

Efficiency of Behavioral Interventions on Cross-Cultural Domestic Energy Use

1. Introduction

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). The economic value of increased efficiency is underscored by the immense costs associated with wasted energy. For instance, 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%. The remaining policy gaps could be substantially reduced by "raising the ambition of existing policies"(IEA, 2025) through behavioral load shifting. The Home Energy Report (HER) trials (ex. Figure 1 and Figure 2), for example, reported an average of 2-3% of energy preservation through behavioral nudges such as social comparison. Given this potential, individual efforts can reduce consumption. Since consumption itself heavily affects economic and environmental savings, the optimization of policy interventions becomes more of a necessity.

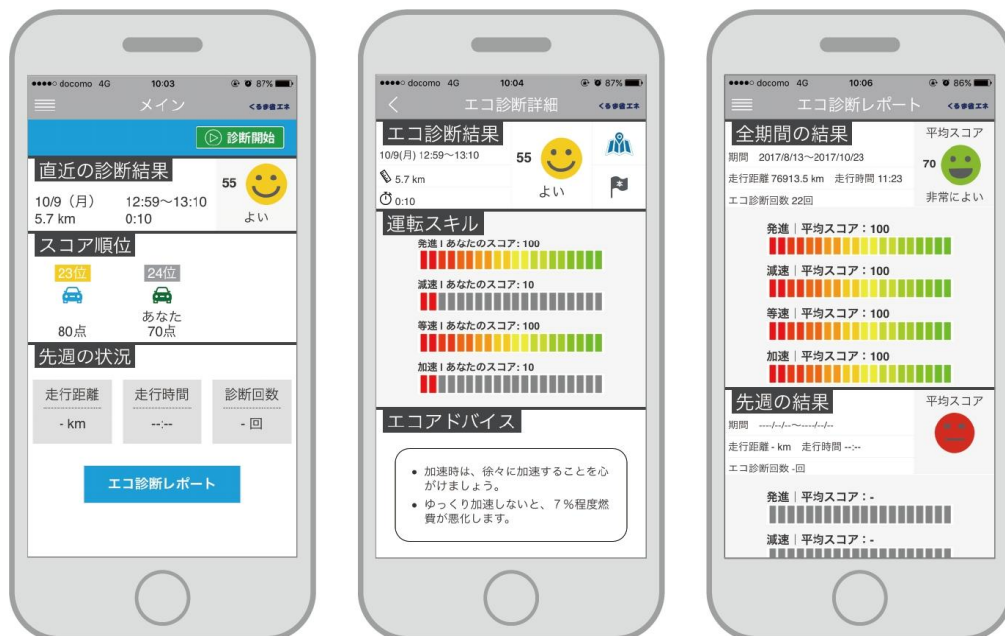


Figure 1. An example of the layout of the home energy reports used in Japanese Energy Trials.

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

Berechneter Energiebedarf des Gebäudes Registriernummer ²
(oder: „Registriernummer wurde beantragt am...“) 2

Primärenergiebedarf CO₂-Emissionen ³ kg/(m²·a)

Primärenergiebedarf dieses Gebäudes kWh/(m²·a)

0 100 200 300 400 500 600 700 800 900 ≥1000

EnEV-Anforderungswert
Neubau (Vergleichswert) ↑
EnEV-Anforderungswert
modernisierter Altbau (Vergleichswert) ↑

Anforderungen gemäß EnEV ⁴

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

Mittlere Wärmedurchgangskoeffizienten ☐ eingehalten

Sonnetischer 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-Wärmegesetzes (EEWärmeG)

Art: Deckungsanteil: %

Ersatzmaßnahmen ⁷

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

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

Verschärfter Anforderungswert Primärenergiebedarf kWh/(m²·a)

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

Verschärfter Anforderungswert 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 Netto-Grundfläche.

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.

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 & Senstein, 2008). However, the efficiency of these tools, seen in the widely implemented HER trials, exhibits certain variabilities depending on the country due to the challenges social nudges pose, as illustrated in Figure. 3. 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. The global diffusion of identical policy interventions 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).

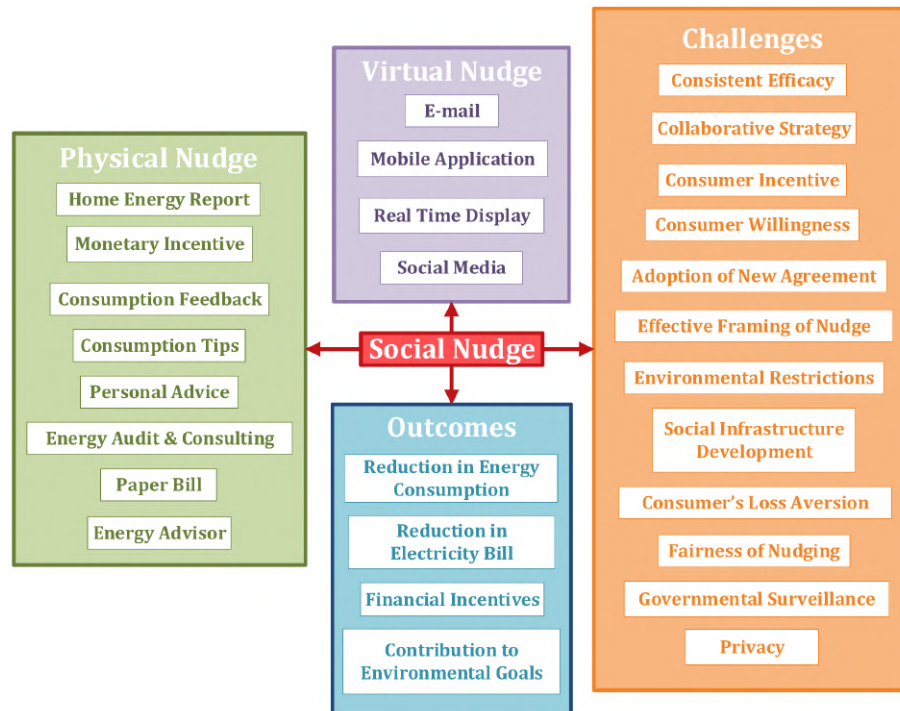


Figure 3. Social nudge framework for energy conservation
(Mochi, et al, 2025)

This paper examines the importance of understanding how cultural values influence policy adaptation through a quantitative cross-cultural analysis of past energy conservation initiatives. We focus specifically on the effectiveness of HER in two distinct high-income economies, Japan and Germany. By systematically aggregating and comparing the Average Treatment Effect (ATE) and Cost-Effectiveness Ratio (CER) of the HER across trials in both countries, the study highlights the pivotal role of cultural identity in shaping public engagement with sustainable energy policies utilizing behavioral interventions. The overarching aim is to best optimize public policy with a cultural-contingent incentive design. This environmental design should activate the lowest-cost informal incentive mechanism available in each society.

To gain insight into the factors behind the gaps in energy conservation policies, this study adopts a mixed-methods approach that integrates qualitative theory-driven analysis with quantitative empirical evaluation to compare the different outcomes of the same policies across countries. In the first section, the paper develops a cultural argument grounded in established frameworks through the psychological and behavioral economics lens to explain why identical Social Norm Feedback (HER) interventions may activate different psychological mechanisms across societies. This theoretical lens is used to generate testable hypotheses regarding cultural moderation effects. Later, the study conducts a cross-cultural comparative meta-analysis of existing randomized

controlled trials in Japan and Germany, synthesizing the reported Average Treatment Effects (ATEs) and Cost-Effectiveness Ratios (CERs). The empirical analysis evaluates whether observed differences in energy savings and costs are consistent with the proposed cultural mechanisms. Together, this mixed-methods design allows the study to move beyond descriptive comparisons and provide a theoretically informed, evidence-based assessment of how cultural context shapes policy effectiveness.

2. Background on Culture and Energy Policy

2.1. The Effectiveness and Variability of Social Norm Nudges

Social Norm Feedback (HER) operates on the principle of descriptive and injunctive norms, typically yielding an average annual energy savings of about 2% of total primary energy consumption across the 144 countries (Jain, M. 2025). However, this comprehensive figure masks significant 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 a full list of each of the 23 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.

2.2. Cultural Theory: Collectivism and Communication Context

To explain this variability, we rely on established cultural theories. Hofstede's dimension of Individualism vs. Collectivism (IDV) provides a clear theoretical lens.

While **Collectivist Societies** (Low IDV) emphasize group loyalty and cohesive in-groups (e.g., Hong Kong, Japan), **Individualist Societies** (High IDV) emphasize personal achievements and individual rights (e.g., the US, Germany).

Furthermore, Edward T. Hall's distinction between **High-Context** (Japan) and **Low-Context** (Germany) is an important factor in 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. 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). This difference in communication styles further emphasizes how the HER is framed to target collectivist high-context societies due to the usage of social comparison.

