

Impact of Cultural Context on Behavioral Energy Conservation Policy

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Abstract

Energy efficiency programs are widely used to reduce household energy consumption because of their potential cost-effectiveness. However, their impact is limited when households perceive the costs of participation to outweigh the expected benefits. This study explores whether cultural context may help explain variation in the effectiveness of Home Energy Report (HER) interventions across Japan and Germany. Using an exploratory comparative review of published HER field trials, the paper descriptively compares reported Average Treatment Effects (ATEs) across studies. To provide additional context on policy efficiency, it also draws on published Cost-Effectiveness Ratio (CER) benchmarks from Andor et al. (2018), rather than estimating CERs from the reviewed studies. The analysis is descriptive rather than meta-analytic, as the included trials differ in intervention design, sample composition, duration, and reporting practices. Across the reviewed studies, mean reported ATEs were 2.53% in Japan and 1.83% in Germany. Independent benchmarks from Andor et al. (2018) indicate estimated cost-effectiveness of approximately 18–45 kWh saved per US\$1 spent in Japan and 11–27 kWh in Germany. Although these findings are not statistically conclusive and should not be interpreted as mutually validating, they are broadly consistent with the possibility that social-comparison feedback may generate stronger behavioral responses in Japan than in Germany. Overall, the findings suggest that adapting HER-style interventions to local social norms and behavioral contexts may improve policy effectiveness, while contextual cost-effectiveness evidence points to potential differences in policy efficiency across national settings.

Keywords: home energy reports (HER), social norm feedback, behavioral energy interventions, residential electricity conservation, cross-cultural policy effectiveness, collectivism vs. individualism, cost-effectiveness analysis, randomized controlled trials

1. Introduction

This paper examines whether cultural context may help explain variation in the effectiveness of Home Energy Report (HER) initiatives through an exploratory comparative review of HER trials conducted in Japan and Germany.

Global energy consumption, primarily electricity and heat production, is the largest single source of greenhouse gas (GHG) emissions, accounting for 34% of 2019 global GHG emissions (United States Environmental Protection Agency, 2025). Many look to renewable energy sources as the solution, but energy efficiency is consistently recognized by organizations like the International Energy Agency (IEA) as the "first fuel", the single largest contributor to emissions reduction due to it being the "quickest and cost-effective CO₂ mitigation options" (IEA, 2024). Despite substantial global investment, global tracking indicates that \$800 billion USD is currently being invested annually in technologies and programs to increase energy efficiency, yet it remains well below the 4% annual improvement target agreed upon at COP28 for 2030 at 1.3%, highlighting persistent policy gaps. This gap could be substantially reduced by "raising the ambition of existing policies" (IEA, 2025) through behavioral load shifting.

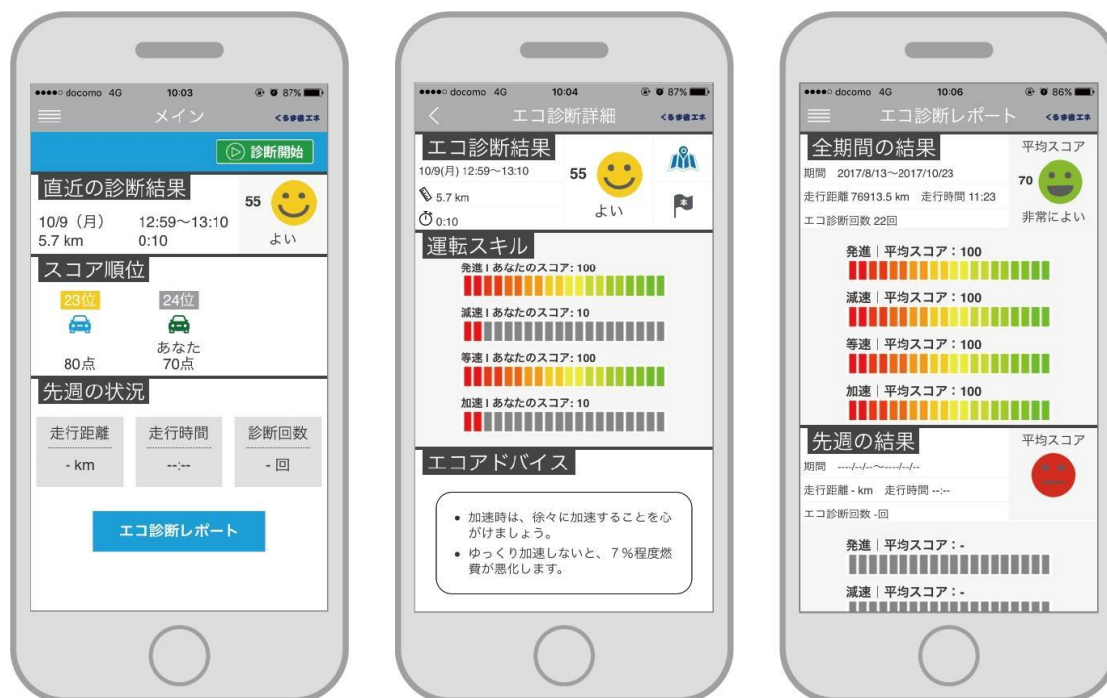


Figure 1: An example of the layout of the home energy reports used in Japanese Energy Trials (Automotive Media Response, 2018).

Behavioral interventions such as Home Energy Reports (HERs) have emerged as a promising tool to address these gaps. By leveraging social norms and comparison, HER trials (e.g., Figure 1 and Figure 2) demonstrated an average of 2-3% of energy preservation. Given this potential, individual efforts can reduce consumption. However, the effectiveness of behavioral

energy consumption intervention policies greatly differs depending on the region, raising questions about the conditions under which such policies succeed.

