CAN BEHAVIORAL NUDGES INCREASE SOLAR PANEL ADOPTION?

EVIDENCE FROM UKRAINE

by

Yurii Kovalenko

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Thesis Supervisor: Professor Monika Pompeo

Approved by

_____

Head of the KSE Defense Committee, Professor

Date _____

Kyiv School of Economics

Abstract

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This thesis tests whether short behavioral messages can increase early-stage adoption decisions for residential solar panels in Ukraine. A four-arm online survey experiment with 231 Ukrainian adults randomly assigns participants to a neutral control message or one of three framed treatments: an environmental message emphasising carbon and ecological benefits, a cost-saving message emphasising private financial returns, or a social-norm message emphasising the growing adoption among Ukrainian households. Outcomes are measured immediately after exposure: a binary willingness to sign up for a free consultation, post-treatment interest, perceived credibility, and an ordered willingness-to-pay category.

Contrary to the standard expectation that nudges should raise pro-adoption outcomes, none of the three framed messages outperforms the neutral practical control. The environmental message produces a robust negative effect on the most behavioral outcome: it lowers sign-up by 18 to 19 percentage points relative to control, with the effect stable across linear probability, logit, and probit specifications. Cost-saving and social-norm messages produce small and statistically insignificant point estimates. Non-experimental readiness models show that ownership, blackout worry, prior

consideration of solar, and financial risk tolerance are the strongest correlates of post-treatment interest and sign-up.

The findings suggest that in a high-cost durable-investment decision under wartime energy insecurity, persuasive framing alone does not move households closer to action over and above plain practical information. The environmental backfire on sign-up is consistent with a motive-mismatch reading: when households evaluate solar as a resilience and investment problem, a climate frame may shift the decision into a less actionable register. Communication targeted at the readiness margin and bundled with financing pathways is likely to outperform broad message framing.

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I thank the survey provider InfoSapiens for fielding the questionnaire and managing random assignment in a wartime environment. Without their professionalism, the empirical work behind this thesis would not have been possible.

Finally, I would like to thank my family for their patience and support throughout my studies.

AI USE DECLARATION

During the preparation of this thesis, Generative AI (ChatGPT) was used as a supplementary tool to:

- Support grammar correction and improvement of sentence clarity in Chapters I–VI of this thesis
- Idea brainstorming on a) Chapter 5, b) Chapter 4.
- Fixing code for Chapter 5.

Any suggestions produced by the AI tool were critically evaluated and substantially modified by the author before being incorporated into the thesis.

The tool was not used to generate research findings, produce literature summaries used directly in the thesis, create citations, or conduct any form of data analysis. All research questions, theoretical framing, methodology, analysis, interpretation of results, and conclusions were developed independently by the author. The author takes full responsibility for the originality, validity, and academic integrity of the work presented in this thesis.

LIST OF ABBREVIATIONS

AME	Average Marginal Effect
CTR	Click-Through Rate
IEA	International Energy Agency
ITT	Intention-to-Treat
LPM	Linear Probability Model
MDE	Minimum Detectable Effect
OLS	Ordinary Least Squares
PV	Photovoltaic
RCT	Randomized Controlled Trial
ROI	Return on Investment
UAH	Ukrainian Hryvnia
WTP	Willingness to Pay

Chapter 1

INTRODUCTION

Ukraine is a relevant context for studying residential solar adoption. Since the full-scale Russian invasion in 2022, the country, which has substantial solar irradiation potential, has faced recurrent damage to the electricity transmission and generation system, and households have lived through repeated blackout cycles. Distributed solar photovoltaic systems are therefore not only a climate-change technology but also a household resilience technology. The International Energy Agency (2024) estimates that, although Ukraine added several gigawatts of large-scale solar capacity over the past decade, installed residential rooftop PV remains well below one percent of households, and argues that decentralised resources, including small-scale solar, are central to reducing peak deficits and strengthening the electricity system. The widespread use of private solar panels in Ukraine therefore remains limited compared to the role it could play. This raises a question: even when the technical and social value of household solar has risen, this does not by itself guarantee household installation decisions.

The problem has clear economic dimensions. Residential electricity prices in Ukraine have been subsidised for years, which compresses the private financial return on rooftop solar (Stubbe et al. 2023). Past support measures, in particular the Green Tariff, helped some households achieve attractive payback periods, but the policy environment has shifted toward net billing, which is expected to lower the anticipated returns for many new adopters (Trypolska et al. 2023). A typical residential system still requires a substantial upfront payment, while savings accrue gradually and are not guaranteed. For a household that faces a daily trade-off between consumption needs and a long-lived energy investment, even a strong stated interest in solar energy may not be sufficient to trigger adoption. In effect, the problem extends beyond a

lack of awareness to include the perceived distance between interest, affordability, and practical action.

The research questions of this thesis are the following. First, do behavioral messages, delivered as short texts highlighting environmental benefits, cost savings, or social norms, change a household's willingness to take an early adoption step relative to a neutral practical message? Second, which of these three frames produces the largest effect on adoption-related outcomes?

To answer these questions, I conducted a four-arm online survey experiment. Respondents were randomly assigned to one of four short information texts about residential solar panels. The control text presented neutral practical information about how a residential PV system works. The environmental message emphasised carbon-emission reductions and ecological benefits. The cost-saving message emphasised payback time and lower future electricity bills. The social-norm message emphasised that a growing share of Ukrainian households are adopting solar. After reading the assigned text, respondents answered questions on their interest in installing solar panels, the maximum amount they would be willing to pay, how credible they found the information, and whether they would sign up for a free consultation. Because assignment was random, differences across treatment arms can be interpreted as intention-to-treat effects of the assigned message frame, subject to sample-size and survey-setting caveats.

The study sits within the field of behavioral energy economics, which treats limited attention, salience, social influence, framing, and cognitive biases as systematic contributors to household decisions (Allcott and Mullainathan 2010; Thaler and Sunstein 2008). The same technology, in this case a residential solar system, can be presented as an environmental contribution, a financial saving, or a social conformity step. The underlying economics is identical, but the information households attend to differs. These messages do not alter prices, subsidies, or the technical characteristics of the product. They alter the relative salience of each motive in the respondent's mind.

The outcomes are survey-based measures of adoption readiness: a binary sign-up intention for a free consultation, post-treatment interest in installing solar panels, ordered willingness-to-pay categories, and a credibility rating. Because much of the prior literature observes actual behavior, while this study observes intentions and an early form of action, the outcomes should be interpreted as evidence on interest and readiness rather than on completed adoption.

The empirical question is critical because the majority of renewable energy policies rest on costly instruments when the capital needed to install a system is large. Compared to such instruments, communication is cheap. A brief informational intervention can significantly narrow the gap between interest and adoption. Communication is a useful complement for energy and municipal agencies, not-for-profit and private providers. If short messages have no effect on adoption-related outcomes, that itself is informative: it implies that communication alone cannot overcome structural barriers, such as ownership status, credit constraints, and uncertainty regarding payback.

This thesis makes three contributions to the literature. First, it employs experimental message framing in the context of a costly, long-lived household investment as opposed to conventional energy-conservation behaviour, such as towel reuse or short-run electricity use. The choice margin is different in substance: a solar system is a long-lived asset requiring capital, ownership rights and trust in installers and expected returns. The second contribution provides a within-design comparison of three canonical frames – environmental, cost-saving and social-norm, against a common neutral control, allowing direct comparison of their relative performance on the same outcomes. In addition, it examines the relevance of these frames within the Ukrainian war context, as installing solar technology simultaneously represents a climate, household, and resilience choice.

Behavioural framing is just one of several determinants of adoption; structural barriers - ownership, affordability, payback uncertainty - are likely to weigh

more heavily on the final installation decision. The experiment examines whether short framed messages can change early-stage adoption outcomes and whether the pattern of results indicates the presence of a more general readiness problem behind household solar adoption in Ukraine.

The remainder of this thesis is organised as follows. Chapter 2 reviews the literature on behavioral nudges, social norms and peer effects, and message framing, and situates the study within the Ukrainian context to identify the research gap. Chapter 3 sets out the research questions and hypotheses, the experimental design and outcome measures, and the empirical strategy, including the discussion of statistical power and the moderators used to examine heterogeneous effects. Chapter 4 describes the data source, sampling frame, and implementation, together with the characteristics of the sample, the balance across treatment arms, and the main outcome patterns. Chapter 5 presents the results, beginning with descriptive patterns and randomisation checks, then the main treatment effects on sign-up, and finally the secondary outcomes, mechanisms, and the heterogeneity analysis. Chapter 6 concludes, discusses the limitations of the study, and offers recommendations for policy and for future research.

Chapter 2

LITERATURE REVIEW

To assess whether short framed messages can move households closer to residential solar adoption, this chapter reviews three related strands of the literature: behavioral nudges in energy decisions, message framing as a contrast between financial and environmental appeals, and social norms with peer effects in solar diffusion. Standard nudge results come from low-cost behavioral contexts - towel reuse, short-run electricity conservation, click-through on online ads - where the action is repeated, cheap, and immediate. The relevant question for this thesis is whether the same logic survives in a high-cost, durable-investment decision under wartime energy insecurity. The literature reviewed below suggests that the answer is far from automatic.

For residential solar this distinction is central. Installing a system is not the same as reusing a towel or trimming a month of electricity use. Adoption requires upfront capital, trust in suppliers, ownership rights, and confidence that the expected returns will materialise. Any account of how a short message changes adoption-related outcomes has to be consistent with these features of the choice.

2.1 Behavioral nudges: definition and scope

A nudge can be defined as a relatively small alteration to the way choices or information are presented that influences our decisions and behaviours in a predictable way. This should not restrict choice or significantly change economic incentives, (Thaler and Sunstein 2008). Nudges are appealing in energy policy because they can serve as a low-cost add-on to a range of government tools. The question is not whether nudges work but when they work and on which outcomes. Reviews of green nudges specifically caution

that their effectiveness is context-dependent and that they raise distinct ethical questions about steering choice (Schubert 2017).