2.3 Energy Trials and Policy in Japan and Germany

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 Germany, energy policy is often 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 may be lower, as the individualistic culture may place less value on conforming to an anonymous neighbor's behavior.

3. Theoretical Framework and Hypotheses

3.1. Framework

The core theoretical framework proposes that the effectiveness of the Social Norm Feedback (HER) is mediated by the dominant cultural orientation of the target population. Specifically, the HER's implicit social pressure will be highly potent in the collectivist context of Japan, but less so in the individualistic context of Germany, where rational economic incentives and direct regulation are likely to be more effective motivators. Certain limitations will occur due to the small sample size and variabilities in methodology, measurement, context, and reporting.

3.2. Testable Hypotheses

Based on the synthesis of cultural and behavioral theory, we derive the following testable hypotheses for the cross-cultural analysis of past energy trial data:

Baseline: The implementation of Social Norm Feedback (HER) trials will be associated with a statistically significant mean reduction in household energy consumption in both Japan and Germany.

Cultural Magnitude: The mean percentage reduction in energy consumption achieved by the Social Norm Feedback (HER) intervention will be significantly larger in Japan (a collectivist, high-context culture) than in Germany (an individualist, low-context culture).

Policy Efficacy: The ratio of energy savings achieved per dollar spent on the HER intervention (Cost-Effectiveness Ratio) will be higher in Japan than in Germany,

confirming that the HER intervention is a lower-cost incentive mechanism in the collectivist context.

4. Quantitative Cross-Cultural Analysis

4.1. Research Design

This study employs a cross-cultural comparative meta-analytic synthesis of previously published randomized controlled trials (RCTs) to evaluate the effectiveness of Social Norm Feedback interventions (Home Energy Reports; HER) in Japan and Germany. Rather than conducting a new field experiment, the analysis draws on existing trials to examine whether cultural context moderates the magnitude and cost-effectiveness of behavioral energy interventions.

A comparative synthesis is appropriate because HER interventions are highly standardized in structure (peer comparison feedback delivered through periodic reports) but implemented in distinct cultural, regulatory, and infrastructural contexts. This approach allows for exploratory assessment of cultural moderation while maintaining external validity. 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 were aggregated from publicly available and credible sources, including:

Peer-reviewed academic journals

Government and ministry reports (e.g., METI, BMWK)

Utility company evaluations and white papers

NGO and policy institute reports

Only studies reporting original empirical results from field trials were considered.

Inclusion Criteria

Studies were included if they met all of the following conditions:

The intervention incorporated a Social Norm Feedback component, such as peer comparison or normative ranking.

The study reported a quantifiable treatment effect, expressed as a percentage change in energy consumption, along with a measure of statistical uncertainty (e.g., p-value, standard error, or confidence interval).

The trial was conducted among a representative sample of residential households in either Japan or Germany through the use of Randomized Controlled Trials (RCTs).

The study provided cost information or a proxy for intervention cost (e.g., printing, distribution, or total program budget).

The post-intervention period lasted at least one billing cycle.

Exclusion Criteria

Households with zero monthly electricity usage, identified through smart meter data, were excluded to avoid distortion of percentage change estimates. Additionally, extreme outliers in monthly energy consumption were removed using the Smirnov–Grubbs test, ensuring that treatment effects were not driven by anomalous observations.

4.3. Data Synthesis and Analytical Strategy

Outcome Variable

The primary outcome variable is the Average Treatment Effect (ATE), defined as the mean percentage change in household electricity consumption for treated households relative to control households.

Effect Size Handling

Reported ATEs were extracted directly from each study. When effects were reported in alternative units (e.g., kWh), they were converted to percentage changes using reported baseline consumption levels. No additional pooling weights were applied.

Given the small number of trials and heterogeneity in study design, country-level averages were calculated using simple unweighted means. This approach prioritizes transparency and avoids imposing assumptions about comparability or variance structures that cannot be reliably verified. This choice is treated as a methodological limitation.

Cross-Country Comparison

Differences between Japan and Germany are reported descriptively, using country-level means and ranges. Formal hypothesis testing is avoided due to:

Small numbers of trials per country, potential non-independence across estimates, and substantial heterogeneity in duration, delivery frequency, and population characteristics.

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{((s_1^2 / N_1) + (s_2^2 / N_2))}}$$

Where heterogeneity was detected, a meta-regression with country dummy variables was used as a robustness check.

Cost-Effectiveness Analysis

For trials reporting cost data, a Cost-Effectiveness Ratio (CER) was calculated as:

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

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, reflecting variation across trials rather than a pooled estimate.

5. Results

5.1. Trial Summary and Baseline Effects

A total of 10 HER trials met the inclusion criteria: 6 conducted in Japan and 4 conducted in Germany. Across both countries, Social Norm Feedback interventions were consistently associated with reductions in residential electricity consumption, supporting the baseline hypothesis that HERs reduce energy use on average.

Japan (n = 6):

Mean ATE = 2.61% reduction

Range = 1.30% to 7.50%

Germany (n = 4):

Mean ATE = 1.23% reduction

Range = 0% to 3.50%

These results indicate that HER interventions produced energy savings in both cultural contexts, though with substantial variation across individual trials. Figure 4 illustrates the cross-cultural mean ATEs.

Country	Mean ATE (%)
Japan	1.59%
Japan	1.40%
Japan	1.85%
Japan	7.50%
Japan	1.30%
Japan	2.00%
Japan Average	2.61%

Table 1. Japan Mean ATE (%) Results

Country ▼	Mean ATE (%)
Germany	0.70%
Germany	0.70%
Germany	3.50%
Germany	0%
German Average	1.23%

Table 2. German Mean ATE (%) Results

Average Treatment Effect (%)

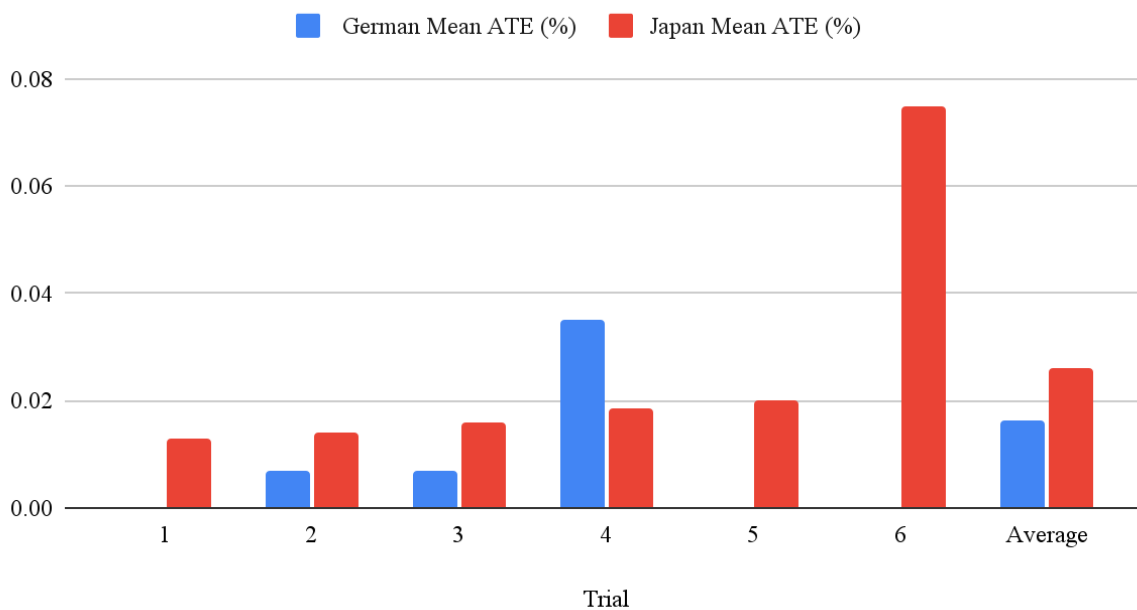


Figure 4. Average Treatment Effect Japan vs Germany

5.2. Cultural Magnitude Comparison

Japanese trials exhibited larger average reductions in electricity consumption than German trials (difference in means: 1.38 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 Ratios (CER) were derived from Table 3 reported cost per kilowatt-hour saved in column 3 (“Cost in Cent/ kWh Saved”). For clarity, values were converted to kWh saved per \$1 spent:

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 3. International Cost-Effectiveness Comparison of HER Interventions

	(1)	(2)	(3)	(4)	(5)
Country	Average Electricity Consumption in kWh	CO ₂ Emissions in g / kWh	Cost in Cent / kWh Saved	Abatement Cost in \$ / t CO ₂	CO ₂ Abatement Cost Relative to US
Canada	11,379	158	1.1 – 2.6	67 – 162	3.3
United States	12,293	489	1.0 – 2.4	20 – 49	1.0
France	5,859	64	2.1 – 5.0	323 – 779	16.0
Germany	3,304	486	3.7 – 8.8	75 – 182	3.7
Italy	2,542	343	4.8 – 11.5	139 – 335	6.9
Poland	1,935	769	6.3 – 15.1	81 – 196	4.0
Spain	4,040	247	3.0 – 7.2	121 – 293	6.0
Sweden	8,025	13	1.5 – 3.6	1,162 – 2,799	57.6
United Kingdom	4,145	459	2.9 – 7.0	64 – 153	3.2
Japan	5,434	572	2.2 – 5.4	39 – 94	1.9
South Korea	3,489	536	3.5 – 8.4	65 – 156	3.2
Australia	6,959	798	1.7 – 4.2	22 – 53	1.1

Notes: Our calculations assume printing and mailing cost of 1 US\$ per report, four reports per year and average electricity reductions of 1.37–3.30%. Average electricity consumption and CO₂ intensities of electricity generation correspond to the most recently available data (for 2013), as documented in WEC (2016) and IEA (2015), respectively.