ENERGIEAUSWEIS für Nichtwohngebäude

gemäß den §§ 16 ff. der Energieeinsparverordnung (EnEV) vom 1

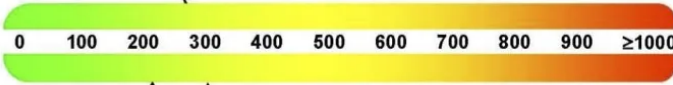
Berechneter Energiebedarf des Gebäudes

Primärenergiebedarf

CO₂-Emissionen ³ kg/(m²·a)

Primärenergiebedarf dieses Gebäudes

kWh/(m²·a)



EnEV-Anforderungswert
Neubau (Vergleichswert)

↑

EnEV-Anforderungswert
modernisierter Altbau (Vergleichswert)

↑

Registriernummer ²

(oder: „Registriernummer wurde beantragt am...“)

2

Anforderungen gemäß EnEV ⁴

Primärenergiebedarf

Ist-Wert kWh/(m²·a) Anforderungswert kWh/(m²·a)

Mittlere Wärmedurchgangskoeffizienten ☐ eingehalten

Sommerlicher Wärmeschutz (bei Neubau) ☐ eingehalten

Für Energiebedarfsberechnungen verwendetes Verfahren

☐ Verfahren nach Anlage 2 Nummer 2 EnEV

☐ Verfahren nach Anlage 2 Nummer 3 EnEV („Ein-Zonen-Modell“)

☐ Vereinfachungen nach § 9 Absatz 2 EnEV

☐ Vereinfachungen nach Anlage 2 Nummer 2.1.4 EnEV

Endenergiebedarf

Energieträger	Jährlicher Endenergiebedarf in kWh/(m ² ·a) für					Gebäude insgesamt
	Heizung	Warmwasser	Eingebaute Beleuchtung	Lüftung ⁵	Kühlung einschl. Befeuchtung	

Endenergiebedarf Wärme [Pflichtangabe in Immobilienanzeigen] kWh/(m²·a)

Endenergiebedarf Strom [Pflichtangabe in Immobilienanzeigen] kWh/(m²·a)

Angaben zum EEWärmeG ⁶

Nutzung erneuerbarer Energien zur Deckung des Wärme- und Kältebedarfs auf Grund des Erneuerbare-Energien-Wärme-gesetzes (EEWärmeG)

Art: Deckungsanteil: %

Ersatzmaßnahmen ⁷

Die Anforderungen des EEWärmeG werden durch die Ersatzmaßnahme nach § 7 Absatz 1 Nummer 2 EEWärmeG erfüllt.

☐ Die nach § 7 Absatz 1 Nummer 2 EEWärmeG verschärften Anforderungswerte der EnEV sind eingehalten.

Verschärfter Anforderungswert kWh/(m²·a)

Primärenergiebedarf: kWh/(m²·a)

☐ Die in Verbindung mit § 8 EEWärmeG um % verschärften Anforderungswerte der EnEV sind eingehalten.

Verschärfter Anforderungswert kWh/(m²·a)

Primärenergiebedarf: kWh/(m²·a)

Gebäudezonen

Nr.	Zone	Fläche [m ²]	Anteil [%]
1			
2			
3			
4			
5			
6			
7			

☐ weitere Zonen in Anlage

Erläuterungen zum Berechnungsverfahren

Die Energieeinsparverordnung lässt für die Berechnung des Energiebedarfs in vielen Fällen neben dem Berechnungsverfahren alternative Vereinfachungen zu, die im Einzelfall zu unterschiedlichen Ergebnissen führen können. Insbesondere wegen standardisierter Randbedingungen erlauben die angegebenen Werte keine Rückschlüsse auf den tatsächlichen Energieverbrauch. Die ausgewiesenen Bedarfswerte sind spezifische Werte nach der EnEV pro Quadratmeter beheizte/gekühlte Nettogrundfläche.

¹ siehe Fußnote 1 auf Seite 1 des Energieausweises ² siehe Fußnote 2 auf Seite 1 des Energieausweises ³ freiwillige Angabe

⁴ nur bei Neubau sowie bei Modernisierung im Fall des § 16 Absatz 1 Satz 3 EnEV ⁵ nur Hilfsenergiebedarf

⁶ nur bei Neubau ⁷ nur bei Neubau im Fall der Anwendung von § 7 Absatz 1 Nummer 2 EEWärmeG

Figure 2: An example of the layout of the home energy reports used in German Energy Trials (Autarc, 2025).

Figure 1 and Figure 2 provide illustrative examples of the Home Energy Report materials used in Japanese and German trials. They are included to show the type of household-facing feedback intervention examined in this paper, including comparative energy-use information and conservation guidance. Although the figures are not themselves evidence of treatment effects, they help clarify the intervention format and provide visual context for the cross-country comparison that follows.

The application of social nudges, a behavioral, economic, and psychological insight to influence individual decision-making, has become widely adopted as a cost-effective policy tool (Thaler & Sunstein, 2008). However, the effectiveness of these interventions varies across populations and implementation contexts depending on region due to the challenges social nudges pose. Evidence by Khosrowpour et al. (2016) suggests the need for tailored interventions for households with different energy consumption patterns, highlighting the fact that different populations may react in different ways to the distribution of social information. This variability is further supported by Grønhøj, A., & Thøgersen, J. (2011), who found that feedback mechanisms influence energy consumption not only through information provision but also through social learning and normative influence, with effectiveness differing across household contexts. Similarly, Gans, W., Alberini, A., & Longo, A. (2013) provide evidence from a natural experiment in Northern Ireland showing that the impact of feedback technologies such as smart meters varies depending on user engagement and contextual factors. The global diffusion of identical policies without sufficient consideration of cultural differences risks diminished marginal returns and inefficient resource allocation (Sunstein, 2019). Cultural values can interfere with how people objectively interpret and react to public policy information; however, this effect can be reduced through effective debiasing strategies. By presenting evidence in ways that align with, rather than challenge, people's existing cultural values, individuals from different backgrounds are more likely to accept the information (Kahan & Braman, 2006). This analysis of literature suggests that the effectiveness of feedback-based interventions is not solely based on information but is socially mediated, reinforcing the importance of cultural context in shaping behavioral responses.

This study examines cultural context as one possible factor that may help interpret this variation. Differences in social norms, communication styles, and collective behavior may influence how individuals respond to normative feedback, leading to divergent policy outcomes across countries. To investigate this, the paper focuses on Japan and Germany, two highly industrialized, energy-dependent economies with similar constraints but contrasting cultural profiles. Empirical evidence suggests that Japanese population behaves more uniformly across social groups than the German population; respondents in the Japanese sample in a recent paper by Schmidt-Petri et al. (2022) reported greater cooperation with vaccinations during the COVID-19 pandemic, regardless of gender, level of education, etc, whereas Germany shows greater individual variations. We can assume through Japan's uniformity, Japan exhibits more uniform behavioral responses across social groups, whereas Germany shows greater individual variation, indicating differing sensitivities to social norms.