How the benefits are framed matters even when the underlying incentive is fixed. Conventional economic theory holds that domestic agents respond to 'private' or 'internal' costs and benefits more strongly than to 'external' costs and benefits. Thus, it would seem that to maximise impact, messages should place greatest emphasis on financial saving. Research in behavioral and psychological science qualifies the prediction made earlier – people don't process all the information available to them equally, and they may respond more strongly to a salient moral, health, social, or identity cue than to a seemingly small or distant monetary gain (Tversky and Kahneman 1981; Thaler and Sunstein 2008). This thesis' experiment is positioned squarely within this tension, pitting environmental, cost-saving, and social-norm framings of the same technology against each other.

Early evidence shows that households can reduce energy use without price changes. In a 2011 study, Allcott examined home-energy reports that compare a household's electricity use with that of similar neighbors. He found reductions in consumption with no price change. What matters is not the size of the effect but the fact that a simple social comparison can change consumption, although later welfare analysis shows that these effects are heterogeneous across households, benefiting some while imposing psychic costs on others (Allcott and Kessler 2019). Later research by Ayres, Raseman, and Shih (2013) as well as Dolan and Metcalfe (2015) confirms the impact of information and social comparison on energy use. Households don't just optimise from a fixed information set; attention and comparison matter.

Different nudges may operate through different mechanisms even when delivered as the same kind of intervention. In Schultz et al. (2007) it is shown that, after discovering their consumption behaviour with respect to the average, those households who consume below average increase their consumption. In this case, a cue that signals socially approved low

consumption behaviour can lessen the risk of the boomerang effect. Essentially, one important consideration for solar communication is that the design of the message, and the reference group, matters: a poorly designed descriptive norm can imply that the technology is unusual or risky rather than common or acceptable.

Research on framing in conservation shows mixed findings regarding effectiveness. The study by Asensio and Delmas (2015) shows that information about the health and environmental externalities of electricity consumption reduced household electricity use, while a cost-saving message did not. A possible interpretation is that the small per-bill savings from minor adjustments in electricity consumption are too abstract to spur change, while health and environmental implications loom large. On the other hand, the evidence from solar adoption itself points in the opposite direction: Bollinger, Gillingham, and Ovaere (2020) find in a community-solar setting that a self-interest frame moved immediate adoption more than a pro-social frame, while pro-social framing was more useful for referrals. Overall, this seems to suggest that the most effective frame depends on whether the action is cheap and behavioral, or costly and investment-like.

When assessing these findings, it is helpful to adopt a phased approach to adoption. The sequence of events begins with a household becoming aware of technology. The sequence continues as the household evaluates costs and benefits and feasibility. Only then does the household take an action (for instance, contact an installer). The nudge may affect different stages: an environmental or norm message may raise awareness, a cost-saving message may be most effective at evaluation, and a small concrete prompt may be most effective at the action stage. The model shown in Figure 1 is used later in the thesis to interpret treatment effects pattern across interest, WTP, credibility and sign-up.

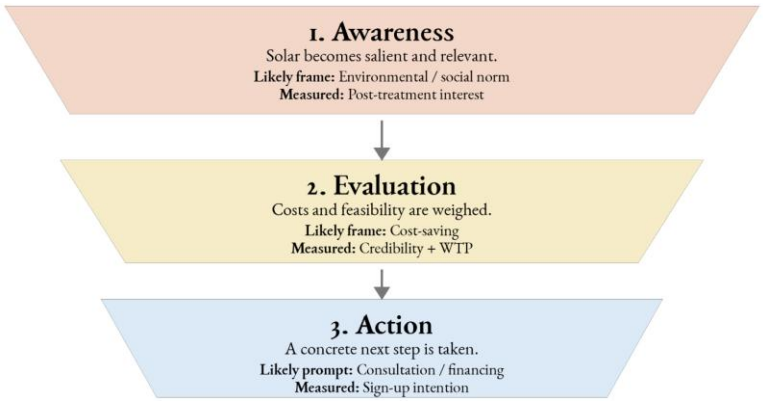


Figure 1. Adoption readiness funnel: from awareness to action.

Across these studies, the same broad idea of behavioral messaging operates through heterogeneous mechanisms, and the outcomes measured differ widely. Table 1 summarises a selected set of representative studies. The variation across columns is itself informative: "nudges" should not be treated as a single policy tool, since their effectiveness depends on the frame, the action, the target population, and the binding barrier.

Table 1. Selected studies on behavioral messaging in energy and environmental contexts

Study	Description	Outcome	Key result
Allcott (2011)	Home-energy reports with peer comparisons.	Electricity use (kWh)	Social comparison reduced consumption by about 2%.
Schultz et al. (2007)	Door-hanger feedback with descriptive and injunctive norms.	Electricity use (kWh)	Descriptive norms alone created a boomerang; injunctive cue offset it.
Goldstein et al. (2008)	Hotel towel reuse experiment.	Share reusing towels	Normative message outperformed a generic environmental appeal.
Asensio & Delmas (2015)	Household energy conservation experiment.	Electricity use	Environmental/health information beat cost-saving information.
Bollinger, Gillingham & Ovaere (2020)	Community-solar campaign.	Solar adoption, referrals	Self-interest framing raised immediate adoption; pro-social framing raised referrals.
Bär et al. (2023)	Field experiment with online solar ads.	Click-through and order placement	Framing differences detectable but small in size.

2.2 Social norms, peer effects, and solar adoption

One theme which emerged from this literature is the power of social influence over energy behaviour. Social norms work as conformity, social learning, reputation mechanisms. Hearing that "people like you are doing X" can legitimize doing X and reduce uncertainty or skepticism about it. When households see their neighbours install solar panels, the visibility itself conveys information: that the technology works, that suppliers are available, and that the investment is socially acceptable. Many empirical studies have found peer effects in solar adoption, i.e., the chance that a household installs solar increases if other residential units in the neighborhood have already done so. Graziano and Gillingham (2015) studied the location of rooftop PV installations in Connecticut and found clear spatial clustering. The propensity of a household to adopt PV increases if several of its neighbors do so. Seeing solar energy systems on neighbors' roofs probably makes people more likely to buy those panels. Most likely, the effect works through visibility and word of mouth. Having new adopters is beneficial because it gives information to others.

Field experiments reinforce this idea. In the program Bollinger et al. (2020) described, even the pro-social message "help your community by going solar" likely worked in part by signalling a norm of community participation. Separate research by Palm and Lantz (2020) in Sweden found that a municipal information campaign promoting solar PV significantly raised adoption, measured through applications and approvals for a national PV subsidy scheme (about a 29% increase), rather than self-reported interest alone." According to Bollinger and Gillingham (2012), a social multiplier effect occurs when a solar system installation in a particular zip code spurs almost 0.78 other installations in that same zip code through a social spillover effect. In my experiment, the social norm treatment explicitly leverages this principle to inform participants that many of their neighbours are going solar,

suggesting that solar adoption is common, accepted, and perhaps expected in one's community.

Sometimes social-norm interventions do not work as intended or have different effects. One example of the classic boomerang effect (Schultz et al, 2007), which was the result of low-consuming households becoming less frugal after being told that they were "better than average", is that they incorporate injunctive norms or social approval cues (smiley face) that praise desirable behaviour to avoid backfiring (Cialdini 2003). When it comes to getting people to adopt solar energy, one might worry about a different kind of asymmetry: if one thinks "very few people like me have solar" then a norm message to someone could encourage ("be one of the first!") or discourage ("no one else is doing it, why should I?") the person. My message says, "Join many of your neighbors who have gone solar". This nicely conveys a descriptive norm (that many are doing it) and a slight injunctive one (that it's a good thing to do). I stress the use by peers to avoid suggesting that uptake is low. I still need to take into account that individuals' baseline perceptions of solar popularity could moderate their response. Past studies imply that social context has an impact too. Peer effects may be stronger in "tighter" communities. But in communities of distrust or differing social identity, people probably do not care what their "neighbours" are doing unless they identify as such. In 2025, I expect Ukraine to have a sense of unity against a shared challenge. Whether an appeal to join one's neighbours in collective action would resonate in this context remains an empirical question.

2.3 Message framing: financial vs environmental appeals

A related question is whether extrinsic (financial) or intrinsic (environmental or moral) motivators are more effective for pro-environmental actions. Standard economic theory emphasises responses to monetary incentives, and much of the existing energy policy relies on subsidies, rebates, or expected

savings to promote efficiency and renewable technologies. According to research based on behavioral and psychological findings, the framing of benefits can change behavior, even if the base incentive does not change. There is a diversification in the empirical record. For low-cost conservation, environmental and health framing has sometimes outperformed monetary framing, as in Asensio and Delmas (2015). For costly durable investments, however, the picture differs. Davis and Metcalf (2016) find that disclosing concrete dollar savings on energy-efficient appliances raises informed choice relative to a generic energy-saving message, and Bollinger, Gillingham, and Ovaere (2020) report that the cost-saving frame moves community-solar adoption more than the pro-social frame at the point of purchase. This is consistent with the idea that when the action has a cost, clear financial details are more convincing than abstract environmental details. The conflict between frames in solar adoption is not therefore resolved a priori. Bär et al. (2023) assess gain, loss and environmental messages in online ads for solar panels. They find only small differences in click-through, with loss slightly ahead. The significant takeaway is that the frame can shift behaviour at the margin, but the effect size is bounded when the underlying decision is complex. Clicking on an ad is several steps removed from completing an installation. In this thesis, survey sign-ups are treated as incrementally closer to behavior than a click but still some distance from an actual purchase. Two further factors shape the expected effect of the frames. First, framing an issue in environmental terms can be read as moralising or as greenwashing, and when the appeal is not linked to anything tangible its persuasive force tends to weaken.

In other words, rather than strengthening action on a costly decision, the framing activates a moral judgment that makes it worse to do harm than to benefit.