(Andor, Gerster, Ankel-Peters, & Schmidt, 2018)

5.4. Significance

These figures indicate that, for comparable implementation costs, social norm feedback interventions in Japan achieve higher energy savings per dollar spent than those in Germany. This pattern is consistent with the observed differences in mean ATEs across the two countries, although, as noted, these differences are not statistically significant. Overall, these findings illustrate that cultural and contextual factors may influence both the effectiveness and cost-efficiency of behavioral energy policies, even if formal statistical testing does not confirm a significant cross-country difference.

6. Discussion

6.1. Interpretation of Findings

The results of the second analysis are consistent with the central hypothesis that culture may function as an important mediator of behavioral intervention efficacy. The greater observed effect size of the Social Norm Feedback (HER) in Japan may be partly attributable to its collectivist, high-context cultural orientation. The intervention effectively leverages the deep-seated value of social harmony and the implicit pressure to conform to group behavior. Conversely, the comparatively smaller response in Germany suggests that in a more individualistic, low-context culture, the implicit social pressure of the HER may be less potent than clear, rational, and individualistic incentives. This varying effectiveness of social nudging strategies can often be traced to psychological mechanisms such as social norm activation, identity alignment, and salience of feedback. For instance, peer comparison is particularly effective when individuals identify closely with the reference group, which enhances internalization of the behavior. Personalized feedback increases engagement by enhancing relevance and perceived control. In contrast, generic or infrequent nudges may fail to create a sense of urgency or personal connection. Environmental awareness, cultural context, and baseline consumption behavior also mediate nudge effectiveness. These factors highlight the need for tailoring nudges to fit the specific behavioral, social, and infrastructural context of the target audience.

6.2. The Culture-Contingent Environmental Incentive Design

Based on the cost-effectiveness analysis, the higher CER observed in Japan indicates 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 certain limitations. First, while we aimed for a structured literature synthesis, the included studies vary widely in terms of methodology, measurement, context, and reporting, which makes direct comparisons difficult. 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, culture remains analytically central to this study because Social Norm Feedback operates primarily through psychological mechanisms rather than material incentives. Structural factors shape the external conditions under which households consume energy, but norm-based interventions depend on how individuals interpret social comparison, internalize group expectations, and respond to perceived conformity pressures. These processes are deeply embedded in cultural orientations such as collectivism, communication context, and uncertainty avoidance. Thus, while regulatory and infrastructural variables may moderate overall outcomes, cultural context directly influences the mechanism through which the intervention exerts its effect.

Second, while we focused on recent field studies with reported positive outcomes, this may introduce publication bias, as unsuccessful or neutral interventions are less frequently reported. Lastly, the limited sampling causes uncertainty in the correlations between cultural context and behavioral energy policy outcomes. While the observed patterns are consistent with cultural theory, the present analysis cannot definitively isolate culture from regulatory, infrastructural, or economic confounders. Future research should involve an identical, contemporaneous field experiment across both nations to control for external variables and more clearly distinguish cultural effects from structural policy differences.

7. Conclusion

This study provides evidence suggesting that the effectiveness of behavioral energy interventions is influenced by cultural context. By analyzing evidence from randomized controlled trials in Japan and Germany, reports show that collectivist, high-context societies such as Japan respond more strongly to social nudges than individualist, low-context societies like Germany. Japanese trials not only achieved larger reductions in household energy consumption (Mean ATE = 2.61% vs. 1.23% in Germany) but also delivered higher returns on investment, as reflected in the cost-effectiveness ratio (18–45 kWh saved per \$1 spent in Japan vs. 11–27 kWh in Germany). These findings are consistent with the interpretation that culture may act as an important moderator of behavioral policy efficacy.

The implications for policymakers suggest that energy conservation strategies should be cautious about relying on a one-size-fits-all approach. In collectivist contexts, low-cost, socially framed incentives can achieve substantial energy savings, while in individualist settings, interventions should be coupled with rational, financially oriented incentives to maximize impact. This culture-contingent approach offers a pathway to more efficient, context-sensitive energy policy design, enhancing both environmental and economic outcomes.

Future research should aim to implement simultaneous, cross-national field experiments to control for extraneous factors and further isolate cultural mechanisms. Additionally, exploring hybrid interventions that integrate social, financial, and technological components could provide actionable insights for global energy policy, ensuring interventions are both culturally appropriate and cost-effective. By aligning behavioral strategies with cultural norms, policymakers can more effectively mobilize households toward sustainable energy use, contributing to the broader goal of global emissions reduction.

8. Appendix

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

Region	Related Work	Outcome	Social Nudge
California	High-frequency smart meter data was used to give occasional data information on electricity consumption to 237 individual loft units situated inside two different private buildings. The authors assessed the impact of information on the household's individual way of behaving.	Apartments receiving personal information on energy data decreased their power use throughout the experiment by roughly 6% more than units not receiving the treatment, compared to their average consumption before the intervention.	Information nudge: weekly emails.

California	The paper investigates the consumption and conservation behaviors of residents in low-income housing in Southern California through a questionnaire-based survey conducted across four housing facilities. It explores factors such as energy burden, satisfaction with building services, and drivers of conservation behaviors among low-income households. Additionally, the study identifies potential intervention strategies aimed at reducing utility bills and improving residents' quality of life, including educational programs and PV installation.	The findings reveal a strong inclination towards energy and water conservation, with 16% of respondents reporting a reduction in electricity bills compared to the preceding year, averaging a drop of 34 USD.	No nudging: survey only.
China	The study conducted a survey among rural residents to assess their willingness to adjust energy use behaviors in response to three virtual electricity pricing scenarios: Peak-valley rate (PVR), Photovoltaic systems (PVS) and original flat rate (OFR). A multi-group analysis was conducted to identify factors influencing residents' willingness to adjust energy consumption, utilizing an extended Theory of Planned Behavior (TPB) framework incorporating social capital and policy variables.	The study revealed varying preferences among rural residents, with 45.22% choosing PVR, 22.89% opting for PVS, and 31.89% selecting OFR. Attitudes significantly influenced residents' willingness to adjust washing machine usage time, while social network presence affected attitude and perceived behavioral control for certain scenarios. Policies and regulations notably impacted the willingness of residents selecting scenario PVS to adjust energy use.	No nudge. Investigating price incentives for DSM.
China	This study investigated the effectiveness of social norm interventions in promoting sustainable behaviors in the context of energy conservation. The research involved a field experiment conducted in university dormitories, with 584 students randomly assigned to control and treatment groups. These groups received social norm information varying in terms of group identification. Data collection included daily electricity meter readings before and after the intervention. Exclusion criteria were applied to participants reporting events that could significantly impact energy usage, resulting in a final sample size of 1027 individuals from 603 rooms.	The results of the study indicate that social norm information about a high identification group led to an 11% reduction in energy consumption, highlighting the importance of group identification in the efficacy of social norms interventions. The findings suggest that identification is a crucial factor in effectiveness for promoting energy-conservation behavior.	Information nudge: daily text message for 18 days.

