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Social Influence and Economic Intervention Policies that Reduce Energy Consumption:

Evidence from Air-conditioning Use

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Key points

- Peer pressure from local communities and social media are effective policy tools for motivating energy saving actions.
- Moderate monetary rewards or penalties are sufficient to induce energy conservation actions.
- The government could target energy consumers with fuller environmental awareness, greater openness to change, and exposure to past policy influence because they are more likely to take desirable energy consumption decisions.
- The government could enhance the effectiveness of intervention policies by utilizing innovative technologies.

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Policy Focus

In 2020, air conditioners consumed 31% of total electricity use in Hong Kong (EMSD, 2022) and electricity generation accounted for 60.4 percent of the city's greenhouse gas emissions (EPD, 2022). Therefore, policies that encourage energy savings in air-conditioner use are critical if the city wishes to achieve carbon neutrality. Nevertheless, successful policy interventions must be cost-effective and socially acceptable to incentivize energy-saving behaviors (Cialdini, 2007). This bulletin introduces a paper by Spandagos (2021) that identifies factors that determine the effectiveness of various policy interventions designed to curb residential air-conditioning energy consumption through a case study set in Hong Kong. In particular, the paper focuses on the following issues:

1. Which one is more responsive to various policy interventions? Energy efficiency decisions (e.g., purchasing more energy-efficient air-conditioners), or energy conservation decisions (e.g., reducing air-conditioning usage)?
2. Which is more effective at motivating air-conditioning energy-saving actions? Policies that apply social pressure or policies that leverage economic instruments?
3. Which is more effective at motivating energy-saving actions? Local community peer pressure (offline) or social media peer pressure (online)?

4. Which is a more important factor in determining Hong Kong citizens' willingness to save energy when they are motivated by various policy interventions? Social demographic factors or psycho-cognitive factors?

Study Methodology

A survey was conducted on residents' perceptions of policy interventions that encourage air-conditioning energy-saving behaviors. The target population was adult household decision-makers. A sample size of 931 was achieved by applying a random sampling method. To prevent social desirability bias, participants were guaranteed anonymity (Tourangeau, R., & Yan, 2007). The survey questions elicited respondents' perceptions of various policy interventions (the original questionnaire can be found in the paper by Spandagos et al., 2021). The respondents were asked to answer questions on a ten-point scale to indicate their willingness to perform energy-saving actions if they were induced by specific policy interventions (1 represents the strongest disagreement, 10 represents the strongest agreement). The survey also elicited information about the respondents' social demographic and psycho-cognitive attributes. Distribution analysis of respondents' perceptions and regression analysis were conducted to answer the above-mentioned research questions, and policy recommendations were offered based on the findings.

Findings and Analysis

Social influence policy interventions are effective at influencing energy-saving decisions

Figures 1 and 2 show the distribution of respondents' perceptions of social influence policy interventions. Around half of the respondents considered both local community and social media pressure highly influential in their air-conditioning energy decisions. These respondents assigned Likert-type values of 8–10 to the related survey questions. However, peer pressure is more impactful on their energy efficiency decisions than on their energy conservation decisions.

Economic instrument policies are effective at motivating energy-conservation decisions

Figure 3 presents the distribution of respondents' perceptions of economic instrument policies. More than half of the respondents agreed that economic instruments, i.e., monetary rewards/penalties, could effectively motivate energy-conservation actions, assigning Likert-type values of 8–10 to the corresponding survey questions. Overall, the respondents perceived rewards and penalties as equally impactful. Nevertheless, comparing the statistics presented in Figures 1, 2, and 3, respondents generally chose lower Likert-type values in response to questions related to the impact of economic instruments than in questions related to the impact of peer pressure, indicating that social influence is more effective at reshaping energy-consumption behaviors.

Moderate economic rewards/penalties can motivate energy-saving actions

Table 1 displays respondents' perceptions of various reward/penalty measures. The most acceptable penalty was a 2%–4% surcharge on electricity bills, which more than 30% of the respondents perceived as a reasonable penalty that incentivizes energy-saving behaviors. On the other hand, a 4%–8% savings on electricity bills was considered a fair reward. Around 36%–47% of the respondents agreed that such a reward could reasonably stimulate energy-saving actions.

