notes: Robust standard error in parentheses.
$*p < 0.1 * *p < 0.05 * * * p < 0.01$

Next, we explore the influence of dormitories' characteristics and electricity use habits on the crowding effect of honor and goal setting. We replace $Honor_i$ in the equation 3 with C_i, i.e. dormitory characteristics and electricity use habits. We demeaned the continuous characteristic variables. The table shows the results of the influence of each characteristic on the crowding effect

of honor incentive and goal setting. In model 1, the coefficient of the triple interaction term in the goal-setting group is significantly negative, so the more high-electricity appliances in the dormitory, the intrinsic motivation for energy saving is more likely to be crowded in by the goal setting. In Model 2, the coefficients of the triple interaction term in the honor incentive and goal-setting groups are both significantly negative, so the more computers and tablets in the dormitory, the more likely the energy-saving intrinsic motivation is crowded in. In Model 3, the coefficient of the triple interaction term in the goal-setting group is significantly positive, so the more permanent residents in the dormitories, the more energy-saving intrinsic motivation is likely to be crowded out by the goal-setting. In both models 4 and 6, the coefficients of the triple interaction term in both the goal setting and honor incentive groups were significantly negative, so the more days dormitories use air conditioning, or the dormitories with the habit of turning off the air conditioning at night, their intrinsic motivation for energy saving was more likely to be crowded in. Models 5 and 7 found that whether lights were turned off when no one was present and the temperature had no effect on the intrinsic motivation of energy saving in dormitories.

4.5. *Robustness test*

We used a double-randomized placebo test to determine whether unobserved features affected the results. We randomly sampled 3000 times for the treatment stage pre_{i2} and the interaction item $pre_{i2}g_{i1}$ and $pre_{i2}g_{i2}$ for the treatment stage, respectively. The kernel densities of the estimated coefficients for the two treatments are shown in Figure 3. From this, we can see that the estimated coefficients conformed to normal distributions and had a mean of 0. Therefore, the placebo test was valid.

5. **Conclusion**

Although price instruments are useful policy tools, they also suffer from certain limitations, such as the political difficulty of raising electricity prices and the crowding-out effect of monetary incentives on people's intrinsic motivation. By contrast, non-monetary incentives, such as the sending of social comparison information, information feedback, and goal setting, are proving to be increasingly effective and are now being applied to the conservation of energy and natural resources. In light of this, in this study, we designed a natural field experiment of electricity saving across three student dormitories to assess the effect of honor-based incentives and goal setting on dormitory electricity saving and the intrinsic motivation to save energy. Using a DID model, we found that both honor-based incentives and goal setting can effectively reduce electricity consumption in dormitories, with the electricity saving effect reaching 10.80% and 15.93%, respectively, compared with the control group. In addition, the study also found that both honor-based incentives and goal setting, on average, did not crowd out the intrinsic motivation to save energy in dormitories. The heterogeneity analysis found that the more the dormitory values honor incentives, the more its intrinsic motivation was crowded in by honor incentives. When the number of computers and tablets in the dormitory

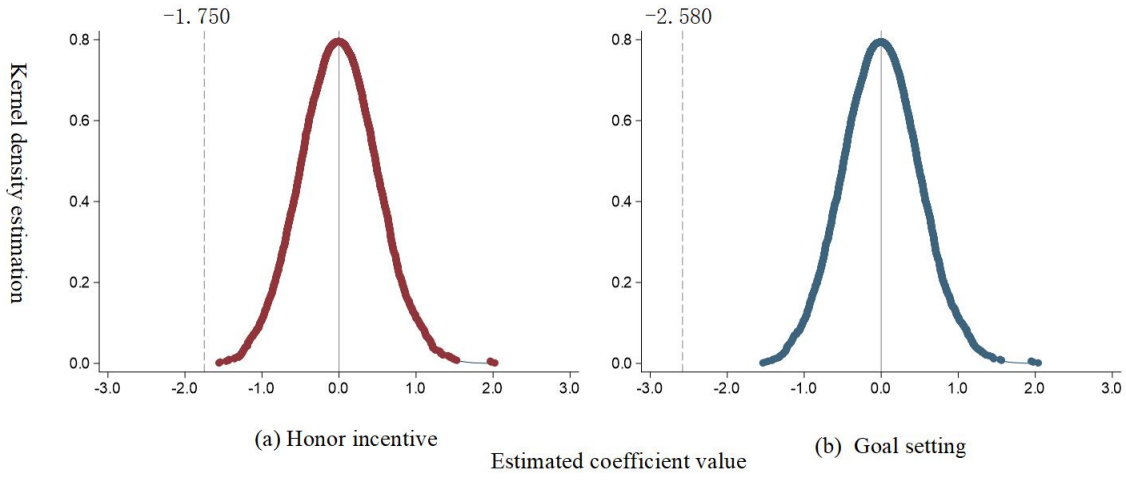

FIGURE 3. Estimation coefficient kernel density distribution

is more, the more days it uses the air conditioner, or the habit of turning off the air conditioner at night, its energy-saving intrinsic motivation is more likely to be crowded in by honor incentives and goal setting; When there are more high-electricity appliances in the dormitory, its intrinsic motivation is more likely to be crowded in by the goal setting; When the dormitory has more permanent residents, its intrinsic motivation for energy conservation is more likely to be crowded out by the goal setting.