Europe	The study investigates the motivation behind employee energy conservation and assesses the impact of an IoT-enabled gamified intervention in three workplaces across Europe. It aims to unravel individual energy-saving behavior factors and understand their influence on organizational energy conservation. Through multiple regression analysis, the study evaluates the predictive ability of various factors, including self-determination, personal norms, and organizational profiles, on energy-related behavioral outcomes at work.	Findings from the study reveal significant insight into energy-saving behavior and the effectiveness of the gamified intervention. The intervention led to a statistically significant increase in participants' intention to conserve electricity at work with a moderate effect size. Additionally, participants reported a positive change in their personal energy-saving habits with large effect size. The intervention resulted in a conservatively estimated energy saving of 6413 kWh during the intervention period, equivalent to 12.99% compared to baseline consumption.	Gamified nudge: personal feedback through an IoT device in the office.
Finland	By utilizing a clever overview and real month-to-month power utilization information, this study is aimed to analyze how aware people are about their power bills, costs, and expenses among a few Finnish families. Six inquiries were performed to examine whether more elevated levels of energy mindfulness are related to power investment funds. The web-based poll was sent to 244 individuals, of whom 184 completed it.	As per the results, only 27.7% of the respondents accurately addressed the six inquiries. Also, 20.8% of total respondents agreed to receive information nudge to improve their power consumption.	Information nudge: once, by email.
Finland	This research included peer comparisons and energy-saving advice while concentrating on nudging and home power consumption. A total of 528 families received emails with energy-saving advice for lowering winter electricity usage. Researchers looked at the relationship between power use and nudge effectiveness.	The key finding is the possibility that households that are more engaged in monitoring their power use may experience lower energy use. During the test period, an energy-saving nudge lowered the energy consumption by 10%.	Information nudge: social comparison treatment, and energy-saving advice. Information was given by monthly emails.
Germany	This research investigates the main finding of the Opower trials in the US—the cost-effectiveness of social resemblance Home Energy Reports (HER) as a climate policy tool. In a descriptive study, they demonstrate that, apart from Australia, lower energy usage levels and emissions levels of power production significantly limit the cost effectiveness potentials of HER. In a German	Due to the information from the HER reports, power usage was, on average, reduced by 0.7%, which is half of what was seen at the lower end of the 1.4–3.3 percent effect size range in the US.	Information nudge: comparing HER reports between households. The information to the households was given monthly for six

	case study, 11,630 residents were sent HER interventions.		months.
Germany	The study conducted a field experiment on resource conservation, specifically focusing on the everyday activity of showering in a student dormitory, known for its energy and water intensity. With 351 participants, two interventions were implemented. The interventions targeted biases arising from imperfect information and limited attention. The experiment involved a three-month duration and tested the effects of each intervention alone and in combination.	The findings revealed a remarkable complementarity between the two interventions. While each intervention individually had limited effectiveness in inducing conservation, the combined implementation yielded significant conservation effects.	Information nudge: daily/monthly information on energy use and real-time feedback, given via email.
Germany	A field experiment was conducted with 111 households equipped with rooftop photovoltaics to test the effectiveness of three sequentially applied behavioral nudges (feedback, benchmark and default) delivered through digital tools. The experiment employed a control group design, baseline measurements and high-frequency smart meter data to assess the causal effects of each intervention on increasing self-consumption.	The study revealed that while feedback and benchmark interventions resulted in a 3–4% in self-consumption, the default intervention led to a substantial 16% increase for active participants. Notably, households with controllable EVs showed stronger effects than those without.	Information nudge: Information (feedback, benchmark, or default) provided through digital tools, i.e., web portal and smart charging app.
Ghana	The study investigates the relationship between energy literacy (EL), attitude towards energy, personal energy value, and energy-savings behavior (ESB) within the context of a lower middle-income country, specifically focusing on hydro-electricity power in Ghana. A survey-based questionnaire was administered to 250 professional workers in Ghana to collect data.	The study found that energy literacy has a positive effect on energy-saving behavior, with attitude towards energy and personal energy value significantly mediating this relationship. Specifically, cognitive skills and affective outcomes of energy literacy were identified as significant predictors of personal energy value and attitude towards energy.	No nudge. Survey only.
Italy	This study used an experiment to evaluate how environmental awareness influences the larger scale effects of information nudging that requires sustained efforts. The authors merged data on consumption with survey data of 4835 consumers in order to investigate probable origins of the messages' diverse effects.	The program typically results in a 0.9% decrease in electricity use. The authors offered hints that targeting particular sub-groups might increase the effectiveness of boosting environmental awareness.	Information nudge: weekly emails.

Italy	Authors examined the impact of integrating financial reward with social nudges using a structured online experiment. Participants optimized their virtual electricity use on a simulated washing machine in a novel incentive-compatible electricity saving assignment suggested by the authors. A total of 566 participants took part in the study.	Electricity saving of 0.148% by the nudge approach and 0.156% electricity saving by the combined approach (nudge and reward) was achieved for the washing machine simulation.	Nudging on virtual study.
Japan	This field study aimed to test the effectiveness of energy efficiency guidance in the residential sector using a message pop-up feature in a mobile app. The app was distributed to approximately 1700 households that voluntarily enrolled in the program. Researchers conducted randomized controlled trials to assess the impact of message pop-ups containing energy efficiency advice. The advice included information about power usage and characteristics, as well as a social nudge approach.	Energy-saving recommendations decreased power use by 1.3%.	Information nudge: energy efficiency guidance via mobile app. Information was given on a daily, weekly, and monthly basis for five months.
Japan	This study is a large-scale randomized experiment of 62,400 homes, investigating the behavioral characteristics of energy-use feedback programs. The work includes social comparison-based home energy reports (HER), and categorization based on peer comparison. The authors used a randomized controlled experiment to analyze data from 62400 homes. There were two different sorts of home energy reports: one with hourly energy use comparisons and the other with yearly comparisons of monthly energy consumption.	The social comparison of HER reports with hourly data to HER with monthly data showed 1.4% lower energy consumption, which is 0.8% higher than the results obtained by historic comparison.	Information nudge: social comparison treatment through HER reports by monthly emails.
Kuwait	This study investigates the impact of the COVID-19 pandemic on energy literacy and conservation behavior in academic buildings in Kuwait. Employing a mixed-methods approach, it combines quantitative surveys with qualitative data collection methods such as questionnaires, focus groups, and interviews. The research included 158 engineering students, 67 faculty members, and 52 administrative staff, totaling 277 participants. Education, awareness, personal motivation, values, religiosity, and culture were identified as crucial factors influencing	The study found that COVID-19 had a significant impact on participants' attitudes, intentions, and behavior related to energy conservation in academic buildings in Kuwait. Specifically, the student group experienced a significant increase in the relationship between their intentions and behavior, while the faculty group exhibited a strong correlation between intention and behavior.	No nudge. Survey of impact of COVID-19 on energy literacy.

	energy literacy and conservation behaviors.		
Lithuania	This study performed an experiment on 2927 apartments to investigate how solely descriptive information, provided via online portals, may be a successful means of achieving energy savings in housing applications. The customized hourly energy demand data was presented on their individual online portals. The installation of new smart energy meters allowed for the availability of hourly energy data for the treatment group.	The outcomes revealed that providing descriptive information decreased electricity usage by 8.6%.	Information nudge: information on own hourly energy consumption data via a web portal.
Middle East	The authors conducted a large-scale field study including around 200,000 families in the Middle East, sending each family periodic messages on their water and power usage. The research was focused on finding whether giving such information on the usage of the two resources jointly may result in decreases in both sectors, as use of this strategy to encourage resource savings spreads.	For this social nudge, there was a reduction in electricity use of about 1.2%, keeping water utilization unaffected.	Information nudge: monthly emails.
Monaco	In this work, the authors investigated the relation between social nudge and the household's environmental awareness. Data from 77 families were gathered and divided into four groups. Ex-ante survey questions included the socio-demographics of the home, ecological dedication and considerations, power usage, heating system, and curtailing practices.	The difference in average energy consumption was noticed in the range of 7% to 31% among the groups.	Information nudging by email for six months.
Poland	This study investigated the preferences for demand-side management (DSM) programs in the electricity consumption of 1000 households. A web-based survey, conducted by a polling agency, was used for data collection. The researchers assessed the willingness to embrace changes in power consumption, and also explored how the social analysis of households' energy use affected their acceptance of DSM.	A majority, i.e., 85.4% of respondents, agreed to perform DSM, but they wanted payment for altering their behavior.	No nudging. Only a survey that supported financial incentives for behavioral change.

Portugal	An empirical experiment was conducted for a system with 20 customers to assess the power exchange cost for local participants. The study incorporated behavioral interventions for energy conservation and the adoption of renewable energy sources. The model followed a simulation-based study for the local electricity market.	Considering a 3% to 5% electricity saving, a cost savings of 5.60% to 19.26% was obtained.	Results from a simulation tool.
Sweden	This study used an experiment of 525 homes to determine the causal effects of social comparison on water and electricity use. The control and treatment groups were randomly assigned.	The daily domestic power usage was reduced by 6.7% on average by the social comparison treatment, while the household's water use remained unaffected.	Information nudge: real-time display for 12 months.
Switzerland	In this study, households in two Swiss neighborhoods (N = 177) participated in an energy conservation program. They were randomly assigned to receive either a concrete intervention or one including abstract environmental information.	Six months later, households exposed to the abstract message paid significantly more attention to energy consumption, with 12–15% more energy saving compared to the group which received concrete information.	Information nudge: comparing concrete and abstract information.