Financial framing might also run into problems of credibility: if respondents think solar saves money in principle but are not able to pay up-front, then

even an informative savings message does not address the binding constraint. The body of knowledge does not indicate which frame should prevail in the case of the housing in Ukraine; this is an empirical question of this thesis.

2.4 Ukraine-specific context and research gap

Most experiments that indicate behavioral energy have been run in stable markets in North America and Western Europe. There are different parameters that Ukraine varies on. Energy insecurity constitutes a household experience that is neither abstract nor a future risk, but recent and repeated. Moreover, electricity prices for home use have been subsidized a lot more than commercial customers. In the third instance, the institutional environment for residential solar has undergone a shift, with a move away from the original Green Tariff conditions toward net billing. The public significance of distributed, behind-the-meter resources has been elevated by the war. All things considered, these features make Ukraine a useful stress case for testing whether standard nudge logic extends from low-cost conservation behaviour to high-cost durable-investment decisions under collective stress.

Another gap relates to behaviours in reality and behaviours people say they make. A number of influential nudge studies observe electricity use, towel reuse, or actual installations. This thesis will present the adoption-related outcomes within a survey that includes a sign-up decision for a consultation. The outcome is more specific than a general attitude, but it is still not the same as buying solar panels and installing them. The intention-behavior gap (Sheeran 2002; Ajzen 1991) is not just a minor caveat but informs the interpretation of the results.

The survey data make this gap visible in another way. Respondents express moderate to high interest in solar, report heavy exposure to blackouts, yet state willingness-to-pay categories well below their own perceived installation costs. This pattern suggests that the main constraint is not indifference:

affordability, ownership, and perceived investment risk may prevent interested households from acting. For the same reason, the four outcomes measured here correspond to different stages of the same decision process: post-treatment interest is closest to an attitude, willingness to pay is closest to an economic threshold, credibility is closest to message acceptance, and sign-up is closest to behavior because it requires a small concrete step. A message can therefore raise one outcome without raising another.

The research gap addressed by this thesis is therefore twofold. First, very little experimental evidence exists on renewable-energy communication in Ukraine or in other conflict-affected and transition-economy settings. Second, there is limited evidence on whether short behavioral messages can affect early adoption decisions for a high-cost household technology when structural barriers are strong and overlapping. In the Ukrainian case, solar is at once a green technology, a household investment, a resilience tool during blackouts, and a visible signal of energy independence. The same respondent may evaluate solar through several lenses simultaneously, and it is not obvious in advance which frame should dominate. The thesis therefore tests the relative performance of the three canonical frames under conditions where theory provides reasons for both positive and weak effects.

Chapter 3

METHODOLOGY

3.1 Research question and hypotheses

The primary objective of this study is to answer: "Can short framed messages – environmental, cost-saving, or social-norm – raise residential solar adoption-related outcomes among Ukrainian households relative to a neutral practical control?" To address this question, I test the hypotheses presented in Table 2.

Table 2. Research Hypotheses

Hypothesis	Description
H1	Compared with a neutral practical message, any of the three framed messages (environmental, cost-saving, or social-norm) raises adoption-related outcomes – sign-up intention, post-treatment interest, and willingness to pay.
H2	Among the three framed messages, the cost-saving frame produces the largest positive effect on sign-up intention and willingness to pay, because solar adoption is a costly durable investment for which private financial returns plausibly dominate.
H3	The social-norm frame outperforms the environmental frame on sign-up intention, because peer information directly reduces uncertainty about a visible but unfamiliar technology, while an abstract environmental appeal does not address the household's binding adoption barrier.
H4	Treatment effects are heterogeneous across pre-treatment moderators – specifically, frequent blackout exposure, home ownership, and financial constraint – with the cost-saving frame expected to be more effective among financially constrained homeowners and the social-norm frame more effective among households with high baseline interest.

The conceptual framework that links the treatment arms to outcomes through message salience and pre-treatment moderators is presented in Figure 2.

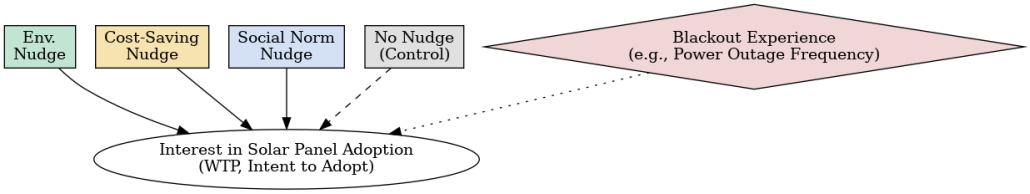


Figure 2. Conceptual framework of the experimental design.

Note: Three message frames (environmental, cost-saving, social-norm) and a neutral practical control affect adoption-related outcomes (interest, credibility, willingness to pay, sign-up) through message salience. Blackout exposure, ownership, baseline interest, and financial constraint are treated as pre-specified moderators. Source: author's own presentation.

3.2 Experimental design and outcomes

The experiment is a four-arm survey-based randomized controlled trial. Each respondent reads one short text about residential solar panels and then answers the same battery of outcome questions. Because assignment is random, differences across treatment arms identify the intention-to-treat effect of being exposed to a given message frame, subject to sample-size and survey-setting caveats.

The control text gives neutral practical information about how a residential PV system works and what it costs. The environmental treatment adds a paragraph which emphasises carbon emission reduction and the ecological benefits. A low-cost treatment has added a paragraph to highlight its payback time and lower electricity bills in future. The social norm treatment implies that an increasing number of households are adopting solar in Ukraine. Except for these framing paragraphs, underlying information is the same across arms.

Arrangement of question is important for clean identification. Screening and baseline questions preceded presentation of treatment text. The blocks that I utilized to collect information regarding the pre-treatment characteristics of the respondents consisted of variables such as respondents' gender, age, education, income category, housing status, dwelling type, electricity expense, blackout exposure, blackout worry, baseline interest in solar, baseline knowledge of solar panels. Then, it was shown the treatment text. Results were assessed through post-treatment queries. The treatment is not impacted by the baseline covariates but limits the bias of the post-treatment control.

The main outcome is signing-up intention. If the respondent said yes to leaving contact details or registering for a free consultation regarding household solar installation, it takes on a value of one, and if otherwise zero. It is the main outcome because it is the most behavioral measure in the experiment: it asks for a small concrete step rather than an abstract view. It may not be an actual installation decision yet, but this is better than a Likert-scale rating.

Secondary outcomes are post-treatment interest in installing solar, perceived credibility of the information, and willingness to pay. Interest and credibility were measured on five-point ordered scales. Willingness to pay was recorded as an ordered category rather than as a continuous monetary amount, since the measure is hypothetical and survey-based and is not incentive-compatible: an incentive-compatible WTP would require a real-stakes mechanism such as a BDM auction. Throughout this thesis, WTP is therefore interpreted as a stated-preference category that approximates an affordability threshold.

Beliefs about cost, savings, and payback time, as well as self-rated confidence in those estimates, were also collected. Because these variables are measured after treatment exposure, they are not used as controls in the main treatment-effect regressions - conditioning on post-treatment mediators would block part of the treatment effect - but they are used descriptively to interpret the channel of any effect. The same logic applies to comprehension checks.

3.3 Empirical strategy and statistical power

The primary estimand is the intention-to-treat (ITT) effect of assignment to each framed message relative to the neutral control. ITT is identified by random assignment and does not require any assumption about how carefully respondents read the assigned text or whether they personally agreed with it. ITT is the standard estimand in randomized experiments (Allcott 2011).

For a generic outcome Y_i, the baseline regression is:

$$Y_i = a + \beta_1 Norm_i + \beta_2 Saving_i + \beta_3 Environment_i + \gamma' X_i + \varepsilon_i \qquad (1)$$

where $Norm_i$, $Saving_i$, and $Environment_i$ are dummies for assignment to the social-norm, cost-saving, and environmental arms (control is the omitted category). X_i is a vector of pre-treatment covariates (age, gender, education, income category, ownership, dwelling type, blackout exposure, blackout worry, baseline interest, and baseline knowledge). α is the control-group mean, β_1-β_3 are the average treatment effects relative to control, and γ are coefficients on the covariates. Including X_i follows the standard recommendation in the experimental literature (Allcott 2011; DellaVigna and Pope 2018) to improve precision when baseline interest is strongly predictive of post-treatment outcomes. An unadjusted specification without X_i is also reported, since group-mean differences provide the most transparent benchmark; if the adjusted and unadjusted estimates differ only marginally, results are not driven by modelling choices.

Because the outcomes are heterogeneous in type - a binary outcome (sign-up), ordered five-point scales (interest, credibility), and ordered WTP categories - several complementary estimators are used so that conclusions do not depend on a single functional form.

For the binary sign-up outcome, a linear probability model (LPM) provides the most readable benchmark:

$$Pr(signup_i = 1 \mid X_i) = a + \beta_1 Norm_i + \beta_2 Saving_i + \beta_3 Environment_i + \gamma' X_i + \varepsilon_i \quad (2)$$

LPM coefficients are interpretable as percentage-point changes in adoption probability. Because LPM is only a linear approximation that can produce fitted values outside the unit interval, logit and probit models are estimated as the main specifications for the binary outcome:

$$Pr(signup_i = 1 \mid X_i) = \Lambda(a + \beta_1 Norm_i + \beta_2 Saving_i + \beta_3 Environment_i + \gamma' X_i) \quad (3)$$

where $\Lambda(\cdot)$ is the logistic CDF. The probit specification has the same structure, with the normal CDF $\Phi(\cdot)$ replacing $\Lambda(\cdot)$; covariates and parameters are defined as in equation (3). For both binary models, average marginal effects are reported so that the magnitudes are directly comparable across LPM, logit, and probit. For the five-point Likert outcomes (interest and credibility), ordered logit is the main specification and ordered probit a robustness check, with OLS reported as a secondary benchmark. The WTP outcome is modelled with ordered logit; because the survey contains a structural-refusal category ("would not install regardless of price"), a two-step robustness specification is also estimated, splitting the decision into participation and category choice.