To examine this relationship, this paper employs an exploratory comparative review of published HER trials in Japan and Germany, comparing reported Average Treatment Effect (ATE) and Cost-Effectiveness Ratio (CER) across studies. Rather than attempting to establish causal proof, the paper uses cultural theory as an interpretive framework for assessing whether observed differences in HER outcomes are broadly consistent with cross-cultural differences in social norms and behavioral responses. Because the reviewed trials differ in intervention structure, sample composition, duration, and reporting practices, the resulting cross-country comparison is descriptive and should not be interpreted as a formal pooled estimate or as a strictly controlled test of cultural causation.



2. Background on Culture and Energy Policy

2.1. The Effectiveness and Variability of Social Norm Nudges

Social Norm Feedback (HER) has emerged as a widely used behavioral policy tool to promote energy conservation. Operating on the principle of descriptive and injunctive norms, HER interventions provide households with information about their energy use compared to others, encouraging reductions through social comparison. On average, such interventions yield annual energy savings of about 2% of total primary energy consumption across the 144 countries (Jain, 2025).

However, this comprehensive figure masks heterogeneity. Trials conducted in different nations, and even different regions within the same nation, have demonstrated savings ranging from reductions of 0.7% to 16%. Refer to Appendix A for an illustrative list of each of the 16 papers, with information on the country where the field experiment or survey was conducted, and a short presentation of the work, results, and type of nudging. This inconsistency suggests that the psychological mechanism of perceived cost of non-conformity is not universally activated.

This inconsistency raises a critical question: what factors determine when and where HER interventions are most effective? One possible explanation could be attributed to cross-cultural differences, which may shape how individuals perceive and respond to social norms.

2.2. Cultural Theory: Collectivism and Communication Context

To explain this variability, we rely on established cultural theories, particularly Hofstede's dimension of Individualism vs. Collectivism (IDV) and Hall's theory of communication context, while also recognizing the limitations of treating national cultures as fixed and internally uniform categories.

Collectivist societies (Low IDV), such as Japan, emphasize group loyalty and cohesion, social harmony, and conformity to in-group norms (e.g., Hong Kong, Japan). In contrast, **individualist Societies** (High IDV) prioritize personal achievements and individual autonomy (e.g., the US, Germany). These differences may shape the extent to which individuals respond to social comparison and normative pressure. However, Hofstede style models have been widely criticized for essentializing national cultures, overlooking within-country diversity, and underestimating the influence of institutional, generational, and situational factors. As such, these frameworks should not be read as deterministic explanations of behavior, but rather as heuristic tools for identifying broad tendencies that may help contextualize cross-national differences in responses to feedback interventions.

Furthermore, Edward T. Hall's distinction between **high-context** (Japan) and **low-context** (Germany) communication provides a second lens to interpreting Japan and Germany's varying response to the Social Norm Feedback (HER). High-context cultures, common in many Asian and African societies, communicate intentions largely through shared understanding, nonverbal cues, and the surrounding social context, placing strong emphasis on social cohesion. In contrast, low-context cultures, including the United States and much of Europe, favor individual accomplishment rather than collective relationships, and social interactions are often more transactional or purpose-driven. At the same time, Hall's framework has also been criticized for simplifying complex communicative practices and for mapping broad communication tendencies too neatly onto national categories. Communication styles vary not only across countries, but also across regions, generations,



organizations, and specific interactional settings. Although no culture exists entirely at either extreme, the distinction illustrates how communication styles and social organization vary according to underlying cultural norms. (Sheposh, 2025).

Together, these frameworks suggest one possible interpretation of why HER may be more effective in some contexts than others, particularly where social comparison and implicit normative cues carry greater social salience. However, our interpretation remains cautious: the observed differences between Japan and Germany should not be attributed to culture alone, nor should either country be treated as culturally homogeneous. Rather, Hofstede's and Hall's theories are used here as interpretive frameworks that help illuminate possible cultural mechanisms behind differential responses to HER, alongside other structural, institutional, and contextual factors.

2.3. Energy Trials and Policy in Japan and Germany

These theoretical expectations are suggested in the contrasting energy policy landscapes of Japan and Germany.

The comparison between Japan and Germany illustrates how cultural frameworks can be used to interpret variation in HER outcomes, but it also highlights the importance of considering alternative structural explanations. In Japan, energy policy is deeply intertwined with national security and collective responsibility, particularly following the 2011 disasters. The government has strategically used top-down appeals and social norms (e.g., the Setsuden and "Cool/Warm Biz" campaigns) that leverage the strong collectivist ethic. Initial HER trials in Japan demonstrated statistically significant and sustained savings, often exceeding the global average.

In contrast, Germany's energy policy is primarily driven by rational incentives (e.g., the feed-in tariff and KfW development bank subsidies) and rigorous regulation (e.g., strict building energy codes like EnEV/GEG). While HER trials have been implemented, their effectiveness appears dependent on cultural context, in which certain demographics are less responsive to anonymous social comparisons. These differences are broadly consistent with the possibility that social norm nudges may resonate more strongly in settings where collective expectations and socially embedded communication styles are more salient.

However, the contrast between Japan and Germany should not be interpreted as evidence that cultural mechanisms alone explain differences in HER effectiveness. Several structural variables may also shape these outcomes, including energy pricing, housing stock, environmental regulation, policy design, and baseline conservation behavior. For example, households in different countries face different energy costs, live in different types of buildings, and operate within different regulatory and infrastructural systems, all of which may influence both energy use and responsiveness to behavioral interventions. These factors may interact with culture, but they may also independently account for part of the observed variation.

For this reason, the findings of this study are best understood as broadly consistent with cultural theories of collectivism, individualism, and communication context, rather than as definitive evidence of cultural causation. Cultural theory provides a useful lens for interpreting why HER may be more effective in some settings than in others, but it should be situated alongside institutional, economic, and policy-based explanations. Presenting culture as one explanatory framework among several offers a more cautious and analytically balanced interpretation of the differences observed between Japan and Germany.



3. Conceptual Framework and Analytical Expectations

3.1. Framework

This study uses cultural and behavioral frameworks as interpretive lenses to understand observed cross-national variation in HER outcomes. Rather than functioning as a formal meta-analysis, however, the study is better understood as an exploratory comparative review of published HER studies in Japan and Germany. Although HER programs have been widely adopted as cost-effective tools for reducing household energy consumption, prior research consistently shows that their effectiveness varies substantially across countries, communities, and household types. Existing studies have largely focused on household-level variables such as baseline energy use, feedback frequency, and user engagement. However, a key gap in the literature is the limited attention given to how broader cultural contexts shape the mechanisms through which behavioral interventions operate.