9. Acknowledgments

The author would like to thank Dr. Aivaliotis and Daryn Howland for their guidance and feedback throughout this project. Gratitude is also extended to the authors of the original field experiments and datasets referenced in this study, whose publicly available work made this analysis possible.

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Suggestion: Revise and resubmit

This is an extremely interesting paper tackling the impact of the role of social nudges in promoting changes in behavior in energy consumption. It is quite clear that this author has done quite a lot of work reviewing the literature, given the long appendix showing an overview of cross-cultural studies addressing this topic. I do have a few actionable suggestions, which I will list below.

- Add an abstract
- It would be helpful to get a general overview of the paper as early as the introduction. The introduction mentions that the author will be conducting a cross-national study, but we only know that they are focusing on the US and Germany further into the background section. Giving us this general overview early on would allow us, as readers, to make sense of how the theoretical frameworks shown in the paper actually help to build the arguments you are testing.
- Overall, a theoretical framework does not quite work as a theoretical framework. There is no actual theory, and then we see a laundry list of hypotheses to be tested. I would suggest either not calling it a theoretical framework or really fleshing out how each hypothesis is drawn from the theoretical framework you present. If going with the section option (which I think is preferred), I would then recommend shortening the introduction to a more traditional format (talking about the problem, explaining the gap in the literature, and saying how this paper meets this gap, removing all images and excessive examples) and then having a much longer argument section that truly builds on what you call a theoretical framework. In any case, the hypotheses should definitely not read just like a list that will be proven either right or wrong. Ideally, they should come with a rationale behind them.
- In the introduction, it is misleading to say that the paper consists of a quantitative analysis (and then a mixed methods study) when this is, in fact, a meta-analysis. There is no actual statistical analysis being conducted, which means this is not a quantitative study. It would be important to have this clear early on and then be consistent with the language you use to describe the methods.
- Then, because this is actually a meta-analysis and not a study, it is important to note that you are not comparing apples to apples when talking about the effect of the nudges in different cultures. Each case is a separate case. You may want to draw conclusions from the different findings, but this is more of a bigger-picture inquiry that should work as food for thought. In your conclusion, you do mention that future studies should look at conducting field experiments, but I missed a lengthier discussion about the limitations of the study you actually have here.
- Finally, along these lines, I would recommend being careful with the language of “this paper provides evidence suggesting that”... you need to be much softer in the language, treating this as more of a conversation starter than as an empirical study.

Overall, I think this is a great topic, and I do like the idea of conducting this sort of cross-cultural comparison. I would just recommend some extensive editorial revisions to make sure the language you use to describe the findings is consistent with the evidence you actually bring.

Author Code: 100171

Submission Code: 100162

Title of Paper: Efficiency of Behavioral Interventions on Cross-Cultural Domestic Energy Use

Originality & Significance:

Does the paper contribute new insights or perspectives to the field?

The paper addresses an interesting and relevant topic. With major revisions, it has the potential to be a strong addition to a future edition of the journal.

1. Clarity & Structure:

Is the argument well-organized and easy to follow? Are ideas clearly presented?

Largely, yes.

The RQ is not presented until page 3. Introducing the RQ and aims of the study in the opening paragraph will make the direction of the paper much clearer to the reader.

Some parts would benefit from being revised for clarity and rigour. For instance, some references have been used to support arguments that are not generalizable based on the context of the studies cited. An example is the use of Khosrowpour et al. (2016) – a paper looking at commercial building energy use – as the only citation to support an argument related to energy consumption in households. In its place, I would recommend using references such as:

Grønhøj, A., & Thøgersen, J. (2011). Feedback on household electricity consumption: learning and social influence processes. *International Journal of Consumer Studies*, 35(2), 138-145.

Gans, W., Alberini, A., & Longo, A. (2013). Smart meter devices and the effect of feedback on residential electricity consumption: Evidence from a natural experiment in Northern Ireland. *Energy Economics*, 36, 729-743.

The background and context in the introduction could be streamlined so that key arguments are presented clearly, and in a logical sequence. For instance, the first paragraph introduces energy efficiency and emissions reduction, then shifts to behavioural nudges. The second paragraph initially addresses the need for

tailored interventions based on energy consumption patterns, then shifts to the effects of cultural differences on global diffusion policy interventions. It would make the paper stronger if the author were to introduce a consistent logical narrative throughout. In other words, I encourage the author to be scrupulous about what they include in each section, and to ask themselves whether it is directly relevant to the research question, the following section(s), and/or the study's findings.

2. Use of Evidence & Research Methods:

Are sources appropriately cited?

Yes. However, I encourage the author to widen their review of literature to include prior research on cultural impacts on behavioural interventions, as well as on national culture in general.

Is their methodology sound and well-explained?

There remains some lack of clarity about the fit between the methods selected and the research design. Specifically, I would have liked to see a clearer, more detailed, and explicit discussion of the rationale for the selection of the chosen methods. There is also some amount of confusion with regard to the methods used – the author mentions a mixed-methods approach, but the findings and discussion appear to rely heavily on the quantitative cross-cultural analysis. The “qualitative theory-driven analysis” does not get much airtime, which is a pity, as it would have added significant depth to the “comparative meta-analytic synthesis”.

I **strongly** recommend that the author revisit the methodology section with the aim of strengthening it.

3. Engagement with Literature:

Does the paper demonstrate an understanding of relevant research in the field?

Overall, the reference list covers a range of papers – this is good. However, it may be worthwhile for the author to consider additional research papers on national culture, behavioural interventions, and effects of culture on policy interventions, such as the ones below, while revising their paper:

- Austin, E., Ward, N., Otto, J., Green, K., & Watson, H. (2022). Assessing the impact of culture: A systematic analysis of culture-based interventions and evaluations. *Frontiers in Future Transportation*, 3, 917915.
- Davidson, R. K. (2017). Cultural impacts on occupant behaviour and energy efficiency. *International Journal of Energy Production and Management*, 2(2), 186-195.
- De Mooij, M., & Hofstede, G. (2011). Cross-cultural consumer behavior: A review of research findings. *Journal of international consumer marketing*, 23(3-4), 181-192.
- Talhelm, T. (2025). Adapting Interventions to Culture Can Improve Effectiveness and Cost-Efficiency. *Policy Insights from the Behavioral and Brain Sciences*, 23727322251408076. [Note: This paper may be of particular interest to the author, as it examines the effectiveness of monetary incentives vs social norms in changing behaviour]
- Tverskoi, D., Babu, S., & Gavrilets, S. (2022). The spread of technological innovations: effects of psychology, culture and policy interventions. *Royal Society Open Science*, 9(6).

Do they acknowledge known results and connect their findings well to them?

The findings from the study are presented clearly. However, there is a need to consider these findings in the context of prior research on the topic. That is, contributions of the study need to be compared to findings from other research, especially as inferences are made about national culture (Japanese vs. German). Prior research appears to suggest that German cultural norms include strict observance of rules, which does not support the observation that due to a “more individualistic, low-context [German] culture, the implicit social pressure of the HER may be less potent than clear, rational, and individualistic incentives.”

The author needs to adopt a more critical perspective on the comparative analysis, without which the findings are at risk of lacking persuasiveness.

Overall, I am not convinced about the methodology adopted, as there appears to be a lack of fit between the research design and the choice of main theoretical perspective adopted (i.e., cultural influences on behavioural interventions). I strongly suggest that the author re-evaluate either the theoretical underpinning (e.g., a wider review of prior research examining cultural influences and their effects on behavioural interventions) or reconsider the research design (e.g.,

carrying out a systematic literature review instead of a cross-cultural comparative meta-analytic synthesis).

4. Grammar & Language

Is the writing clear and professional?

The writing is clear; however, there are multiple ideas being presented in each section which need to be synthesized better. I would also recommend that the author revise the manuscript to be tonally more neutral, to draw on evidence to support arguments, and to not take sources at face value (i.e., critically analyse data and references).

Other Comments:

- Suggest changing the title to more clearly present the RQ, e.g., “Impact of Cultural Values on Energy Conservation Initiatives”.

FINAL RECOMMENDATION:

- Accept as is
- Accept with minor revisions
- Accept with major revisions
- **Revise and resubmit**
- Reject

Impact of Cultural Context on Behavioral Energy Conservation Policy

Abstract

Energy efficiency policy programs are among the most widely adopted policy instruments for reducing household energy consumption, valued by governments for their cost-effectiveness. However, policy uptake remains underused in cases where households perceive the costs of engagement to outweigh the expected benefits. We hypothesize that cultural context mediates the effectiveness and cost-efficiency of behavioral energy interventions across countries. To analyze the specific effects of cultural identity, this study conducted a secondary cross-cultural analysis of existing energy efficiency field trials in advanced economies, focusing on social comparison feedback mechanisms, specifically the Home Energy Report (HER), in Japan and Germany. The analysis compared Average Treatment Effect (ATE) and Cost-Effective Ratio (CER). Mean ATEs differ by 1.38 percentage points between Japan (2.61%) and Germany (1.23%). In addition, estimated cost-effectiveness ranges from approximately 18–45 kWh saved per dollar spent in Japan and 11–27 kWh saved per dollar in Germany. The patterns suggest that aligning energy transition initiatives with prevailing social norms and social identities could enhance public acceptance and the overall effectiveness of behavioral energy policies.