Because null treatment effects are central to the interpretation in Chapter 5, the design's statistical power needs to be made explicit. With 231 completed observations distributed across four arms, each arm has approximately $N \approx 55$ respondents. For the binary sign-up outcome with a control-arm

probability of about 0.30, a two-sample test at $\alpha = 0.05$ and 80% power detects a minimum effect of roughly 20-25 percentage points between the control and a single treatment arm. Effects below this minimum detectable effect (MDE) are unlikely to be picked up with statistical significance. The implication is that, in this design, statistically insignificant point estimates for the cost-saving and social-norm arms do not rule out smaller positive (or negative) effects; they only rule out large ones. This power consideration is used in Chapter 5 to qualify the null results and to distinguish them from the more robust environmental effect, which is sufficiently large to clear the MDE threshold.

In the adjusted specifications used in the results, the covariate vector includes baseline interest, ownership, dwelling type, frequent blackouts, blackout worry, and basic demographics. Trust in the information block and self-rated confidence in cost/savings/payback estimates are treated as exploratory: they are reported as descriptive statistics and included in supplementary readiness models, but they are not included as controls in the main causal regressions because they are post-treatment measures and could mediate the treatment effect. This is a deliberate design choice rather than an omission; conditioning on post-treatment mediators would bias the ITT estimate downward.

Randomisation was implemented automatically by the survey platform. Respondents did not choose their message and did not see the alternatives, which limits self-selection and demand effects and removes the risk that fieldwork decisions influence treatment exposure. Balance checks comparing pre-treatment covariates across arms are reported in Chapter 4. Where minor imbalances appear in finite-sample terms, regression adjustment serves both to improve precision and to ensure that the estimated treatment effects are not driven by chance imbalance.

3.4 Heterogeneous effects and moderators

A central motivation for this thesis is that wartime energy insecurity may make solar adoption salient in Ukraine in ways that change how messages are received. Blackouts may shift households' evaluation of solar from a green technology toward a resilience technology. The survey contains several items on the frequency and severity of blackouts and on worry about future outages. From these, a small set of moderators is constructed: an indicator for frequent outages, an indicator for home ownership, an indicator for financial constraint, and an indicator for high baseline interest. To limit false positives in a student-scale sample, the heterogeneity analysis is restricted to these four pre-specified moderators, each with a clear theoretical motivation and a direct link to the Ukrainian context: outage exposure (salience), ownership (feasibility), financial constraint (affordability), and baseline interest (motivation).

Interaction models are estimated as follows:

$$Y_i = a + \Sigma_k \beta_k T_{ki} + \delta\, Outage_i + \Sigma_k \theta_k (T_{ki} \times Outage_i) + \gamma' X_i + \varepsilon_i \qquad (4)$$

where T_{ki} indexes the Norm, Saving, and Environmental dummies. δ captures a main effect of outage exposure; θ_k captures how the effect of treatment k differs for respondents with recent outages. A statistically significant θ_k indicates effect modification by outage status. For example, $\theta_2 > 0$ would imply a larger cost-saving effect among outage-exposed households. Heteroskedasticity-robust (HC1) standard errors are reported. The same interaction structure is estimated separately for each of the four moderators. Because each moderator interacts with the three framed-message dummies, H4 is evaluated not from individual interaction coefficients but from a joint Wald test of the null that all three interactions for a given

moderator are simultaneously zero, which is the appropriate omnibus criterion for effect modification. These joint tests form the basis for the H4 results reported in Section 5.3.

This framework allows for tests of, for example, whether the cost-saving frame works more strongly among respondents with higher bills, or whether the social-norm frame works more strongly among respondents who already observe solar adoption locally. Because subgroup splits in a small sample can produce noisy and inflated false positives, the moderators are kept few, pre-specified, and tied to the Ukrainian context.

Chapter 4

DATA

4.1 Data source, sampling frame, and implementation

The dataset analysed contains 231 complete observations that were collected from an online survey administered by InfoSapiens. Ukrainian respondents aged 25 to 60 years involved in major household purchases but not owning installed solar panels were considered eligible respondents. The sampling frame is suitable for the research question because it focuses on households which may consider adoption in future but have not yet adopted.

All respondents were sourced from InfoSapiens's online panel. The survey platform automatically assigned treatments at random, meaning that respondents did not select their message, and the fieldwork team could not assign treatments manually. As a source of variation in treatment exposure, it removes discretion from the interviewer. The fieldwork, using a structured online survey (not a nationally representative population survey), should be interpreted as evidence from the analysed sample rather than nationally representative estimates for all Ukrainian households.

A four-arm experiment needs many observations per arm so as to detect plausible treatment effects relative to a control. The binary sign-up outcome's implied minimum detectable effect addressed in Section 3.2 suggests that effects smaller than this size are unlikely to clear standard significance thresholds in this design.

Standard steps were followed in data cleaning. Survey responses come from different people. Using the skip logic of the survey, I re-evaluated the missing values: most of the missed observations were structural – for example, blackout-duration questions which were missed for respondents reporting no

outages. The main analysis sample retains all responders with non-missing values on the main outcomes.

Quality checks were done several times. Each respondent is in one and only one treatment arm, treatment indicators are mutually exclusive, categorical variables take valid response codes. Comprehension questions were used to gauge the strength of treatment exposure rather than as exclusion criteria, since excluding respondents on the basis of comprehension would create post-treatment selection bias.

4.2 Sample characteristics, balance, and outcome patterns

The sample is roughly balanced in terms of gender and has a high proportion of homeowners. Moreover, the sample tends to be urban or semi-urban. On average, the respondents are 44.5 years old; 55.4% are women; 84.0% claim to own their dwelling or live in a family-owned dwelling (Table 3). The ownership structure is important because ownership is a practical precondition for many types of solar installation. The sample does not have external validity because the homeowner share is high. As explained in Section 6.4, the 84% homeowner share is higher than the share of homeowners in the urban Ukrainian population. Because of that, the sample's proximity is closer to the subpopulation that could plausibly adopt. The sample is also likely to be richer than the average household.

Table 3. Main sample characteristics

Indicator	Value
Number of observations	231
Mean age	44.5 years
Women	55.4%
Residents of cities over 100,000 people	49.4%
Residents of towns 10,000-100,000 people	32.9%
Residents of small towns/villages below 10,000	17.7%
Live in a private house	43.3%
Owner or family-owned dwelling	84.0%

43.3% of respondents live in a private house, indicating rooftop installation is more viable than for apartment renters or owners. The other respondents reside in apartments, townhouses and so on.

In the last three months many respondents faced frequent power cuts. A survey reveals that 62.8% of respondents have blackouts several times a day in their area and 79.7% have had outages of at least four hours (Table 4). A high level of concern about outages in the future: 65.8% rate their concern at 4 or 5. The descriptive statistics confirm the respondents experience an energy insecurity type that makes residential solar relevant as a decision margin.

Table 4. Baseline beliefs, energy experience, and financial expectations

Indicator	Value
Blackouts several times per day	62.8%
Longest outages of at least four hours	79.7%
High concern about blackouts (4-5 on 1-5 scale)	65.8%
Low self-reported knowledge about solar panels (1-2)	41.6%
High baseline interest in solar panels (4-5)	47.2%
Had searched for information or contacted a provider	40.7%
Personally know someone with solar panels	63.2%
Median perceived installation cost	256,150 UAH
Median expected monthly savings	1,356 UAH
Median expected payback time	7 years

In general, knowledge about solar panels at baseline is limited. The respondents who rated themselves as poor or very poor was only 41.6% while the average baseline knowledge is 2.6 out of five. Thus, this bolsters the case for informational interventions: even where no final installation has occurred, respondents may be missing basic information on technology, costs and feasibility. The average level of interest in solar at baseline is moderate (mean 3.37 on five-point scale). Just under half (47.2%) express a high level of interest in solar at baseline. The sample is not against solar in principle, but endorsement alone does not guarantee investment appetite.

Affordability gap is a key descriptive finding. The median perceived cost of a typical rooftop system is 256,150 UAH and the median expected monthly saving is 1,356 UAH. Nonetheless, 72.7% of respondents report a maximum upfront willingness to pay less than 100,000 UAH, while 10.0% would not install solar at any price. There is a large gap between the perceived installation costs and the WTP that shapes the interpretation of this experiment. If people already believe solar works in principle and treat the upfront amount as out of reach, a short message is unlikely to move someone into a higher payment category.

The gap also aids in explaining the null effects on WTP discussed in Chapter 5. When it is the case that the median perceived cost is well above the threshold which most consumers are willing to pay up front, then a short informational ad may not shift many into a higher payment threshold. As a result of this design, WTP is a measure of preference, though not simply a measure of preference, but also a measure of liquidity and credibility of future savings.

A household may think that solar is good, but if they cannot afford the upfront payment, they will report a low WTP. The same policy implication suggests that communication and finance are complements rather than substitutes. When the binding barrier is upfront cost, merely framing the issue will not help, and should instead be paired loans, grants, leasing or credible payback information.

The staged adoption framework was introduced in Chapter 2 (awareness → evaluation → action), which maps directly onto the variables used in the empirical analysis. Blackout worry captures salience; ownership and dwelling type capture feasibility; Prior consideration captures existing motivation; financial risk tolerance captures investment readiness; WTP categories capture perceived affordability boundary.

The experimental messages only enter the system at the salience stage; they make one benefit temporarily more salient in the mind of the respondent. A message that is well-designed may have little effect if other parts of the adoption process are binding constraints. The staged reading that follows explains why the empirical analysis in Chapter 5 will report treatment-effect regressions and exploratory readiness models.

Treatment allocation is approximately balanced across arms (Table 5). The cell sizes are unequal in magnitudes consistent with random assignment in a finite sample, and all 231 observations are used in the main analysis because the primary outcomes are observed for every respondent.

Table 5. Sample distribution across treatment arms

Treatment arm	**N**	**Share of sample, %**
Control	67	29.0
Environment	54	23.4
Cost-saving	58	25.1
Social norm	52	22.5

Notes: Random assignment was implemented automatically by the survey platform.