This gap is important because HER interventions rely not only on information provision but also on social and psychological processes that may function differently across societies. As Austin et al. (2022) argue, interventions that align with local cultural values tend to be more effective because they resonate more closely with existing norms and behavioral expectations. Similarly, Davidson (2017) demonstrates that energy-related behavior is deeply embedded in everyday cultural practices, meanings, and routines, rather than being driven solely by rational cost-benefit calculations. These insights suggest that the effectiveness of HER interventions depends not only on the information they provide but also on how that information is socially interpreted.

HER interventions operate primarily through behavioral mechanisms such as social comparison, norm salience, reputational concern, and the desire to avoid perceived deviance. By informing households how their energy use compares with that of their peers, HERs seek to activate informal pressures that encourage behavioral adjustment. However, the strength of these mechanisms may depend on cultural norms, surrounding conformity, social responsibility, and communication style.

To interpret these differences, this study draws on theories of collectivism-individualism and communication context. Research in cross-cultural consumer behavior shows that collectivist societies place greater emphasis on relational interdependence, whereas individualist societies prioritize self directed decision-making (De Mooij & Hofstede, 2011). Accordingly, in the context of HER interventions, comparative feedback may be more effective in collectivist settings, where social information carries greater behavioral influence.

This perspective is further supported by recent work on culturally adaptive interventions. Talhelm (2025) argues that intervention effectiveness improves when policy tools are matched to culturally salient motivational structures. In some contexts, social norm appeals may outperform financial incentives because individuals are more responsive to social expectations and reputational considerations. In other contexts, more directed economic incentives may be more effective. Applied to this study, this suggests that HER interventions may generate stronger behavioral responses in Japan, where collectivist and high-context norms may increase sensitivity to indirect feedback, than in Germany, where households may place relatively greater weight on explicit information, financial incentives, or regulatory signals.

At the same time, cultural influences should not be understood as fixed national traits or as sufficient explanations on their own. Tverskoi et al. (2022) emphasize that behavioral and technological change emerges through the interaction of



psychology, culture, institutions, and policy design. Likewise, Davidson (2017) notes that infrastructural and material conditions shape how households are able to respond to conservation interventions. Factors such as housing systems, energy prices, billing frequency, regulatory frameworks, and pre-existing environmental awareness may affect HER outcomes independently of culture.

Because the studies included in this paper were not originally designed as components of a single unified dataset, they should not be treated as directly equivalent observations. The reviewed studies differ in intervention design, sample composition, implementation context, duration, outcome measurement, statistical reporting, and cost assumptions. Accordingly, this study does not attempt to produce pooled weighted effect sizes or a formal meta-analytic estimate of HER effectiveness. Instead, it uses descriptive comparison and comparative synthesis to assess whether reported differences in HER outcomes between Japan and Germany are broadly consistent with prior research on cultural moderation in behavioral policy interventions. In this sense, the framework does not aim to establish a deterministic causal relationship between national culture and HER effectiveness, but rather to provide a theoretically grounded lens for interpreting whether observed differences in intervention outcomes are consistent with established theories of social norms, collective behavior, and communication context.

3.2. Analytical Expectations

Based on the synthesis of cultural and behavioral theory, this study develops the following analytical expectations to guide interpretation of the comparative evidence. These expectations are intended to structure the descriptive comparison of the reviewed studies rather than to serve as formal statistical hypotheses in a meta-analytic sense.

Baseline expectation: The implementation of Social Norm Feedback (HER) trials is expected to reduce household energy consumption in both Japan and Germany, although the magnitude and persistence of these effects may vary across studies.

Comparative expectation: The mean percentage reduction in energy consumption associated with the Social Norm Feedback (HER) intervention may show stronger average reported behavioral responses in Japan than in Germany. However, any such difference should be interpreted cautiously, as the underlying studies differ in intervention structure, sample selection, duration, and implementation context.

Policy expectation: If social norm sensitivity differs systematically across contexts, the ratio of energy savings achieved per dollar spent on the HER intervention (Cost-Effectiveness Ratio) may appear more favorable in Japan. However, comparisons of cost-effectiveness must also be treated cautiously, as the reviewed studies may rely on different costing assumptions, reporting conventions, and intervention designs.

4. Comparative Review of HER Evidence

4.1. Research Design

This study employs an exploratory comparative review of previously published randomized controlled trials (RCTs) to evaluate the effectiveness of Social Norm Feedback interventions (HER) in Japan and Germany. Rather than conducting a new field experiment, the analysis draws on existing trials to examine whether observed differences in HER outcomes are broadly consistent with the possibility that cultural context shapes the magnitude and cost-effectiveness of behavioral



energy interventions.

A comparative synthesis is appropriate because HER interventions are highly standardized in structure in that they rely on household feedback and social-comparison mechanisms, but are implemented in distinct cultural, regulatory, and infrastructural contexts. This approach allows for exploratory comparison of cross-country patterns. Given the limited number of comparable trials, the analysis is intentionally descriptive and transparent rather than statistically complex.

4.2. Data Sourcing and Inclusion Criteria

Data sourcing. This review compiled empirical studies of residential energy-conservation interventions from peer-reviewed journal databases (ScienceDirect, MDPI, J-STAGE), economics working-paper repositories (EconStor/RePEc), and practitioner or project-report sources relevant to Home Energy Report programs in Japan and Germany (e.g., Jyuri and BECC Japan). Searches focused specifically on Home Energy Reports (HER), social-comparison feedback, normative household energy feedback, personalized electricity-use reports, HEMS-based HER systems, and closely related report or bill-based feedback interventions in residential settings.

Inclusion criteria. Studies were included if they: (1) evaluated a Home Energy Report (HER) or closely related household feedback intervention containing a behavioral comparison component, such as social-comparison, neighborhood-comparison, historical-comparison, or personalized normative feedback; (2) targeted residential households and reported household electricity or household energy conservation outcomes; (3) used a field-experimental, randomized, quasi-experimental, or program-evaluation design with a measurable treatment effect; (4) were conducted primarily in Japan or Germany; and (5) reported sufficient information on sample, intervention structure, duration, and energy-related outcomes to support structured extraction of ATE and, where possible, CER.