Psycho-cognitive attributes help to determine the effectiveness of policy interventions

Regression analysis shows that psycho-cognitive factors were more crucial in determining the effectiveness of policy interventions that incentivize energy-saving decisions than social-demographic attributes (readers may refer to the paper by Spandagos et al., 2021 for detailed regression results). Psycho-cognitive attributes, namely environmental awareness, openness to change, and past exposure to policy interventions were statistically significant factors that could enhance the potential for any policy intervention to influence energy-saving decisions. In contrast, income and age affected only the potential of economic instruments to influence such decisions, and had no effects on social pressure interventions. The study found statistically significant relationships between education and the effectiveness of 3 of 6 policy interventions. Gender and location had no statistically significant effects on the influence of any policy instrument. Interestingly, the number of peers encountered did not even affect the potential of peer pressure to influence energy-saving decisions, perhaps because interactions between neighbors are rare in a highly urbanized city like Hong Kong.

Recommendations

Encouraging energy-saving behaviors through peer comparison

As social pressure influences both energy-efficiency decisions and energy-conservation actions, the government could enlarge the scope of peer comparison programs by encouraging the use of energy-efficient appliances, e.g., by purchasing energy-efficient air-conditioners. Energy-efficiency decisions can reduce energy use dramatically in the long run (Abrahamse et al., 2005).

Unlike energy-efficiency decisions which involve one-time actions, energy-conservation actions require continuous efforts. After citizens make energy-efficiency decisions, the government may utilize peer pressure to motivate

persistent energy-conservation behaviors.

Generating peer pressure by utilizing social media technology

Peer pressure is equally effective at encouraging energy-saving behaviors whether it stems from local communities or social media. Policymakers could leverage social media technology to generate peer pressure by establishing peer comparison platforms.

Traditionally, air-conditioning consumption is a private behavior, and as such is not very responsive to social pressure (Abrahamse and Steg, 2013). Innovative social media technology, however, may enhance the visibility of energy consumption.

Inasmuch as the number of peers does not affect the influence of social pressure, the government could formulate a social influence network that centers on a few impactful individuals with the required attributes to serve as "environmental champions" (Anderson and Menassa, 2014).

Utilizing economic instruments supported by emerging technology as supplementary measures

Statistics generated in this study show that economic instruments were perceived as influential in motivating energy-conservation actions, although they are less effective than social pressure. In the long run, moderate rewards/penalties may serve as supplementary policy instruments that encourage energy-conservation behaviors that require perseverance. The government may also apply smart city technology and blockchain technology to improve the effectiveness, privacy, and reliability of rewards/penalties programs (Su et al., 2011; Ahl et al., 2019).

Targeting specific groups of citizens

Evidence presented in this study indicates that energy consumption decisions taken by citizens with specific internal attributes, namely fuller environmental awareness, greater openness to change, and exposure to past policy influence, were more likely to be influenced policy interventions. Micro-targeting (Metcalf et al., 2019) citizens with these attributes may significantly enhance the likelihood that such interventions succeed. Citizens' willingness to perform energy-saving actions depends on past influence, however, so policymakers should target citizens who have not been previously influenced by any policy interventions as early as possible.

Nevertheless, policymakers must ensure data privacy when collecting personal data, e.g., data about personal psycho-cognitive attributes. Smart technology and secure data-processing protocols should help to mitigate privacy risks.

Enhancing environmental awareness

Energy consumption decisions taken by citizens with fuller environmental awareness are more likely to be influenced by policy interventions. The government could raise environmental awareness by organizing public campaigns and introducing specialized courses into curricula across education levels. Employing social media technology, policymakers could build interactive platforms to facilitate knowledge exchange between educators, building-industry experts, energy specialists, and citizens.

Figure 1 The distribution of respondents' perceptions of the potential for local community (LC_e) and social media (SM_e) peer pressure to influence energy-efficiency behaviors associated with residential cooling

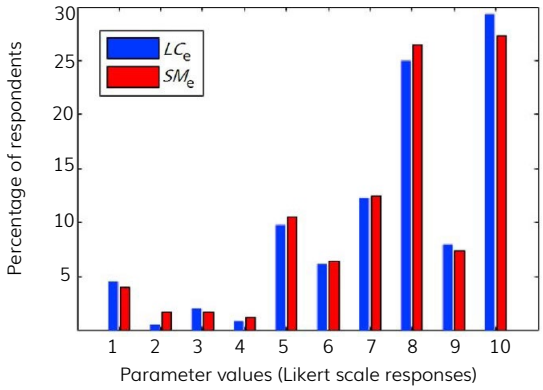

Figure 2 The distribution of respondents' perceptions of the potential for local community (LC_c) and social media (SM_c) peer pressure to influence energy-conservation behaviors associated with residential cooling