Balance checks comparing pre-treatment covariates across arms (Table 6) show that pre-treatment characteristics are balanced across arms: none of the omnibus p-values falls below 0.10. Some minor differences appear, particularly for blackout exposure, blackout worry, and baseline interest, but they do not reach conventional significance levels. The adjusted regressions reported in Chapter 5 include pre-treatment covariates (in particular baseline interest and ownership) so that estimates are not sensitive to the finite-sample differences across arms.

Table 6. Balance checks for pre-treatment variables

Variable	Control	Environment	Cost-saving	Social norm	p-value
Age (years)	43.33	43.83	45.98	45.12	0.46
Female (=1)	0.60	0.50	0.53	0.58	0.72
Education (1-7)	4.96	4.70	4.91	4.69	0.46
Income category (1-6)	2.99	2.91	2.98	2.71	0.63
Owner (=1)	0.87	0.83	0.86	0.79	0.67
Private house (=1)	0.54	0.37	0.41	0.44	0.29
Frequent blackouts (=1)	0.87	0.80	0.79	0.94	0.10
Blackout worry (1-5)	4.24	3.80	3.90	3.92	0.11
Baseline interest (1-5)	3.63	3.35	3.19	3.25	0.21
Solar knowledge (1-5)	2.70	2.46	2.60	2.62	0.52

Notes: p-values come from omnibus balance tests across the four arms. All variables are measured before exposure to the treatment text.

Each outcome is recorded from the post-treatment block of the questionnaire. Sign-up intention equals one when a respondent agrees to register interest for a free consultation about solar installation. Post-treatment interest is recorded on a five-point scale, as is perceived credibility of the information block. Willingness to pay is recorded as an ordered category, with a structural-refusal option ("would not install regardless of price") as the lowest category in the main specification.

Comprehension checks suggest that the information block was processed, though not by every respondent. After reading the text, 73.6% of respondents correctly identified the expected lifespan of a solar PV system, 54.5% identified that a balcony system can typically be installed independently, and 57.1% identified the main topic of the text they read. Overall, 62.3% answered at least two of three comprehension questions correctly, while 33.8% answered all three correctly (Table 7). This implies that the treatment was

noticed by most respondents but not fully understood by all of them, a point that returns as a limitation in Section 6.4.

Table 7. Information comprehension by treatment arm

Comprehension indicator	Value
Correctly identified expected system lifespan	73.6%
Correctly identified that a balcony system can often be self-installed	54.5%
Correctly identified the main topic of the assigned text	57.1%
At least two correct answers out of three	62.3%
All three correct answers	33.8%

Notes: Comprehension questions are used to interpret treatment exposure, not as exclusion criteria.

Descriptive outcome patterns are summarised in Table 8. The control group records the highest raw sign-up rate at 29.9%. The cost-saving group follows at 22.4%, the social-norm group at 15.4%, and the environmental group at only 7.4%. Differences in average post-treatment interest, credibility, and willingness to pay across arms are smaller and not statistically significant. The most concrete descriptive difference therefore appears for the follow-up action, not for stated attitudes or stated valuation, which already foreshadows the regression results in Chapter 5.

Table 8. Outcome means by treatment arm

Treatment arm	N	Share, %	Sign-up, %	Interest	Credibility
Control	67	29.0	29.9	3.72	3.69
Environment	54	23.4	7.4	3.37	3.63
Cost-saving	58	25.1	22.4	3.33	3.64
Social norm	52	22.5	15.4	3.35	3.54

Notes: Sign-up is a binary indicator for willingness to register for a free consultation. Interest and credibility are measured on 1-5 scales.

Chapter 5

RESULTS

5.1 Sample, randomisation, and descriptive patterns

The analytical sample consists of 231 completed observations. All of the respondents passed through the basic eligibility filters defined in section 4.1. The dataset contains no duplicate identifiers and has no missing values on the outcomes of interest. The allocation of treatment is approximately balanced.

The energy-security context underlying the thesis is reflected in the realised sample. The average age of respondents is 44.5 years. Moreover, 55.4% are women; 84.0% state they own their dwelling or live in a dwelling owned by other family members; and 79.7% experienced power cuts of four or more hours during the last three months. People show moderate interest in solar energy with a mean of 3.37. Many respondents currently experience outages and therefore have direct reasons to consider alternatives.

Raw sign-up rates differ across arms (Table 8). The control group has the highest sign-up rate at 29.9%. The cost-saving group has a 22.4% sign-up rate. The social-norm group has a 15.4% sign-up rate. The environmental group has the lowest sign-up rate at only 7.4%. The direct comparison suggests a difference that can be statistically detected. In contrast, average differences across arms for post-treatment interest, credibility, willingness to pay and the broader consideration item are smaller, and not statistically significant. This means that differences in their follow-up actions are clearer than the differences in what they say and value.

These differences are not caused by any obvious pre-treatment imbalance the balance checks confirm. The omnibus p-values for age, sex, education, income category, ownership, dwelling type, blackout exposure, blackout worry, baseline interest, and baseline solar knowledge all exceed 0.10. There are some small differences for blackout exposure and baseline interest, but

these do not achieve conventional significance. The regressions reported here take pre-treatment covariates into account. These covariates enhance precision and ensure that the estimates are not sensitive to small realised differences across arms.

5.2 Main treatment effects on sign-up

The environmental message causes a reduction in the intention to sign-up by 18 to 19 percentage points compared to the neutral control based on the experiment's clearest result. Further, the effect is consistent across linear and non-linear specifications. Cost-saving and social-norm messaging produce no statistically significant effect on sign-up. Thus, it is not the case that one frame is more effective than another; rather the effectiveness of environmental frames is less than a neutral practical text.

Table 9 contains primary outcome estimates. The dependent variable is a binary variable indicating whether the individual signed up. As shown in the table, I report fitting three specifications: an adjusted linear probability model, the adjusted logit average marginal effects, along with the adjusted probit average marginal effects. The control group is the omitted category so that each coefficient measures the effect of the assigned framed message relative to the neutral information text. All specifications include pre-treatment covariates, including baseline interest in solar (added as a control following the Section 4.2 balance discussion), to ensure that small finite-sample imbalances do not drive the estimate.

Table 9. Adjusted treatment effects on sign-up intention

Treatment	LPM (adjusted)	Logit AME (adjusted)	Probit AME (adjusted)
Cost-saving	−0.043 (0.078)	−0.030 (0.059)	−0.036 (0.061)
Environment	−0.184*** (0.065)	−0.194** (0.078)	−0.187** (0.073)
Social norm	−0.104 (0.075)	−0.089 (0.066)	−0.086 (0.065)

*Notes: Entries are coefficients or average marginal effects with robust standard errors in parentheses. Adjusted models include pre-treatment covariates: baseline interest, ownership, dwelling type, frequent blackouts, blackout worry, and basic demographics. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.*

The environmental treatment has a large and statistically significant negative effect on sign-up in all three specifications. The LPM delivers an estimated effect of -0.184, which indicates an 18.4-percentage-point decline in the likelihood of signing up as compared to control. Logit and probit average marginal effects are very similar (-0.194 and -0.187). The strength of the estimate in both linear and non-linear models suggests that the influence is not simply a function of the model used. After controlling for baseline interest, the size of the environmental effect is almost unchanged, which eliminates the possibility that the environmental arm non-randomly drew respondents with lower baseline interest.

The cost-saving and social-norm messages produce no detectable effect on the observed outcome. For all three models, the point estimate for the cost-saving frame is small and negative. Meanwhile, the social-norm point estimate is also negative, but more precisely estimated. The lack of results could mean any of several things: that the design is underpowered for detecting effects smaller than about 20 percentage points (see Section 3.2); that the cost-saving content largely repeats information that respondents already have; or that the social-norm cue is not credible at the implied magnitude. The data do not adjudicate between these explanations.

I can now return to the pre-specified hypotheses in view of these estimates. H1, the general expectation that any framed message would raise adoption-related outcomes, was not supported. The expectation that the cost-saving message (H2) would produce the largest positive effect is not supported. The social-norm raw sign-up rate (15.4%) is higher than the environmental rate (7.4%) and, so, the effect receives weak descriptive support. However, in adjusted regressions, the social-norm effect is not statistically significantly higher than control. Thus the most strongly supported empirical finding is not that one persuasive frame beats another but rather that a neutral practical information text beats the environmental frame on the concrete sign-up margin.

One way to interpret this design, is according to what it measures. Respondents allocated to the control condition read a factual yet plain paragraph about how a residential solar system works. It is not an empty condition. Thus, the pertinent contrast is persuasive framing versus neutral practical information, rather than any information versus nothing. The estimates show that additional persuasive framing does not improve outcomes on this sample, and, for the environmental message, lowers the likelihood of conversion.

Another way to look at this is to consider what's in the environmental frame. Installing a residential solar system is a costly decision. The questions respondents are likely to weigh - installation cost, reliability during outages, payback time, and technical feasibility - are all practical. A message about carbon emissions and environmental advantages may have normative appeal but does not address these practical questions. When the next step is a consultation, a neutral practical text frames that consultation as a useful source of information. However, an environmental appeal may reframe the next step as a choice about morality or the public good, making it less actionable. The response does not provide evidence of resistance to

environmental arguments, but rather evidence that environmental framing may be poorly matched to the immediate decision margin measured here.

5.3 Secondary outcomes, mechanisms, and heterogeneity

The secondary outcomes help locate the treatment effect within the staged adoption process described in Chapter 2. The adjusted estimates for post-treatment interest, credibility, and willingness to pay are in Table 10. The estimates are uniformly small and not statistically significant. The messages do not raise interest, do not change the perceived credibility of the information, and do not shift the WTP distribution. The fact that the negative environmental effect on sign-up is not matched by an equally large decline in general interest or credibility is informative on its own.