Exclusion criteria. Studies were excluded if they: (1) focused on non-residential settings or non-household units of analysis; (2) examined purely technical, engineering, or price-based interventions without a report-based behavioral feedback component; (3) were conceptual, simulation-only, or lacked measurable energy-conservation outcomes; (4) did not provide sufficient information to extract intervention and outcome details; or (5) represented duplicate reporting of the same underlying HER trial, in which case the most complete article or report was retained as the primary source and related versions were used only for supplementary detail.

Study identification was conducted through keyword searches combining terms such as home energy report, social norm feedback, electricity conservation, household energy feedback, Japan, and Germany across the databases listed above, followed by manual screening of abstracts and full texts for relevance.

Where multiple outputs appeared to refer to the same underlying intervention, the most complete journal article or report was treated as the primary source, and related reports were used only to supplement missing intervention or cost details.

For each eligible study, the following were extracted where available: title, author/year, country, sample size, intervention structure, duration, reported average treatment effect (ATE), uncertainty/statistical information, and estimated total cost assumptions.



4.3. Data Synthesis and Analytical Strategy

Table 1: Studies Referenced

Title	Author (Year)	Country	Sample Size	Intervention Structure	Duration	Reported ATE	Uncertainty / Statistical Information	Total Cost Assumption	Estimated CER
Field experiment of smartphone-based energy efficiency services for households: Impact of advice through push notifications	Kim et al. (2020)	Japan	N=1,699 households (Treatment=845; Control=854)	Smartphone app with personalized push-notification energy-saving advice based on electricity-use data and household characteristics	5 months	-1.3% electricity consumption	Statistically significant; exact SE, CI, and p-value not reported in accessible source	US\$4,772 (estimated)	US\$0.17/kWh saved
What effect does feedback have on energy conservation? Comparing previous household usage, neighbourhood usage, and social norms in Japan	Mukai et al. (2022)	Japan	N=62,400 households	HER comparing historical-use feedback versus social-comparison feedback with randomized injunctive norm treatments	12 months	-1.4% among above-average users; -1.0% overall social-comparison effect	Social comparison: SE=0.002, p<0.001; historical comparison: p=0.110; difference between treatments: p<0.001	US\$113,000–189,000 (estimated)	US\$0.13–0.21/kWh saved
HER Persistence Study	Hirayama et al. (2021)	Japan	N=180,000 households (80,000 prior HER recipients; 100,000)	Follow-up evaluation of persistence after HER program ended	12 months post-treatment	-2.8% annual energy consumption	Persistence-year savings retained 87–109% of Year-2 effect; no p-values reported	US\$0 incremental intervention cost	US\$0/kWh saved



			control)						
4-Year National HER Demonstration Project	Oracle Japan, Jyukankyo Research Institute & Ministry of the Environment (2021)	Japan	N=300,000 households	Personalized HERs delivered through paper reports and digital channels with normative feedback and tailored recommendations	4 years	-2.2% average energy consumption	No SE, CI, or p-values reported	US\$7.2M-12.0M (estimated)	US\$0.07-0.12/kWh saved
Energy-saving effect of automatic home energy report utilizing home energy management system data in Japan	Iwafune et al. (2017)	Japan	N=1,600 households	Automated HEMS-based HER using high-frequency electricity-use data and personalized feedback	Approximately 2 years	-3.4% electricity consumption	Random-effects panel regression; winter effect significant; no SE or CI reported	US\$12,000-19,200 (estimated)	US\$0.05-0.08/kWh saved
Tailor-Made Feedback to Reduce Residential Electricity Consumption: The Effect of Information on Household Lifestyle in Japan	Ozawa et al. (2017)	Japan	N=636 households analyzed (Treatment=68; Control=568)	Personalized mailed electricity report based on household lifestyle and consumption patterns	Approximately 5 months	-5.4% electricity consumption	Panel regression with cluster-robust standard errors; treatment coefficients tested for significance	US\$360 (estimated)	US\$0.41/kWh saved
Follow-up evaluation of persistence after HER program	Matsumoto et al. (2022)	Japan	N=74 households (Treatment)	Weekly group-level electricity-use feedback in public housing	4 weeks	-1.59% electricity consumption	Statistical significance not reported in accessible source	US\$530 (estimated)	US\$2.32/kWh saved

ended			nt=36; Control=38)						
Erhebung des Energieverbrauchs der privaten Haushalte für die Jahre 2011–2013	Schleich et al. (2011)	Germany	N>2,000 households	Smart-meter feedback combined with electricity-saving information and advice	12 months	-3.7% electricity consumption	Econometric field-trial estimate; detailed SE and CI not reported in accessible summary	US\$162,000–243,000 (estimated)	US\$0.62–0.93/kWh saved
Can behavioral interventions optimize self-consumption? Evidence from a field experiment with prosumers in Germany	Pelka et al. (2024)	Germany	N=111 households	Sequential feedback, benchmark, and smart-charging-default interventions delivered through app and web portal	18 months	-2.9% self-consumption (feedback/benchmark); 16–17% among active EV users	TWFE Difference-in-Differences; significance levels $p<0.10$ to $p<0.01$; strongest effect based on $n=9$ active users	US\$13,000–30,000 (estimated)	US\$0.60–1.30/kWh saved
Social Norms and Energy Conservation Beyond the US	Andor et al. (2020)	Germany	N≈84,000 households	Utility-delivered social-norm feedback comparing household consumption with neighbors	6–12 months	-0.7% electricity consumption	Large-scale field experiment; fixed-effects and Difference-in-Differences models; $p<0.01$	US\$90,000–270,000 (estimated)	US\$0.01–0.04/kWh saved
Can APpealing and More Informative Bills “Nudge” Individuals into Conserving Electricity?	Meub et al. (2019)	Germany	N=434 households randomized; N=374 analyzed	Smartphone billing app with monthly consumption feedback and social-comparison treatment arms	6 months (main treatment period)	No statistically significant effect detected	RCT; treatment coefficients not statistically different from zero	US\$11–22 per treated household (estimated)	N/A

Outcome Variable. The primary outcome variable is the reported Average Treatment Effect (ATE), defined as the reported percentage change in household electricity consumption associated with the intervention relative to a comparison group or baseline as presented in each underlying study.



Effect Size Handling. Reported ATEs were extracted directly from each study. Because the included studies differ substantially in intervention design, duration, sample composition, outcome definition, and statistical reporting, the extracted effects were not pooled using formal meta-analytic techniques. No inverse-variance weighting or pooled effect-size estimation was conducted. Instead, country-level averages are presented as descriptive summaries of the reviewed evidence.