The findings of this study provide evidence for the real-world application of honor-based incentives and goal setting as tools for reducing energy use. It should be noted, though, that our research suffers from some limitations. For instance, we carried out the study in student dormitories, but the electricity consumption of student dormitories is small compared to that of ordinary households. Therefore, the broader validity of our results still needs to be tested. In addition, future research can compare the differences between externally set and self-set goals.

References

Abrahamse, W. and Steg, L. (2013). Social influence approaches to encourage resource conservation: A meta-analysis. *Global Environmental Change*, 23(6):1773–1785.

Allcott, H. (2011). Social norms and energy conservation. *Journal of Public Economics*, 95(9):1082–1095.

Allcott, H. (2015). Site selection bias in program evaluation. *The Quarterly Journal of Economics*, 130(3):1117–1165.

Allcott, H. and Mullainathan, S. (2010). Behavior and energy policy. *Science*, 327(5970):1204–1205.

Andor, M. A. and Fels, K. M. (2018). Behavioral economics and energy conservation–a systematic review of non-price interventions and their causal effects. *Ecological economics*, 148:178–210.

Ariely, D., Bracha, A., and Meier, S. (2009). Doing good or doing well? image motivation and monetary incentives in behaving prosocially. *American Economic Review*, 99(1):544–55.

Barclay, P. and Barker, J. L. (2020). Greener than thou: people who protect the environment are more cooperative, compete to be environmental, and benefit from reputation. *Journal of Environmental Psychology*, 72:101441.

Benabou, R. and Tirole, J. (2003). Intrinsic and extrinsic motivation. *Review of Economic Studies*, 70(3):489–520.

Bénabou, R. and Tirole, J. (2006). Incentives and prosocial behavior. *American economic review*, 96(5):1652–1678.

Bowles, S. (2008). Policies designed for self-interested citizens may undermine "the moral sentiments": Evidence from economic experiments. *Science*, 320(5883):1605–1609.

Cardenas, J. C., Stranlund, J., and Willis, C. (2000). Local environmental control and institutional crowding-out. *World development*, 28(10):1719–1733.

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *J of Personality & Social Psychology*, 18(1):105–115.

Deci, E. L., Koestner, R., and Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, 125(6):692–700.

Delmas, M. A. and Lessem, N. (2014). Saving power to conserve your reputation? the effectiveness of private versus public information. *Journal of Environmental Economics and Management*, 67(3):353–370.

Ding, Y., Zhang, Z., Zhang, Q., Lv, W., Yang, Z., and Zhu, N. (2018). Benchmark analysis of electricity consumption for complex campus buildings in china. *Applied Thermal Engineering*, 131:428–436.

Ernest-Jones, M., Nettle, D., and Bateson, M. (2011). Effects of eye images on everyday cooperative behavior: a field experiment. *Evolution and Human Behavior*, 32(3):172–178.

Fehr, E. and Falk, A. (2002). Psychological foundations of incentives. *European Economic Review*, 46(4):687–724.

Frey, B. S. and Jegen, R. (2001). Motivation crowding theory. *Journal of Economic Surveys*, 15(5):589–611.

Griskevicius, V., Tybur, J. M., and Van den Bergh, B. (2010). Going green to be seen: status, reputation, and conspicuous conservation. *Journal of personality and social psychology*, 98(3):392.

Harding, M. and Hsiaw, A. (2014). Goal setting and energy conservation. *Journal of Economic Behavior & Organization*, 107:209–227.

Kraft-Todd, G., Yoeli, E., Bhanot, S., and Rand, D. (2015). Promoting cooperation in the field. *Current Opinion in Behavioral Sciences*, 3:96–101.

Lazaric, N. and Toumi, M. (2022). Reducing consumption of electricity: A field experiment in monaco with boosts and goal setting. *Ecological Economics*, 191:107231.

Lepper, M. R., Greene, D., and Nisbett, R. E. (1973). Undermining children's intrinsic interest with extrinsic reward: A test of the "overjustification" hypothesis. *Journal of Personality & Social Psychology*, 28(1):129–137.

Lokhorst, A. M., Werner, C., Staats, H., van Dijk, E., and Gale, J. L. (2013). Commitment and behavior change: A meta-analysis and critical review of commitment-making strategies in environmental research. *Environment and Behavior*, 45(1):3–34.

Magali, D. and Doctori, B. V. (2010). Measuring corporate environmental performance: the trade-offs of sustainability ratings. *Business Strategy and the Environment*, 19(4):245–260.