Table 10. Adjusted estimates for secondary outcomes

Outcome / model	Cost-saving	Environment	Social norm
Interest, OLS	−0.127 (0.141)	−0.154 (0.132)	−0.116 (0.128)
Interest, ordered logit	−0.259 (0.389)	−0.282 (0.393)	−0.247 (0.388)
Credibility, OLS	0.047 (0.156)	0.009 (0.191)	−0.052 (0.158)
Credibility, ordered logit	0.056 (0.336)	0.072 (0.360)	−0.125 (0.343)
Any WTP, logit AME	−0.036 (0.048)	−0.041 (0.049)	−0.002 (0.051)
WTP, ordered logit	−0.122 (0.346)	−0.038 (0.361)	0.001 (0.349)

Notes: Entries are coefficients or average marginal effects with standard errors in parentheses. All specifications include pre-treatment covariates. No coefficient in this table is significant at the 10% level.

The raw means for post-treatment interest are slightly lower in all treatment arms than in the control group. Adding baseline interest and other pre-treatment covariates shrinks the differences further and keeps them statistically insignificant. In other words, post-treatment interest is largely explained by baseline interest and respondent characteristics rather than by

the short framing message. Ordered logit and ordered probit deliver the same qualitative conclusion as the OLS benchmark.

The credibility does not vary significantly among the arms. The environmental text isn't rated as much less credible than the control, nor is the social-norm text. I can dismiss the simple story that respondents rejected one of the treatments because they did not believe it. It could be suggested that credibility is necessary but not sufficient for action; respondents may accept the message and still choose not to register if the message does not tackle the constraint that is actually binding in their household.

The clearest signal that affordability matters most comes from willingness to pay. There are no treatment effects on WTP that have a significant impact. Simultaneously, the descriptive statistics reveal a large discrepancy between perceived installation costs and stated capacity to pay, the median perceived cost being 256,150 UAH, 72.7% of respondents would not pay more than 100,000 UAH and 10.0% would not install at any price. Not finding a treatment effect on WTP should not be taken to mean that money does not matter; it is closer to the opposite, namely that a short cost-saving paragraph is too weak to overcome a binding upfront-cost barrier.

The present pattern also aids in interpreting the non-support for H2. Interested households may already know that solar panels reduce future electricity bills. What is lacking is not the awareness of savings, but the availability of credible information about affordability, financing, payback, technical reliability and installation. A brief communication stating that solar saves money would repeat a benefit that respondents generally already accept without removing the reason for their hesitation.

Non-experimental models of readiness point to the same thing (Table 11). There are significant relationships between ownership, blackout worry, having thought about getting solar in the past and financial risk tolerance. Homeowners are more likely than non-owners to show strong adoption interest. A one-point increase in the fear of a blackout almost doubles the

odds of being highly interested. A step up for consideration on the baseline consideration scale is associated with roughly 2.8 times higher odds of having a high post-treatment interest. Financial risk tolerance has a significant positive impact.

Table 11. Readiness model for high post-treatment interest

Predictor	**Odds ratio**	**p-value**
Owner of dwelling	3.13	0.018
Blackout worry (per 1 point)	1.89	<0.001
Prior consideration of solar (per 1 level)	2.80	<0.001
Financial risk tolerance (per 1 point)	1.65	0.007
Environment vs control	0.95	0.918
Cost-saving vs control	0.71	0.448
Social norm vs control	1.12	0.807

Notes: Logistic regression of an indicator for high post-treatment interest (4-5 on 1-5 scale) on pre-treatment readiness variables and treatment dummies.

The sign-up model treats interest as the precursor to action (Table 12). Higher post-treatment interest is the strongest predictor of sign-up. With every additional point on interest, there are about 2.15 times higher odds of signing up. The environmental treatment is still negatively associated with sign-up after controlling for interest, credibility, and comprehension. This suggests that the environmental frame impacts the movement from interest to action more than overall interest does. Respondents may still want solar panels, but the environmental message reduces the probability that they take the concrete follow-up step offered in the survey.

Table 12. Conversion model for sign-up intention

Predictor	Odds ratio	p-value
Environment vs control	0.21	0.009
Cost-saving vs control	0.78	0.576
Social norm vs control	0.50	0.164
Post-treatment interest (per 1 point)	2.15	<0.001
Credibility (per 1 point)	1.03	0.906
Comprehension score	1.19	0.352

Notes: Logistic regression of sign-up intention on treatment dummies and post-treatment readiness variables. The environmental frame remains negatively related to sign-up after controlling for interest, credibility, and comprehension.

Across the pre-specified moderators, treatment effects show little systematic variation. Many of the interaction coefficients have the expected signs, but the cell sizes are too small for strong claims; the cost-saving frame, for instance, looks marginally less unfavourable among non-owners than among owners, though this pattern is fragile given the small number of non-owners and should not be over-interpreted. The formal tests of effect modification that underpin H4 are reported next.

A closer look at H4 is warranted, since it makes a claim about effect modification rather than about an average effect. H4 predicts that a given frame works better for some households than others: the cost-saving frame should help more among financially constrained homeowners, for whom the payback argument is most decision-relevant, while the social-norm frame should help more among households with high baseline interest, for whom a peer signal can convert an already-favourable disposition into action. The relevant quantities are therefore the treatment-by-moderator interaction terms in equation (4), not the main treatment coefficients. To avoid over-reading any single interaction, H4 is assessed both from the individual interaction coefficients and from a joint Wald test of the null that all

interactions for a given moderator are zero, which is the appropriate omnibus criterion for effect modification.

Table 13 reports this analysis for the binary sign-up outcome across four pre-specified moderators: frequent blackout exposure, home ownership, financial constraint, and high baseline interest. The picture is consistent and asymmetric. The readiness variables are strong predictors of the level of adoption intention, as already seen in Tables 11 and 12, where ownership, prior consideration, blackout worry, and financial risk tolerance each raise the odds of high interest, and post-treatment interest dominates conversion. The interaction terms, by contrast, are mostly small and statistically insignificant. For three of the four moderators – frequent blackouts, ownership, and financial constraint – the joint Wald tests are clearly non-significant ($p = 0.63$, 0.36, and 0.60), so there is no evidence that the effect of any frame depends on outage exposure, tenure, or affordability. The exception is baseline interest, whose joint test is marginally significant ($F = 2.34$, $p \approx 0.08$), offering weak and exploratory evidence that responsiveness to framing differs between more and less interested households, the direction anticipated by H4. Even there the result is fragile: the relevant subgroups are small, and a single marginal test among four invites caution about multiple comparisons.

Table 13. H4 – joint tests of effect modification on sign-up

Moderator	Interaction terms	Joint Wald F	p-value
Frequent blackouts	3	0.58	0.630
Home ownership	3	1.07	0.364
Financial constraint	3	0.62	0.604
High baseline interest	3	2.34	0.075*

*Notes: Each row reports a joint Wald test of the null that the three treatment-by-moderator interaction terms are simultaneously zero in a linear probability model for sign-up, estimated with HC1-robust standard errors and the same pre-treatment covariates as Table 9. Each moderator interacts with the three framed-message dummies, giving three interaction terms per test. A non-significant p-value indicates no detectable effect modification by that moderator. * $p < 0.10$. Among the four moderators, only baseline interest reaches even marginal significance.*

H4 therefore receives partial and asymmetric support. The component that treats ownership, blackout salience, prior consideration, and financial readiness as determinants of where a household sits in the adoption funnel is clearly borne out, since these variables dominate both interest and sign-up. The component that treats them as moderators of message effectiveness finds at most weak support: only baseline interest shows even marginally significant effect modification, while outage exposure, ownership, and financial constraint do not. In this sample, then, readiness operates predominantly on the level of adoption intention rather than on responsiveness to framing, with only a weak and exploratory hint that responsiveness rises with baseline interest, the pattern H4 anticipated: households differ mainly in how close they are to action, and a short framed message does not, for the most part, differentially close that gap depending on who receives it. This reading sits comfortably within the staged-adoption framework of Chapter 2, in which framing acts weakly at the salience stage while the binding variation across households lies at the feasibility and affordability stages that no message in this design addresses. The interaction results should nonetheless be read with the same power caution as the main nulls: splitting an already small sample into subgroups leaves the joint tests able to detect only large effect modification, so the evidence rules out strong moderation rather than establishing exact equality, and confirming the marginal baseline-interest interaction would require the larger, pre-registered frame-by-financing design proposed in Chapter 6.

Statistical power restricts conclusions from the null results. With $N \approx 55$ per arm, the minimum detectable effect for the binary sign-up outcome is around 20-25 percentage points assuming $\alpha = 0.05$, 80% power (see Section 3.2). This suggests that the confidence intervals for the cost-saving and social-norm arms are consistent with a range of true effects, including the null; they only rule out large ones. The environmental effect, by contrast, is large enough to

cross this threshold and is consistent across LPM, logit, and probit. It is therefore the most robust finding of the experiment.

When all the experiments are taken into consideration, the original behaviour-change story needs a more cautious reading. The three frames do not improve adoption-relevant outcomes compared to a neutral practical control. The environmental message reduces registration by 18-19 percentage points, with LPM, logit, and probit yielding similar estimates. Post-treatment interest, credibility and WTP do not move with treatment, while household readiness variables – ownership, blackout worry, prior consideration and financial risk tolerance – are strongly associated with both interest and sign-up. Inside the framework of staged adoption, framing seems to act at the final conversion stage not in increasing the overall interest.

These findings motivate the discussion of policy implications, limitations, and future research developed in Chapter 6. They raise two questions: what does the environmental backfire mean theoretically, and what should communication look like when structural readiness factors dominate intentions?

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

According to the experiment, the test messages do not enhance willingness to consider residential solar adoption in this Ukrainian sample, with one exception: the environmental frame reduces concrete signup for a free consultation by 18-19 percentage points compared to a neutral practical control. The negative impact is consistent across linear probability, logit, and probit specifications, being unaffected by baseline interest and other pre-treatment controls. The messages that concerned cost-savings and social-norm suggested point estimates that were small and statistically indistinguishable from zero on sign-up, with no detectable effects on interest, credibility, or willingness to pay.