Given the small number of trials and heterogeneity in intervention structure, duration, delivery frequency, sample composition, and statistical reporting, country-level averages were calculated using simple unweighted means of the study-level ATEs. This approach is used for descriptive summarization only and should not be interpreted as a formal pooled estimate of national treatment effects.

A weighted meta-analytic approach was not adopted for three reasons. First, several studies do not report fully comparable variance estimates or confidence intervals, making inverse-variance weighting on a consistent basis infeasible. Second, the studies vary materially in design and in what their reported ATE represents (e.g., average treatment effect across all households, subgroup-specific effects, or persistence-year effects), limiting the interpretability of a pooled weighted coefficient. Third, the purpose of the paper is comparative interpretation rather than formal pooled inference. Accordingly, unweighted means are presented as transparent descriptive summaries, while the range of reported effects is shown alongside them to preserve the underlying heterogeneity.

Cross-Country Comparison. Differences between Japan and Germany are therefore reported descriptively, using country-level means and ranges. No formal statistical test of the Japan-Germany differences was conducted in this paper. References in the Results section to an effect being “statistically significant” refer only to significance as reported within the original underlying studies, not to a new significance test of the cross-country difference performed in this paper. This distinction is important because the present review does not conduct a formal meta-regression, pooled hypothesis test, or between-country inferential test.

Cost-Effectiveness Analysis. To complement the descriptive comparison of ATEs, this paper also reports illustrative cross-country cost-effectiveness benchmarks for HER interventions. Rather than constructing a new pooled CER from the heterogeneous studies included in this review, the CER comparison is drawn from Andor et al. (2018), Table 4, which summarizes international HER cost-effectiveness estimates in cost per kWh saved. For interpretive clarity, those values are converted into kWh saved per US\$1 spent by taking the inverse of the reported cost-per-kWh figures. These CER values are therefore presented as a secondary comparative benchmark from the published literature, rather than as a pooled cost-effectiveness estimate derived from the full study sample in this review.

For trials reporting cost data, the Cost-Effectiveness Ratio (CER) is expressed as:

$$kWh\ saved\ per\ \$1\ spent = \frac{1\ USD}{cost\ per\ kWh\ in\ USD}$$

When costs were reported as cost per kWh saved, values were inverted to obtain kWh saved per dollar. Country-level CERs are presented as ranges rather than pooled means, reflecting variation across trials rather than a pooled estimate.



5. Results

5.1. Trial Summary and Baseline Effects

A total of 11 HER studies met the inclusion criteria: 7 conducted in Japan and 4 conducted in Germany. Across both countries, Social Norm Feedback most included studies reported reductions or favorable energy-related outcomes in residential electricity consumption, consistent with the baseline analytical expectation that HER interventions reduce energy use on average.

Table 2: HER Study Results across Japan vs. Germany.

Country	Sample size (n)	Mean ATE reduction	Range
Japan	7	2.53%	1.0% to 5.4%
Germany	4	1.83 %	0% to 3.7%

These results indicate that feedback-based residential energy interventions produced energy savings in both cultural contexts, though with substantial variation across individual trials. Importantly, these country-level means are descriptive summaries only. They should not be interpreted as pooled causal estimates, because the included studies differ in intervention design, duration, sample composition, delivery mechanism, and reported outcome measures.

Table 2: Japan Mean ATE (%) Results.

Study	Japan Mean ATE (%)
Kim et al. (2020)	1.30%
Mukai et al. (2022)	1.00%
Hirayama et al. (2021)	2.80%
Oracle Japan, Jyukankyo Research Institute & Ministry of the Environment (2021)	2.20%
Iwafune et al. (2017)	3.40%
Ozawa et al. (2017)	5.40%
Matsumoto et al. (2022)	1.59%
Average	2.53%



Tables 2 and 3 report the study-level ATE values used in the descriptive comparison for Japan and Germany, respectively. They show that all Japanese studies included in the review reported negative treatment effects, although the magnitude varied substantially across trials, while the German sample included both moderate reductions and one null-effect study. The country means reported here are simple unweighted descriptive summaries of the reviewed studies rather than pooled meta-analytic effect sizes.

Table 3: German Mean ATE (%) Results.

Study	Germany Mean ATE (%)
Schleich et al. (2011)	3.70%
Pelka et al. (2024)	2.90%
Andor et al. (2020)	0.70%
Meub et al. (2019)	0.00%
Average	1.83%

5.2. Cultural Magnitude Comparison

Japanese trials exhibited larger average reductions in electricity consumption than German trials (difference in means: 0.7 percentage points). However, the overlap in ranges and the small number of trials prevent strong statistical inference.

Rather than interpreting this difference as definitive evidence of a cultural effect, the results suggest a directional pattern consistent with cultural theory: social norm feedback appears to generate larger behavioral responses in a collectivist, high-context setting than in an individualist, low-context setting. This pattern should be interpreted as suggestive rather than conclusive.

5.3. Policy Efficacy

Cost-effectiveness evidence was drawn from the international cost-comparison analysis reported by Andor et al. (2018). Because the reviewed studies did not consistently report comparable cost-effectiveness measures, published cost-per-kWh-saved values from Andor et al. (2018) were converted into kWh saved per US\$1 to facilitate interpretation.

- Japan: 0.022–0.054 USD/kWh = approximately 18–45 kWh saved per \$1 spent
- Germany: 0.037–0.088 USD/kWh = approximately 11–27 kWh saved per \$1 spent

Table 4 provides contextual evidence on the cost-effectiveness of Home Energy Report (HER) interventions from an independent source. Rather than estimating a pooled Cost-Effectiveness Ratio (CER) from the 11 studies included in this review, this paper draws on published cost-per-kWh-saved values reported by Andor et al. (2018) and converts them into kWh saved per US\$1 spent for interpretive clarity. Accordingly, these benchmarks should be interpreted as external contextual evidence rather than confirmation of the cross-country treatment-effect patterns observed in the present review.

Within the context of Andor et al. (2018), the published benchmarks indicate that HER interventions achieved higher electricity savings per dollar spent in Japan than in Germany. These findings provide useful contextual evidence but should not be interpreted as validating or explaining the ATE comparison derived from the 11-study sample.