1. Introduction

This paper examines the importance of understanding how cultural values influence the effectiveness of policy adaptation through a comparative meta-analysis of Home Energy Report (HER) initiatives between 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.

Behavioral interventions such as Home Energy Report (HER) have emerged as a promising tool to address these gaps. By leveraging social norms and comparison, HER trials (ex. 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.

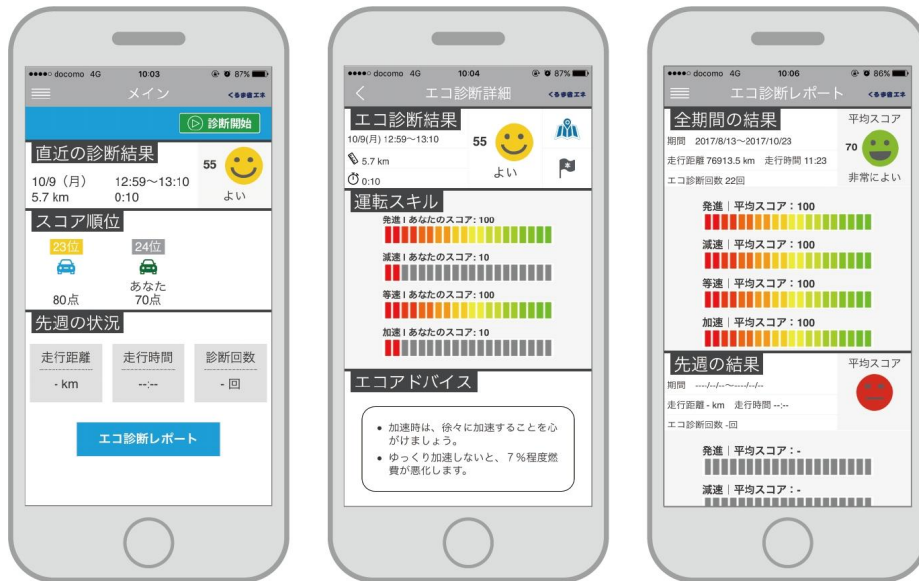


Figure 1. An example of the layout of the home energy reports used in Japanese Energy Trials.
(Automotive Media Response, 2018)

ENERGIEAUSWEIS für Nichtwohngebäude

gemäß den §§ 16 ff. der Energieeinsparverordnung (EnEV) vom 1.10.2002

Berechneter Energiebedarf des Gebäudes

Primärenergiebedarf

CO₂-Emissionen ³ kg/(m²·a)

Primärenergiebedarf dieses Gebäudes kWh/(m²·a)

0 100 200 300 400 500 600 700 800 900 ≥1000

EnEV-Anforderungswert Neubau (Vergleichswert) ↑

EnEV-Anforderungswert modernisierter Altbau (Vergleichswert) ↑

Anforderungen gemäß EnEV ⁴

Primärenergiebedarf kWh/(m²·a) Anforderungswert kWh/(m²·a)

Mittlere Wärmedurchgangskoeffizienten ☐ eingehalten ☐ eingehalten

Sommerlicher Wärmeschutz (bei Neubau) ☐ eingehalten ☐ eingehalten

☐ Verfahren nach Anlage 2 Nummer 2 EnEV

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

☐ Vereinfachungen nach § 9 Absatz 2 EnEV

☐ Vereinfachungen nach Anlage 2 Nummer 2.1.4 EnEV

Endenergiebedarf

Energieträger	Heizung	Warmwasser	Eingeblaute Beleuchtung	Lüftung ⁵	Kühlung einschl. Beleuchtung	Gebäude insgesamt

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 Ersatzmaßnahmen 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/gelüftete Netto-grundfläche.

¹ siehe Fußnote 1 auf Seite 1 des Energieausweises ² siehe Fußnote 2 auf Seite 1 des Energieausweises
⁴ nur bei Neubau sowie bei Modernisierung im Fall des § 16 Absatz 1 Satz 3 EnEV ⁵ freiwillige Angabe
⁶ nur bei Neubau ⁷ nur bei Neubau im Fall der Anwendung von § 7 Absatz 1 Nummer 2 EEWärmeG ⁸ nur Hilfsenergiebedarf

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

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 & Senstein, 2008). However, the efficiency of these tools exhibits certain variabilities depending on the 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 significantly 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 argues that cultural context is a key factor shaping 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. 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 a comparative meta-analysis of existing randomized controlled trials, specifically in Japan and Germany respectively,

systematically comparing the Average Treatment Effect (ATE) and Cost-Effectiveness Ratio (CER) of HER interventions in both countries. By integrating cultural theory with empirical synthesis, the paper aims to provide a theoretically grounded explanation for cross-national differences in policy effectiveness.

Ultimately, the study seeks to address this gap by conducting a comparative review of HER trials in Japan and Germany. Rather than seeking to establish casual proof, the paper uses cultural theory as an interpretive framework to examine whether observed differences in intervention outcomes are consistent with broader cross-cultural behavioral patterns. However, findings drawn from heterogeneous trials conducted under varying conditions should be interpreted with caution, as they do not constitute strictly controlled comparisons.

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, M. 2025).

However, this comprehensive figure masks significant 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 a full list of each of the 23 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 can 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) dimension and Hall's theory of communication context.

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 influence how strongly individuals respond to social comparison and normative pressure.

Furthermore, Edward T. Hall's distinction between **High-Context** (Japan) and **Low-Context** (Germany) communication is another important factor in 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. 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 further emphasizes how the HER is framed to target collectivist high-context societies, which rely on social comparison and implicit normative cues, due to the inherent effectiveness of social nudges in collectivist, high-context societies than in individualist, low-context ones.

2.3 Energy Trials and Policy in Japan and Germany

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

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.

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. 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 significant 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 how 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 is likely to 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.

Accordingly, this framework does not seek to establish a deterministic causal relationship between national culture and HER effectiveness. Rather, it provides a theoretically grounded lens for interpreting whether observed differences in HER outcomes between Japan and Germany are broadly consistent with prior research on cultural moderation in behavioral policy interventions.

Instead of testing a formal causal theory, the study examines whether observed differences in intervention outcomes are consistent with established theories of social norms, collective behavior, and communication context. HER interventions have a myriad of behavioral mechanisms: social comparison, norm salience, reputational concern, avoidance of perceived deviance.

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.

Baseline expectation: The implementation of Social Norm Feedback (HER) trials are expected to reduce household energy consumption in both Japan and Germany.

Comparative expectation: The mean percentage reduction in energy consumption achieved by the Social Norm Feedback (HER) intervention may show significantly stronger average behavioral responses in Japan than in Germany.

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 cost-effective in Japan.

4. Comparative Meta-Analysis

4.1. Research Design

This study employs a cross-cultural comparative meta-analytic synthesis 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 cultural

context moderates the magnitude and cost-effectiveness of behavioral energy interventions.

A comparative synthesis is appropriate because HER interventions are highly standardized in structure (peer comparison feedback delivered through periodic reports) but implemented in distinct cultural, regulatory, and infrastructural contexts. This approach allows for exploratory assessment of cultural moderation while maintaining external validity. 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 were aggregated from publicly available and credible sources, including:

Peer-reviewed academic journals

Government and ministry reports (e.g., METI, BMWK)

Utility company evaluations and white papers

NGO and policy institute reports

Only studies reporting original empirical results from field trials were considered.

Inclusion Criteria

Studies were included if they met all of the following conditions:

The intervention incorporated a Social Norm Feedback component, such as peer comparison or normative ranking.

The study reported a quantifiable treatment effect, expressed as a percentage change in energy consumption, along with a measure of statistical uncertainty (e.g., p-value, standard error, or confidence interval).

The trial was conducted among a representative sample of residential households in either Japan or Germany through the use of Randomized Controlled Trials (RCTs).

The study provided cost information or a proxy for intervention cost (e.g., printing, distribution, or total program budget).

The post-intervention period lasted at least one billing cycle.

Exclusion Criteria

Households with zero monthly electricity usage, identified through smart meter data, were excluded to avoid distortion of percentage change estimates. Additionally, extreme

outliers in monthly energy consumption were removed using the Smirnov–Grubbs test, ensuring that treatment effects were not driven by anomalous observations.

4.3. Data Synthesis and Analytical Strategy

Outcome Variable

The primary outcome variable is the Average Treatment Effect (ATE), defined as the mean percentage change in household electricity consumption for treated households relative to control households.