Experimental evidence is complemented by non-experimental readiness models. There is a strong association between ownership, blackout concern, previous consideration of solar panels, financial risk tolerance and both post-treatment interest and sign-up. The process of registration is best understood as a process of conversion: respondents with greater interest are much more likely to take the small follow-up step, and the environment frame depresses this conversion, even controlling for interest and credibility.

Regarding the four pre-stated hypotheses discussed in Chapter 3: H1 (that any framed message raises adoption-related outcomes) is unsupported; H2 (that the cost-saving message is the strongest positive frame) is unsupported; H3 (that the social-norm frame outperforms the environmental frame) receives only weak descriptive support – the raw sign-up gap goes in the predicted direction, but is not robust in all adjusted regressions; H4 (that heterogenous treatment effects will occur across moderators) receives partial support in that ownership and prior consideration shapes readiness, but interaction terms between treatment and moderators are mostly not robust

statistically. The joint Wald tests of effect modification (Table 13) bear this out: outage exposure, ownership, and financial constraint show no effect modification, and only baseline interest is marginally significant ($p \approx 0.08$), so readiness shapes mainly the level of adoption intention rather than responsiveness to the message.

The finding that the environmental message reduces concrete sign-up is by far the most informative result of the experiment. It deserves careful interpretation, however. Though the data cannot identify the underlying mechanism, three readings consistent with this result are worth flagging. The motive mismatch is the first reading. Ukrainians report wartime energy insecurity and regular blackouts. Solar power will be chiefly considered as a household investment that provides resilience rather than a technology for climate change. According to an environmental appeal, the decision relates to morality and the common good. But these kinds of questions can feel distant from the practical ones that households in fact weigh, like installation cost, payback time, technical reliability, and compatibility with the dwelling. As a result, the reframing tends to lower the likelihood that respondents embark on the next concrete step.

The most informative result of the study is the finding that the environmental message reduces concrete sign-up. But it warrants close reading. While the data cannot pinpoint an underlying mechanism, three findings consistent with this result are worth noting. The initial interpretation is the motive discordance. Ukrainians report wartime energy insecurity and regular blackouts. Solar power is likely to be seen as a household investment that offers resilience rather than a climate solution. According to an environmental appeal, the decision relates to morality and the common good. However, these types of inquiries can feel far removed from the more pragmatic ones considered by households: installation cost, payback time, technical reliability, and compatibility with the home. Consequently,

reframing often reduces the chance that respondents will take the next tangible step.

There are many policy implications. The primary obstacle in this sample is not lack of knowledge or lack of environmental motivation. Individuals show a medium to high interest in solar, incur a lot of blackouts and find solar relevant, the binding gap is the installation cost they perceive and the amount they state to pay. An economic benefit can become more salient after a short message but it cannot resolve upfront cost, payback uncertainty, ownership constraints or technical uncertainty. The policy implication is that communication and finance are complements, not substitutes.

Messaging must be targeted to households which are near the action and not be uniform. The readiness frameworks of Chapter 5 isolate the relevant subgroup: homeowners who worry a lot about blackouts, have previously considered solar and are somewhat financially risk tolerant. Communication that provides what respondents do not already have – installation steps, funding options, expected payback under realistic tariff assumptions, reliability and warranty information, and compatibility with their dwelling type. At broader policy development level bundling, rather than stand-alone campaigns, is what this implies. A message about how to save money along with a subsidised loan or installation scheme; a message based on the social norm along with a representative demonstration project; an environmental or energy-resilience message along with contacts for installers and a household-specific payback calculator. People typically match their framing to the stage of the household's decision: awareness, evaluation or action. The framework I introduced in Chapter 2 is useful precisely because it clarifies that no one message can do all three jobs.

Two caveats limit how far these implications can be pushed. The sample size (N = 231) and design (single online survey, one exposure per respondent) warrant narrow causal claims but not national policy prescriptions. Of the three formats tested, environmental backfire is the only one that is statistically

robust here. The cost-saving and social-norm nulls are the product of many potential explanations and need replication before generic policy advice can be drawn from them. Accordingly, the most defensible reading is that short framed messages alone do not move sign-up here, the environmental backfire deserves replication and structural readiness factors dominate intentions.

There are some limitations that one should consider while interpreting the results. In the survey, willingness to pay is measured through ordered categories and there is no real-stakes payment; hence, there is no incentive for respondents to report their true reservation price. As a result, stated WTP may under-report willingness to act in a setting with credible financing. Understanding of the Manipulation is limited. Only 33.8% of respondents got all three comprehension questions right. Meanwhile, 62.3% managed to get at least two of the three questions right. Since fewer people got completely right, this suggests that there was heterogeneous attention to the text assigned. This may dampen the measured effect of the framing. The sample also leans heavily towards homeowners (84.0%), which is well above the share of homeowners in the urban Ukrainian population, so conclusions generalize more easily to homeowner subpopulations than to renters or apartment dwellers.

The measured outcome and the design itself raise further limitations. The main behavioral outcome I am looking for here is to register for a free consultation. Whether or not the installation decision occurs is the second-order outcome. Some who sign-up may not go on to install and some who don't sign-up may install through some other channel. So, my findings should be read as evidence about the conversion from interest to a little next step. They should not be read as evidence about the completed adoption. Each respondent saw the assigned framed paragraph once, in a controlled survey setting. Real-world campaigns typically rely on repeated exposure, multi-channel delivery and personalised information. So while a single short paragraph is a clean test of a framing manipulation, it is a weak test of what

well-designed communication can achieve over time. The design detects effects on the binary sign-up outcome of around 20-25 percentage points or larger with N ≈ 55 per arm, so with this sample they cannot rule out smaller effects on the cost-saving and social-norm frames. To conclude, the sample for this research has been recruited through an online panel, and is not nationally representative; estimates should be read as evidence from the analysed sample.

Consequently, three specific guidelines for future research arise from these limitations. The most urgent next step is a preregistered replication of the environmental backfire in a larger sample: the -18 to -19 percentage-point effect on sign-up is the most novel finding and is also the one most exposed to small-sample concerns, and a preregistered design with several hundred respondents per arm and an equivalent neutral practical control would establish whether the effect is robust, whether it generalises beyond the Ukrainian wartime setting, and whether it survives slightly different operationalisations of the environmental message. Next, a head-to-head comparison could test the motive-mismatch reading directly by comparing a resilience-framed message ("keep your home powered through blackouts") against a climate-framed one. It would also rule out the alternative that any environmental framing backfires. Thirdly, as affordability would appear to be the binding constraint, the obvious next experiment varies both the message frame and the presence of a credible financing pathway (subsidised loan, instalment scheme, leasing offer) in a 2 × 2 design; this will test whether communication only works when it is bundled with finance and whether the environmental backfire disappears, persists or even reverses when respondents are offered a way to pay for the item they read about.

Solar adoption in Ukraine should not be framed as a communication problem. The final step to sign-up can be influenced by behavioral nudges at the margin. But behavioral nudges cannot do the work of ownership, energy-security concern, prior consideration and a credible way to pay. A neutral

practical message outperforms persuasive frames in this sample, while the environmental frame performs worse on concrete sign-up. The main takeaway from the insights into households on solar energy is that household readiness – ownership, salience, prior interest, and financial wherewithal – is a prerequisite for solar adoption, and communication is most useful when it meets households where they already are.

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APPENDIX A. SURVEY INSTRUMENT

START

Dear participant!

Thank you for taking part in this survey. We are conducting an academic study on household energy-consumption decisions in Ukraine.

Your answers will help us understand how people make decisions about energy consumption in their households. This survey will take approximately 5–7 minutes.

All answers are anonymous and will be used exclusively for research purposes.

There are no right or wrong answers; we are interested in your personal opinions and experience.

Section 1 - Screening and eligibility

Q1.1. How old are you in full years?

If the respondent is under 18 years old, end the survey.

Q1.2. Do you currently live in Ukraine?

1. Yes (continue)
2. No (end the survey)

Q1.3. Which option best describes your role in making decisions about major household purchases or investments?

1. I make most decisions
2. I make decisions jointly with another person/other people
3. I do not participate in these decisions (end the survey)

Section 2 - Socio-demographic data and housing

Q2.1. What is your gender?

1. Male
2. Female
3. Other / Prefer not to answer

Q2.2. What is the highest level of education you have completed?

1. No formal education
2. Basic secondary education (completed 9 grades)
3. Complete general secondary education (completed 11 grades)
4. Vocational education / college
5. Higher education: Bachelor's degree
6. Higher education: Master's degree (Specialist)
7. Academic degree: Candidate or Doctor of Sciences

Q2.3. Which of the following statements best describes your family's current financial situation?

1. We cannot afford enough food and basic necessities
2. We can afford food and basic necessities, but not clothing and shoes when needed
3. We can afford food and clothing, but not small household appliances (for example, a phone or microwave oven)
4. We can afford small household appliances, but not major purchases (for example, furniture or a TV)
5. We can afford major purchases, but not very expensive items (for example, a car or major renovation)
6. We can afford very expensive items if necessary

Q2.4. What is your family's approximate monthly income?

1. Less than UAH 10,000

2. UAH 10,000–19,999

3. UAH 20,000–29,999

4. UAH 30,000–49,999

5. UAH 50,000+

6. Prefer not to answer

Q2.5. What type of housing do you live in?

1. Apartment in a multi-apartment building

2. Private house

3. Townhouse / duplex (two-family house)

4. Other (please specify) _____

Q2.6. What is your housing status?

1. Fully owned (by you or your relatives)

2. Mortgage

3. Rental

4. Other arrangement

Q2.7. In which oblast do you currently live?

Drop-down list of oblasts + "Prefer not to answer."

Section 3 - Energy situation, expectations, and baseline beliefs

Q3.1. What is your average monthly spending on electricity?