Nisa, C. F., Bélanger, J. J., Schumpe, B. M., and Faller, D. G. (2019). Meta-analysis of randomised controlled trials testing behavioural interventions to promote household action on climate change. *Nature Communications*, 10(1):4545. Number: 1 Publisher: Nature Publishing Group.

Rode, J., Gómez-Baggethun, E., and Krause, T. (2015). Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. *Ecological Economics*, 117:270–282.

Sexton, S. E. and Sexton, A. L. (2014). Conspicuous conservation: The prius halo and willingness to pay for environmental bona fides. *Journal of Environmental Economics and Management*, 67(3):303–317.

Titmuss, R. M. (1970). The gift relationship. from human blood to social policy. *Medical Care*, 11(3):261–263.

Velez, M. A., Murphy, J. J., and Stranlund, J. K. (2010). Centralized and decentralized management of local common pool resources in the developing world: experimental evidence from fishing communities in colombia. *Economic Inquiry*, 48(2):254–265.

Vesely, S., Klöckner, C. A., Carrus, G., Tiberio, L., Caffaro, F., Biresselioglu, M. E., Kollmann, A. C., and Sinea, A. C. (2022). Norms, prices, and commitment: A comprehensive overview of field experiments in the energy domain and treatment effect moderators. *Frontiers in Psychology*, 13:967318.

Zhou, Y., Sun, L., Hu, X., and Ma, L. (2021). Clustering and statistical analyses of electricity consumption for university dormitories: A case study from china. *Energy and Buildings*, 245:110862.

Appendix

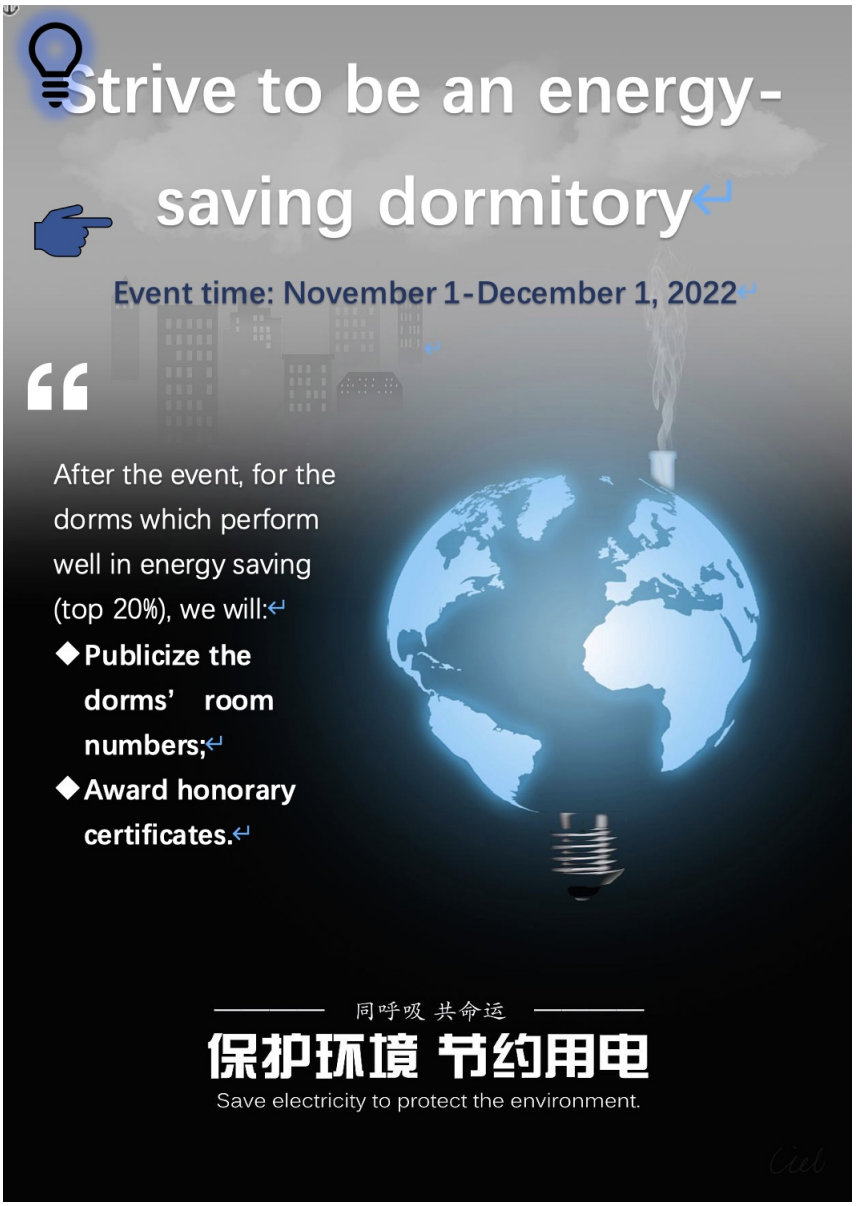

FIGURE 4. Honor-based-incentives group's electricity saving flyer

FIGURE 5. Electricity saving flyer for goal-setting group