Effect Size Handling

Reported ATEs were extracted directly from each study. When effects were reported in alternative units (e.g., kWh), they were converted to percentage changes using reported baseline consumption levels. No additional pooling weights were applied.

Given the small number of trials and heterogeneity in study design, country-level averages were calculated using simple unweighted means. This approach prioritizes transparency and avoids imposing assumptions about comparability or variance structures that cannot be reliably verified. This choice is treated as a methodological limitation.

Cross-Country Comparison

Differences between Japan and Germany are reported descriptively, using country-level means and ranges. Formal hypothesis testing is avoided due to:

Small numbers of trials per country, potential non-independence across estimates, and substantial heterogeneity in duration, delivery frequency, and population characteristics.

Given the small sample size of trials and substantial heterogeneity in study design, duration, delivery frequency, and sample composition, cross-country comparisons are presented descriptively using country-level means and ranges. This approach prioritizes transparency while avoiding unwarranted statistical assumptions.

Cost-Effectiveness Analysis

For trials reporting cost data, a Cost-Effectiveness Ratio (CER) was calculated as:

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

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, reflecting variation across trials rather than a pooled estimate.

5. Results

5.1. Trial Summary and Baseline Effects

A total of 10 HER trials met the inclusion criteria: 6 conducted in Japan and 4 conducted in Germany. Across both countries, Social Norm Feedback interventions were consistently associated with reductions in residential electricity consumption, consistent with the baseline analytical expectation that HER interventions reduce energy use on average.

Japan (n = 6):

Mean ATE = 2.61% reduction

Range = 1.30% to 7.50%

Germany (n = 4):

Mean ATE = 1.23% reduction

Range = 0% to 3.50%

These results indicate that HER interventions produced energy savings in both cultural contexts, though with substantial variation across individual trials. Figure 3 illustrates the cross-cultural mean ATEs.

Country	Mean ATE (%)
Japan	1.59%
Japan	1.40%
Japan	1.85%
Japan	7.50%
Japan	1.30%
Japan	2.00%
Japan Average	2.61%

Table 1. Japan Mean ATE (%) Results

Country ▼	Mean ATE (%)
Germany	0.70%
Germany	0.70%
Germany	3.50%
Germany	0%
German Average	1.23%

Table 2. German Mean ATE (%) Results

Average Treatment Effect (%)

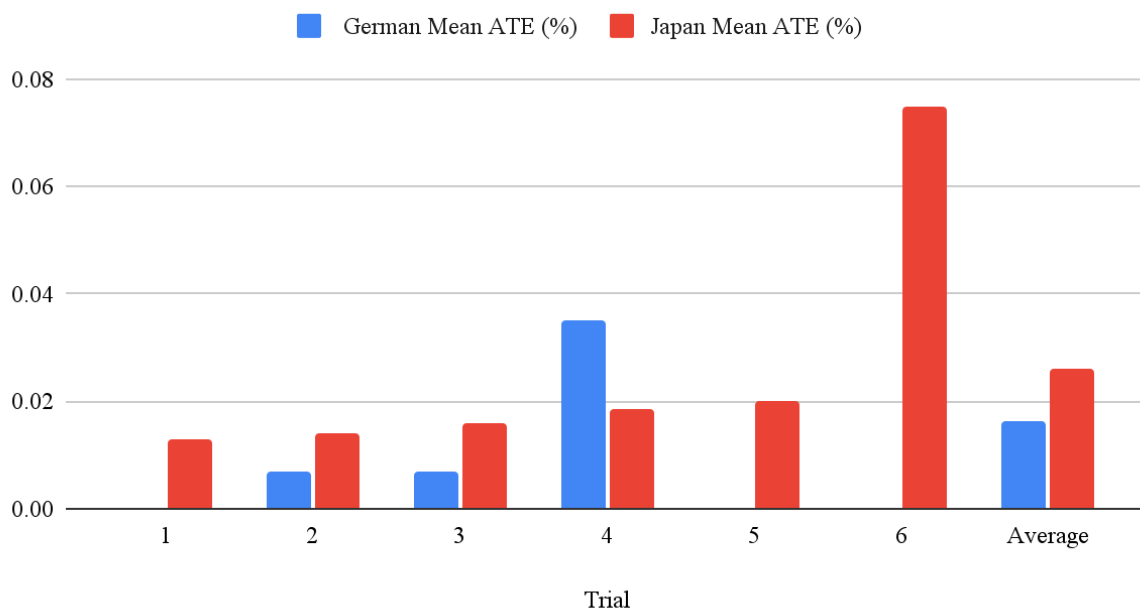


Figure 3. Average Treatment Effect Japan vs Germany

5.2. Cultural Magnitude Comparison

Japanese trials exhibited larger average reductions in electricity consumption than German trials (difference in means: 1.38 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 Ratios (CER) were derived from Table 3 reported cost per kilowatt-hour saved in column 3 (“Cost in Cent/ kWh Saved”). For clarity, values were converted to kWh saved per \$1 spent:

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 3. International Cost-Effectiveness Comparison of HER Interventions

	(1)	(2)	(3)	(4)	(5)
Country	Average Electricity Consumption in kWh	CO ₂ Emissions in g / kWh	Cost in Cent / kWh Saved	Abatement Cost in \$ / t CO ₂	CO ₂ Abatement Cost Relative to US
Canada	11,379	158	1.1 – 2.6	67 – 162	3.3
United States	12,293	489	1.0 – 2.4	20 – 49	1.0
France	5,859	64	2.1 – 5.0	323 – 779	16.0
Germany	3,304	486	3.7 – 8.8	75 – 182	3.7
Italy	2,542	343	4.8 – 11.5	139 – 335	6.9
Poland	1,935	769	6.3 – 15.1	81 – 196	4.0
Spain	4,040	247	3.0 – 7.2	121 – 293	6.0
Sweden	8,025	13	1.5 – 3.6	1,162 – 2,799	57.6
United Kingdom	4,145	459	2.9 – 7.0	64 – 153	3.2
Japan	5,434	572	2.2 – 5.4	39 – 94	1.9
South Korea	3,489	536	3.5 – 8.4	65 – 156	3.2
Australia	6,959	798	1.7 – 4.2	22 – 53	1.1

Notes: Our calculations assume printing and mailing cost of 1 US\$ per report, four reports per year and average electricity reductions of 1.37–3.30%. Average electricity consumption and CO₂ intensities of electricity generation correspond to the most recently available data (for 2013), as documented in WEC (2016) and IEA (2015), respectively.

(Andor, Gerster, Ankel-Peters, & Schmidt, 2018)

5.4. Significance

These figures indicate that, for comparable implementation costs, HER interventions may deliver higher energy savings per dollar spent in Japan than in Germany. This pattern is consistent with the observed differences in mean ATEs across the two countries, although, as noted, these differences are not statistically significant. Overall, these findings illustrate that cultural and contextual factors may influence both the effectiveness and cost-efficiency of behavioral energy policies, even if formal statistical testing does not confirm a significant cross-country difference.

6. Discussion

6.1. Interpretation of Findings

The results of the second analysis are consistent with the central hypothesis that culture may function as an important mediator of behavioral intervention efficacy. The greater observed effect size of the Social Norm Feedback (HER) in Japan may be partly attributable to its collectivist, high-context cultural orientation. The intervention effectively leverages the deep-seated value of social harmony and the implicit pressure to conform to group behavior. Conversely, the comparatively smaller response in Germany suggests that in a more individualistic, low-context culture, the implicit social pressure of the HER may be less potent than clear, rational, and individualistic incentives. This varying effectiveness of social nudging strategies can often be traced to psychological mechanisms such as social norm activation, identity alignment, and salience of feedback. For instance, peer comparison is particularly effective when individuals identify closely with the reference group, which enhances internalization of the behavior. Personalized feedback increases engagement by enhancing relevance and perceived control. In contrast, generic or infrequent nudges may fail to create a sense of urgency or personal connection. Environmental awareness, cultural context, and baseline consumption behavior also mediate nudge effectiveness. These factors highlight the need for tailoring nudges to fit the specific behavioral, social, and infrastructural context of the target audience.

6.2. The Culture-Contingent Environmental Incentive Design

Based on the cost-effectiveness analysis, the higher CER observed in Japan indicates 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 certain limitations. First, while we aimed for a structured literature synthesis, the included studies vary widely in terms of methodology, measurement, context, and reporting, which makes direct comparisons difficult. 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, culture remains analytically central to this study because Social Norm Feedback operates primarily through psychological mechanisms rather than material incentives. Structural factors shape the external conditions under which households consume energy, but norm-based interventions depend on how individuals interpret social comparison, internalize group expectations, and respond to perceived conformity pressures. These processes are deeply embedded in cultural orientations such as collectivism, communication context, and uncertainty avoidance. Thus, while regulatory and infrastructural variables may moderate overall outcomes, cultural context directly influences the mechanism through which the intervention exerts its effect.