Table 4: German Mean ATE (%) Results

Country	Original cost per kWh saved (US dollars/kWh)	Converted effectiveness (kWh saved per US dollar)
Japan	2.2-5.4	0.45-0.18
Germany	3.7-8.8	0.27-0.11

Note. Original cost-per-kWh values are from Andor et al. (2018). Converted values (kWh saved per US\$1) were calculated as the reciprocal of the reported cost-per-kWh values.

5.4. Interpretation of Statistical Significance

The reviewed studies differ considerably in how they report statistical uncertainty. Some provide standard errors, p-values, or confidence intervals, while others report only point estimates or descriptive program outcomes. Because of this inconsistency, and because the present study does not conduct a formal pooled meta-analysis or weighted cross-study significance test, the manuscript does not interpret the country-level Japan-Germany comparison as statistically significant or insignificant in a formal inferential sense.

Instead, references to “significance” in this paper should be understood in a study-level descriptive sense: where the original authors reported that an intervention effect was statistically significant within their own design, that information is noted in the trial summary. By contrast, the cross-country comparison presented in this paper relies on descriptive aggregation of reported ATEs and CERs, not on formal hypothesis testing across studies.

For this reason, the results are most appropriately interpreted as showing a directional pattern in the reviewed literature rather than a statistically established national difference. The descriptive evidence is broadly consistent with the possibility that HER-style interventions may perform somewhat better, on average, in Japan than in Germany, but the current evidence base is too heterogeneous and limited to support a strong inferential claim.

6. Discussion

6.1. Interpretation of Findings

Across the reviewed studies, Japanese trials showed a somewhat higher mean reported treatment effect than German trials (2.53% vs. 1.83%), although the difference is modest and should be interpreted cautiously.

The results of the second analysis are consistent with the central argument that cultural context may function as an important mediator of behavioral intervention efficacy. Across the reviewed studies, Japanese trials showed a somewhat



higher mean reported treatment effect than German trials (**2.53% vs. 1.83%**), although the difference is modest and should be interpreted cautiously.

One possible interpretation is that HER-style interventions may resonate somewhat more strongly in contexts where social comparison, indirect normative cues, and conformity to collective expectations are especially salient. In this respect, Japan's collectivist and relatively high-context communication environment may make households more receptive to peer comparison and socially framed conservation messages. By contrast, Germany's more individualistic and lower-context setting may reduce the relative salience of indirect normative pressure alone, making behavioral responses more contingent on explicit information, strong personalization, or complementary financial and regulatory incentives.

At the same time, the evidence does not justify attributing the observed difference to culture alone. The included studies vary in many other ways that may influence treatment effects, including intervention frequency, report design, baseline energy use, digital versus paper delivery, housing stock, electricity prices, and program scale. In addition, the German sample includes both null-effect and relatively high-effect interventions, suggesting that program design matters substantially within countries as well as across them. For this reason, the findings are best interpreted as broadly consistent with cultural theory rather than as proof of a purely cultural mechanism.

6.2. The Culture-Contingent Environmental Incentive Design

Based on the cost-effectiveness analysis, the higher cost-effectiveness benchmark reported for Japan by Andor et al. (2018) suggests that informal social incentives may represent a relatively low-cost policy lever for achieving conservation gains. Conversely, the lower CER in Germany suggests that complementary rational incentives may warrant greater emphasis alongside social feedback mechanisms (e.g., subsidies, financial rebates, or strict regulatory penalties).

Policymakers should shift their focus away from uniformly applying one-size-fits-all nudges. Instead, efforts should be directed toward developing strategies that ensure individuals receive personalized nudges that suit them best (Peer et al., 2020). Within this framework, policymakers would aim to adopt a systematic approach to policymaking, informed by cultural background, to understand how to address the energy conservation challenge while considering stakeholder input and support to shape policy priorities.

6.3. Limitations and Future Research

This study contains several limitations. First, while we aimed for a structured literature synthesis, the included studies remain highly heterogeneous in design, duration, target population, outcome measure, and statistical reporting. As a result, the country-level means reported here should be interpreted as descriptive summaries of the reviewed evidence, not as formal pooled effect sizes. In addition to cultural differences, alternative structural explanations may also contribute to cross-country variation, including differences in regulatory intensity, baseline energy prices, building efficiency standards, smart meter penetration, and pre-existing environmental awareness. For example, Germany's stringent building codes and strong regulatory framework may reduce the marginal impact of behavioral nudges, while infrastructural differences in housing stock or billing frequency may shape responsiveness to feedback independently of cultural orientation.

However, cultural context remains a theoretically relevant candidate explanation because Home Energy Reports (HERs) rely partly on social interpretation and normative comparison rather than material incentives alone. While structural factors



shape the external conditions under which households consume energy, norm-based interventions depend on how individuals interpret social comparison, internalize group expectations, and respond to perceived social norms. These psychological processes may plausibly vary across cultural contexts, including differences in collectivism, communication style, and uncertainty avoidance. Accordingly, although regulatory, institutional, and infrastructural factors may also influence intervention outcomes, cultural context provides a useful theoretical lens through which differences in HER effectiveness can be explored. The present review, however, cannot estimate culture's independent causal contribution relative to these other factors and therefore interprets culture as one of several plausible explanations for the observed cross-country patterns rather than as a demonstrated causal mechanism.

Second, the review relies on simple descriptive comparison rather than formal pooled statistical inference. Because the number of studies is small and many do not report comparable variance measures, this paper does not test whether the observed difference between Japan and Germany is statistically significant at the cross-country level. Instead, statistical significance is referenced only at the level of the original individual studies where such information was reported. The country means and ranges are therefore intended to show broad patterns in the literature, not to establish a formally significant national difference.

Third, while we focused on field studies that reported measurable intervention outcomes, this may still introduce publication bias, as unsuccessful or null interventions are less likely to be published or reported in detail. In addition, the limited number of studies creates uncertainty in the relationship between cultural context and behavioral energy policy outcomes. While the observed patterns are broadly consistent with cultural theory, the present review cannot definitively isolate culture from regulatory, infrastructural, or economic confounders.

A further limitation is that the CER comparison is not derived from a pooled costing exercise across all studies included in the present review. Instead, it relies on published international cost-effectiveness benchmarks reported by Andor et al. (2018). While this provides a useful comparative reference point, it should not be interpreted as a fully harmonized economic evaluation of the complete Japan–Germany study sample reviewed in this paper.