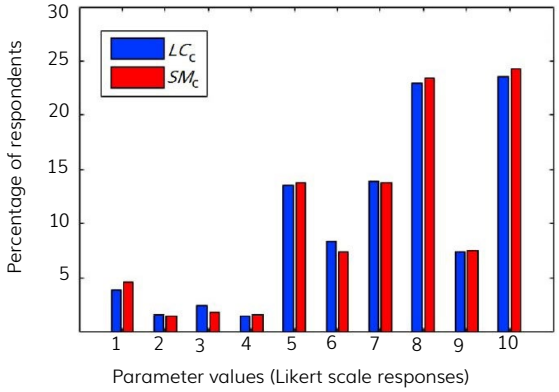

Figure 3 The distribution of respondents' perceptions of the potential for penalties (PEN) and rewards (REW) to influence energy-conservation behaviors associated with residential cooling

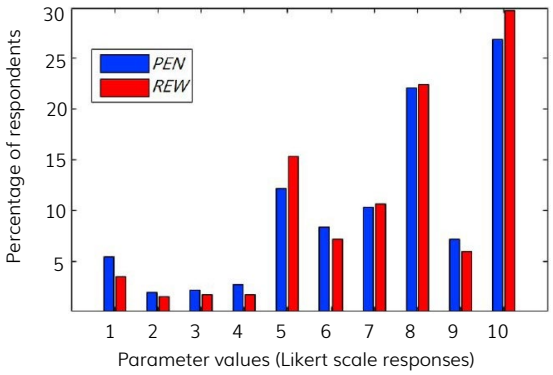

Table 1 Survey respondents' perceptions of hypothetical penalty and reward measures, in percentages of respondents' assessments (VL = very low, L = low, RES = reasonable, H = high, VH = very high).

	Perception assigned to measure (% of respondents)					
Measure	**VL**	**L**	**RES**	**H**	**VH**	**Total**
Penalty (% of annual bill)						
2	13.4	20.9	33.1	16.5	14.7	99.5
4	4.6	12.4	30.5	24.8	25.9	99.2
6	1.6	4.9	18.3	30.8	42.6	99.2
8	1.1	2.5	8.8	23.5	62.2	99.1
10	0.7	0.7	5	13.2	78.4	99.1
12	0.5	0.6	3.3	8.3	85.3	99.1
Reward (% of annual bill)						
2	37.0	37.3	22.6	1.7	0.9	98.5
4	15.9	34.6	37.8	8.8	2.1	98.1
6	6.8	16.0	47.1	20.7	8.5	98.1
8	3.6	8.5	36.5	31.0	19.5	98.0
10	1.4	4.2	24.6	34.3	34.8	98.0
12	1.1	2.9	17.1	30.8	47.2	98.0

Main Reference

Spandagos, C., Baark, E., Ng, T. L., & Yarime, M. (2021). Social influence and economic intervention policies to save energy at home: Critical questions for the new decade and evidence from air-condition use. *Renewable and Sustainable Energy Reviews*, 143, 110915.

References

Abrahamse, W., & Steg, L. (2013). Social influence approaches to encourage resource conservation: A meta-analysis. *Global environmental change*, 23(6), 1773-1785.

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. Journal of environmental psychology, 25(3), 273-291.

Ahl, A., Yarime, M., Tanaka, K., & Sagawa, D. (2019). Review of blockchain-based distributed energy: Implications for institutional development. Renewable and Sustainable Energy Reviews, 107, 200-211.

Anderson, K., Lee, S., & Menassa, C. (2014). Impact of social network type and structure on modeling normative energy use behavior interventions. *Journal of Computing in Civil Engineering*, 28(1), 30-39.

Cialdini, R.(2007). Influence: *The psychology of persuasion (Vol. 55, p. 339)*. New York: Collins.

Electrical and Mechanical Services Department (EMSD) (2022). Hong Kong Energy End-use Data 2022.

Likert, R. (1932). A technique for the measurement of attitudes. Archives of psychology.

Metcalf, A. L., Phelan, C. N., Pallai, C., Norton, M., Yuhas, B., Finley, J. C., & Muth, A. (2019). Microtargeting for conservation. Conservation Biology, 33(5), 1141-1150.

Su, K., Li, J., & Fu, H. (2011, September). Smart city and the applications. In 2011 international conference on electronics, communications and control (ICECC) (pp. 1028-1031). IEEE.

The Environmental Protection Department (EPD) (2022). Greenhouse Gas Emissions in Hong Kong (by Sector).

Tourangeau, R., & Yan, T. (2007). Sensitive questions in surveys. *Psychological bulletin*, 133(5), 859.

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