1. Less than UAH 500

2. UAH 500–1,000

3. UAH 1,000–1,500

4. UAH 1,500–2,000

5. UAH 2,000–3,000

6. More than UAH 3,000

7. I do not know

Q3.2. How often have power outages occurred in your area during the last 3 months?

1. Several times a day

2. Once a day

3. Several times a week

4. Once a week

5. Several times a month

6. Once a month

7. Less often than once a month

8. There were no outages during this period

Q3.2.1. What was the longest duration of outages during this period?

1. Up to 1 hour

2. 1–4 hours

3. 4–8 hours

4. 8–12 hours

5. 12–24 hours

6. 1–3 days

7. More than 3 days

Q3.3. How concerned are you about power supply disruptions over the next few months?

1. 1 – not concerned at all

2. 2

3. 3

4. 4

5. 5 – very concerned

Q3.4. How would you rate your knowledge of residential solar panels?

1. Very poor

2. Poor

3. Average

4. Good

5. Very good

Q3.5. How interested are you in installing solar panels in your home?

1. 1 – not interested at all

2. 2

3. 3

4. 4

5. 5 – very interested

Q3.6. Do you personally know anyone who has installed solar panels?

1. Yes, I personally have — end the survey

2. Yes, a close friend or family member

3. Yes, an acquaintance or neighbor

4. No

Q3.7. How much do you think it costs to install a typical rooftop solar system?

Slider: UAH 20,000–500,000.

Q3.8. How confident are you in this estimate?

1. Not confident at all

2. Slightly confident

3. Moderately confident

4. Very confident

Q3.9. In your opinion, how much money can a solar system save each month on electricity bills?

Slider: UAH 0–5,000.

Q3.10. How confident are you in this estimate?

1. Not confident at all

2. Slightly confident

3. Moderately confident

4. Very confident

Q3.11. How many years do you think it takes for solar energy to pay back the initial costs?

Slider: 1–20 years.

Q3.12. How confident are you in this estimate?

1. Not confident at all

2. Slightly confident

3. Moderately confident

4. Very confident

Q3.13. How risky do you think investing in solar panels in Ukraine is at the moment?

1. 1 – not risky at all

2. 2

3. 3

4. 4

5. 5 – very risky

Section 4 - Behavioral economics block

"Present bias" module

Q4.1. What would you choose: UAH 1,000 today OR UAH 1,500 in 12 months?

1. UAH 1,000 today
2. UAH 1,500 in 12 months

Q4.2. What would you choose: UAH 1,000 in 12 months OR UAH 1,500 in 24 months?

1. UAH 1,000 in 12 months
2. UAH 1,500 in 24 months

Q4.3. How willing are you to give up something beneficial today in order to receive a greater benefit in the future?

1. 0 – completely unwilling
2. 1
3. 2
4. 3
5. 4
6. 5 – neither willing nor unwilling
7. 6
8. 7
9. 8
10. 9
11. 10 – very willing

Risk preference module

Q4.4. In general, I am willing to take financial risks if the potential benefits are high.

1. 1 – strongly disagree
2. 2
3. 3
4. 4
5. 5 – strongly agree

Q4.5. How would you describe your overall willingness to take financial risks?

1. Very low
2. Low
3. Moderate
4. High
5. Very high

Section 5 - Randomized information message and comprehension checks

Random assignment takes place automatically here. The participant reads one message and then answers questions to check comprehension.

Control group (neutral information)

Solar systems convert sunlight into electricity which is used in homes. In the case of houses, the panels are usually installed on the roof whereas, most residential systems have a capacity between 5 to 10kW. For apartments, it is preferred to install smaller balcony solar systems (300–800 W) and connect them directly to your home's electrical grid.

Both forms produce energy during the day.

The installation process for a residential rooftop system normally takes between one to three days while balcony systems are simpler and can often

be installed by themselves. Solar panels need little maintenance: a clean every so often plus a periodic check of their inverter. With no moving parts, they are quite sturdy in nature. The solar PV system is expected to last for around 25 years.

Your home is powered directly by the power generated during the day. In a net-metering arrangement or net-billing facility, surplus energy may be contributed back to the grid. The performance of the system is determined by the orientation of the panel, sunlight conditions in that locality, and size of the system.

There are many conditions to consider when contemplating solar panel installation. For example, the orientation of your roof or balcony, the amount of sunlight available in that area, space availability, and household electricity consumption.

There are choices for small plug in balcony systems to bigger rooftop installations with batteries, depending on house and budget. System type drives the installation requirements. Certified installers and your area's energy agencies can provide you with more complete details.

Environmental framing

Solar photovoltaic (PV) systems convert sunlight into electricity for household use. For houses, panels are usually installed on the roof, and most residential systems have a capacity of 5 to 10 kW. For apartments, smaller balcony solar systems (300–800 W) can be installed and connected directly to the home's electrical grid. Both types generate electricity during daylight hours.

Installing a residential rooftop system usually takes 1–3 days; balcony systems are simpler and can often be installed independently. Solar panels require minimal maintenance: occasional cleaning and periodic inspection of the inverter. They have no moving parts, which contributes to their durability. The expected service life of a solar PV system is approximately 25 years.

During daylight hours, the system generates electricity that directly powers your home. Excess electricity can be stored in batteries or, where available, returned to the grid through a net-metering system. System performance depends on panel orientation, local sunlight conditions, and system size.

Installing solar panels helps reduce air pollution and dependence on fossil fuels. Because they generate electricity without burning fuel, they reduce carbon emissions associated with household energy consumption. Each kilowatt of rooftop solar capacity prevents approximately 1.2 tonnes of CO_2 emissions per year. Using solar energy at home also reduces demand during peak load hours, supporting grid stability and reducing the need for high-emission backup power sources. Switching to solar energy is a step toward cleaner air for your community and for Ukraine.

Economic framing

Solar photovoltaic (PV) systems convert sunlight into electricity for household use. For houses, panels are usually installed on the roof, and most residential systems have a capacity of 5 to 10 kW. For apartments, smaller balcony solar systems (300–800 W) can be installed and connected directly to the home's electrical grid.

Both types generate electricity during daylight hours.

Installing a residential rooftop system usually takes 1–3 days; balcony systems are simpler and can often be installed independently. Solar panels require minimal maintenance: occasional cleaning and periodic inspection of the inverter. They have no moving parts, which contributes to their durability. The expected service life of a solar PV system is approximately 25 years.

During daylight hours, the system generates electricity that directly powers your home. Excess electricity can be stored in batteries or, where available, returned to the grid through a net-metering system. System performance depends on panel orientation, local sunlight conditions, and system size.

Solar panels can significantly reduce electricity costs. From the first month after installation, household electricity bills can decrease by approximately UAH 1,000–2,000 per month, depending on consumption and system size. The greatest savings are achieved when you use more of the electricity generated directly during the day. Over the system's 25-year service life, total savings can substantially exceed the initial investment. Many households find that the system pays for itself within 5–7 years, and all electricity generated after that is effectively free...

Social framing

Solar photovoltaic (PV) systems convert sunlight into electricity for household use. For houses, panels are usually installed on the roof, and most residential systems have a capacity of 5 to 10 kW. For apartments, smaller balcony solar systems (300–800 W) can be installed and connected directly to the home's electrical grid.

Both types generate electricity during daylight hours.

Installing a residential rooftop system usually takes 1–3 days; balcony systems are simpler and can often be installed independently. Solar panels require minimal maintenance: occasional cleaning and periodic inspection of the inverter. They have no moving parts, which contributes to their durability. The expected service life of a solar PV system is approximately 25 years.

During the day, the system generates electricity that directly powers your home. Excess electricity can be stored in batteries or, where available, returned to the grid through a net-metering system. System performance depends on panel orientation, local sunlight conditions, and system size.

Solar panels are becoming increasingly popular in Ukraine. Over the past two years, more than 50,000 households have installed rooftop systems, which is 40% more than before. Balcony panels have also become more popular, especially among residents of apartment buildings who are looking for a practical way to generate their own electricity. More and more Ukrainian

families are choosing to produce their own electricity at home. This trend is especially strong in urban areas, where residents find that even small balcony systems noticeably affect their daily energy consumption.

ASSIGNMENT ACROSS FRAMING CONDITIONS (First two questions for all texts)

Q5.1. According to the text, what is the approximate service life of a solar PV system?

1. 5–10 years
2. 15–20 years
3. 25 years
4. 40 years

Q5.2. Which type of solar system can often be installed independently?

1. Rooftop systems
2. Balcony systems
3. Both types equally
4. Neither

Manipulation check (all options, softened wording):

Q5.3. Which of the following topics was discussed in the text you read?

1. The environmental impact of using solar energy
2. Financial savings from using solar energy
3. The growing number of households switching to solar energy
4. Practical factors to consider before installing solar panels
5. I do not remember

Section 6 - Outcomes (interest, willingness to pay, consultation sign-up)

Q6.3. How interested are you in installing solar panels in your home?

1. 1 – not interested at all
2. 2
3. 3
4. 4
5. 5 – very interested

Q6.4. What is the maximum amount you are willing to pay for installing solar panels?

1. Less than UAH 50,000
2. UAH 50,000–100,000
3. UAH 100,000–150,000
4. UAH 150,000–200,000
5. UAH 200,000–250,000
6. More than UAH 250,000
7. I would not install them regardless of the price

Section 7 - Trust and feedback

Q7.1. How credible do you find the information provided about solar panels?

1. 1 – not credible at all
2. 2
3. 3
4. 4
5. 5 – very credible

Q6.1. Final question: would you like to register for a free online consultation on installing solar panels in your home?

1. Yes

2. No

If “Yes,” ask Q6.2. If “No,” go to Q6.3.

Q6.2. (If the answer to Q6.1 = “Yes”) Please provide your email address or phone number: Open text field.

Q7.2. Do you have any comments or feedback about this survey?

Open text field.

FINAL PAGE

Thank you for taking the time to complete this questionnaire and participate in this academic study. We greatly value your participation, which contributes to the development of research on household energy decisions in Ukraine.