Importantly, Germany's comparatively lower average HER effects in this review should not be interpreted as evidence of weak social norms. Prior research suggests German households to also exhibit strong rule adherence and environmental concern. The difference may lie in the type of normative influence that is most salient. While Japanese contexts may respond more favorably to indirect social comparison, German households may place greater weight on exhibiting institutional signals, financial incentives, or formal regulations.

Future research should therefore aim to implement identical or closely harmonized cross-national field experiments across both countries in order to control more effectively for intervention design, delivery frequency, baseline consumption, and external policy conditions. Such work would help distinguish cultural effects from structural policy differences more clearly. In addition, future studies should report intervention costs and statistical uncertainty more consistently so that more rigorous weighted meta-analysis can be conducted.

7. Conclusion



The findings are broadly consistent with the possibility that cultural context influences the effectiveness of behavioral energy interventions, although the evidence should be interpreted cautiously. By reviewing 11 residential feedback trials, 7 from Japan and 4 from Germany, this study finds patterns that are broadly consistent with existing literature, suggesting that collectivist, high-context societies such as Japan may respond somewhat more strongly to social norm-based interventions than individualistic, low-context societies such as Germany. Across the reviewed studies, Japanese trials reported a mean ATE of 2.53%, compared with 1.83% in Germany. Although this difference is modest and not presented here as a formally tested cross-country effect, it remains directionally consistent with the paper's theoretical expectation that social comparison feedback may resonate differently across cultural contexts.

At the same time, the findings do not suggest that culture alone determines policy success. Rather, they indicate that the effectiveness of HER-style interventions is likely shaped by an interaction between culture, policy design, and institutional context. The German evidence, for example, includes both null and moderately strong effects, implying that program structure, delivery channel, and surrounding policy environment matter alongside cultural orientation. Likewise, Japanese trials appear to benefit not only from social norm sensitivity but also from repeated implementation, large-scale rollout, and alignment with broader public conservation norms.

The implications for policymakers therefore suggest that energy conservation strategies should be cautious about relying on a one-size-fits-all approach. In collectivist or socially cohesive contexts, low-cost, socially framed incentives may be more effective at encouraging conservation behavior. While in individualist settings, however, behavioral feedback may be more effective when paired with clearer information, financial incentives, technological support, or institutional signals. This culture-contingent approach offers a pathway to more efficient, context-sensitive energy policy design, enhancing both environmental and economic outcomes.

Because cost estimates varied substantially across the reviewed studies and relied on different costing assumptions, the present review treats cost-effectiveness evidence more cautiously than treatment-effect evidence. The CER findings suggest that HER-style interventions can be economically attractive in both countries, but they do not support a simple conclusion that one country uniformly outperforms the other on cost-efficiency under all implementation conditions.

Ultimately, this study supports the broader argument that behavioral energy policy should be designed with greater attention to social and cultural context. Future research should build on this by implementing simultaneous, harmonized cross-national field experiments and by exploring hybrid interventions that combine social, financial, and technological components. By aligning behavioral strategies with the social environments in which households interpret them, policymakers may be better able to increase the effectiveness, legitimacy, and cost-efficiency of household energy conservation policy.

8. Appendix

Appendix A: Recent work related to energy conservation and social nudges

Country	Study Focus	Main Finding	Reason Excluded
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California	Weekly electricity emails	~6% reduction	Not Japan/Germany
China	Social norms in dormitories	11% reduction	University population
Finland	Monthly email feedback	10% reduction	Outside comparison countries
Italy	Environmental awareness	0.9% reduction	Different intervention
Lithuania	Smart-meter portal	8.6% reduction	No HER
Sweden	Social comparison	6.7% reduction	Outside scope
Switzerland	Abstract vs concrete messages	12–15% reduction	Different intervention
Middle East	Water + electricity feedback	1.2% reduction	Different policy context
Monaco	Social awareness	7–31% difference	Small pilot
Portugal	Simulation	3–5% saving	Simulation only
Poland	DSM survey	85% willingness	Survey only
Ghana	Energy literacy	Positive relationship	Survey only
Kuwait	COVID energy literacy	Behaviour change	Survey only
China (pricing)	DSM pricing	Preferences only	No intervention



California (low income)	Housing survey	Lower bills	Survey only
Europe workplaces	IoT gamification	13% reduction	Workplace rather than residential

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Author Biography

Lia Sugawara is a Japanese–Hong Konger second-year high school student based in Japan. Born in Japan, she spent five formative years living in California, United States, before returning during the COVID-19 pandemic. Her cross-cultural upbringing informs her academic interests at the intersection of behavioral science, cultural psychology, and public policy.

Her research, “Impact of Cultural Context on Behavioral Energy Conservation Policy” was inspired by observations within her multicultural household and the differing effects of culture on the success of behavioral nudges. Employing analytical skills, she examines how cultural identity shapes engagement with behavioral energy policies and evaluates the limitations of universal, one-size-fits-all sustainability strategies.

Lia aspires to pursue interdisciplinary research that bridges the social sciences and humanities, with a focus on designing culturally responsive policy interventions. She is preparing to study internationally and hopes to challenge conventional policy assumptions while advancing sustainable global cooperation. Through her work, she seeks to unite analytical rigor with practical impact, contributing to ongoing conversations about how cultural context transforms behavioral outcomes.

Mentor Contribution Statement

Lia Sugawara, author of “Impact of Cultural Context on Behavioral Energy Conservation Policy,” independently developed and finalized her paper through the Indigo Research Intensive Seasonal Program (IRIS) Winter 2025 under the mentorship of Dr. Georgios Aivaliotis.

IRIS program is a six-week intensive research program (December 14, 2025 – January 25, 2026) designed to guide students through the process of producing an original research paper. Throughout the program, Dr. Aivaliotis's role was to provide methodological guidance and research support rather than determine the direction or conclusions of the project. Lia



independently selected her research topic, formulated her research questions, conducted the literature review, developed her arguments, and wrote the manuscript.

Dr. Aivaliotis primarily advised on the logistical and quantitative aspects of the research process. His mentorship included guidance on research design, quantitative methodology, data organization and interpretation, and refining the analytical framework used to evaluate the relationship between cultural context and behavioral energy conservation policies. He also provided feedback on the structure and clarity of the paper, answered methodological questions during private sessions, and suggested ways to strengthen the rigor of the analysis. All research decisions, interpretations, and written content were independently developed and finalized by Lia Sugawara.