Second, while we focused on recent field studies with reported positive outcomes, this may introduce publication bias, as unsuccessful or neutral interventions are less frequently reported. Lastly, the limited sampling causes uncertainty in the correlations between cultural context and behavioral energy policy outcomes. While the observed patterns are consistent with cultural theory, the present analysis cannot definitively isolate culture from regulatory, infrastructural, or economic confounders. Future research should involve an identical, contemporaneous field experiment across both nations to control for external variables and more clearly distinguish cultural effects from structural policy differences.

Importantly, Germany's comparatively lower HER effects 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 exhibit institutional signals, financial incentives, or formal regulations.

7. Conclusion

The overall effectiveness of behavioral energy interventions is likely to be influenced by cultural context. By analyzing evidence from randomized controlled trials in Japan and Germany, the findings are broadly consistent with existing literature suggesting that collectivist, high-context societies such as Japan may respond more strongly to social norm-based interventions than individualistic, low-context societies such as Germany. Japanese trials not only achieved larger reductions in household energy consumption (Mean ATE = 2.61% vs. 1.23% in Germany) but also delivered higher

returns on investment, as reflected in the cost-effectiveness ratio (18–45 kWh saved per \$1 spent in Japan vs. 11–27 kWh in Germany). These findings reinforce the view in the literature that culture may act as an important moderator of behavioral policy efficacy.

The implications for policymakers suggest that energy conservation strategies should be cautious about relying on a one-size-fits-all approach. In collectivist contexts, low-cost, socially framed incentives can achieve substantial energy savings, while in individualist settings, interventions should be coupled with rational, financially oriented incentives to maximize impact. This culture-contingent approach offers a pathway to more efficient, context-sensitive energy policy design, enhancing both environmental and economic outcomes.

Future research should aim to implement simultaneous, cross-national field experiments to control for extraneous factors and further isolate cultural mechanisms. Additionally, exploring hybrid interventions that integrate social, financial, and technological components could provide actionable insights for global energy policy, ensuring interventions are both culturally appropriate and cost-effective. By aligning behavioral strategies with cultural norms, policymakers can more effectively mobilize households toward sustainable energy use, contributing to the broader goal of global emissions reduction.

8. Appendix

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

Region	Related Work	Outcome	Social Nudge
California	High-frequency smart meter data was used to give occasional data information on electricity consumption to 237 individual loft units situated inside two different private buildings. The authors assessed the impact of information on the household's individual way of behaving.	Apartments receiving personal information on energy data decreased their power use throughout the experiment by roughly 6% more than units not receiving the treatment, compared to their average consumption before the intervention.	Information nudge: weekly emails.
California	The paper investigates the consumption and conservation behaviors of residents in low-income housing in Southern California through a questionnaire-based survey conducted across four housing facilities. It explores factors such as energy burden, satisfaction with building services, and drivers of conservation behaviors among low-income households. Additionally, the study identifies potential intervention strategies aimed at	The findings reveal a strong inclination towards energy and water conservation, with 16% of respondents reporting a reduction in electricity bills compared to the preceding year, averaging a drop of 34 USD.	No nudging: survey only.

	reducing utility bills and improving residents' quality of life, including educational programs and PV installation.		
China	The study conducted a survey among rural residents to assess their willingness to adjust energy use behaviors in response to three virtual electricity pricing scenarios: Peak-valley rate (PVR), Photovoltaic systems (PVS) and original flat rate (OFR). A multi-group analysis was conducted to identify factors influencing residents' willingness to adjust energy consumption, utilizing an extended Theory of Planned Behavior (TPB) framework incorporating social capital and policy variables.	The study revealed varying preferences among rural residents, with 45.22% choosing PVR, 22.89% opting for PVS, and 31.89% selecting OFR. Attitudes significantly influenced residents' willingness to adjust washing machine usage time, while social network presence affected attitude and perceived behavioral control for certain scenarios. Policies and regulations notably impacted the willingness of residents selecting scenario PVS to adjust energy use.	No nudge. Investigating price incentives for DSM.
China	This study investigated the effectiveness of social norm interventions in promoting sustainable behaviors in the context of energy conservation. The research involved a field experiment conducted in university dormitories, with 584 students randomly assigned to control and treatment groups. These groups received social norm information varying in terms of group identification. Data collection included daily electricity meter readings before and after the intervention. Exclusion criteria were applied to participants reporting events that could significantly impact energy usage, resulting in a final sample size of 1027 individuals from 603 rooms.	The results of the study indicate that social norm information about a high identification group led to an 11% reduction in energy consumption, highlighting the importance of group identification in the efficacy of social norms interventions. The findings suggest that identification is a crucial factor in effectiveness for promoting energy-conservation behavior.	Information nudge: daily text message for 18 days.
Europe	The study investigates the motivation behind employee energy conservation and assesses the impact of an IoT-enabled gamified intervention in three workplaces across Europe. It aims to unravel individual energy-saving behavior factors and understand their influence on organizational energy conservation. Through multiple regression analysis, the study evaluates the predictive ability of various factors, including self-determination, personal norms, and organizational profiles, on energy-related behavioral outcomes at work.	Findings from the study reveal significant insight into energy-saving behavior and the effectiveness of the gamified intervention. The intervention led to a statistically significant increase in participants' intention to conserve electricity at work with a moderate effect size. Additionally, participants reported a positive change in their personal energy-saving habits with large effect size. The intervention resulted in a conservatively	Gamified nudge: personal feedback through an IoT device in the office.

		estimated energy saving of 6413 kWh during the intervention period, equivalent to 12.99% compared to baseline consumption.	
Finland	By utilizing a clever overview and real month-to-month power utilization information, this study is aimed to analyze how aware people are about their power bills, costs, and expenses among a few Finnish families. Six inquiries were performed to examine whether more elevated levels of energy mindfulness are related to power investment funds. The web-based poll was sent to 244 individuals, of whom 184 completed it.	As per the results, only 27.7% of the respondents accurately addressed the six inquiries. Also, 20.8% of total respondents agreed to receive information nudge to improve their power consumption.	Information nudge: once, by email.
Finland	This research included peer comparisons and energy-saving advice while concentrating on nudging and home power consumption. A total of 528 families received emails with energy-saving advice for lowering winter electricity usage. Researchers looked at the relationship between power use and nudge effectiveness.	The key finding is the possibility that households that are more engaged in monitoring their power use may experience lower energy use. During the test period, an energy-saving nudge lowered the energy consumption by 10%.	Information nudge: social comparison treatment, and energy-saving advice. Information was given by monthly emails.
Germany	This research investigates the main finding of the Opower trials in the US—the cost-effectiveness of social resemblance Home Energy Reports (HER) as a climate policy tool. In a descriptive study, they demonstrate that, apart from Australia, lower energy usage levels and emissions levels of power production significantly limit the cost effectiveness potentials of HER. In a German case study, 11,630 residents were sent HER interventions.	Due to the information from the HER reports, power usage was, on average, reduced by 0.7%, which is half of what was seen at the lower end of the 1.4–3.3 percent effect size range in the US.	Information nudge: comparing HER reports between households. The information to the households was given monthly for six months.
Germany	The study conducted a field experiment on resource conservation, specifically focusing on the everyday activity of showering in a student dormitory, known for its energy and water intensity. With 351 participants, two interventions were implemented. The interventions targeted biases arising from imperfect information and limited attention. The experiment involved a three-month duration and tested the effects of each	The findings revealed a remarkable complementarity between the two interventions. While each intervention individually had limited effectiveness in inducing conservation, the combined implementation yielded significant conservation effects.	Information nudge: daily/monthly information on energy use and real-time feedback, given via email.

	intervention alone and in combination.		
Germany	A field experiment was conducted with 111 households equipped with rooftop photovoltaics to test the effectiveness of three sequentially applied behavioral nudges (feedback, benchmark and default) delivered through digital tools. The experiment employed a control group design, baseline measurements and high-frequency smart meter data to assess the causal effects of each intervention on increasing self-consumption.	The study revealed that while feedback and benchmark interventions resulted in a 3–4% in self-consumption, the default intervention led to a substantial 16% increase for active participants. Notably, households with controllable EVs showed stronger effects than those without.	Information nudge: Information (feedback, benchmark, or default) provided through digital tools, i.e., web portal and smart charging app.
Ghana	The study investigates the relationship between energy literacy (EL), attitude towards energy, personal energy value, and energy-savings behavior (ESB) within the context of a lower middle-income country, specifically focusing on hydro-electricity power in Ghana. A survey-based questionnaire was administered to 250 professional workers in Ghana to collect data.	The study found that energy literacy has a positive effect on energy-saving behavior, with attitude towards energy and personal energy value significantly mediating this relationship. Specifically, cognitive skills and affective outcomes of energy literacy were identified as significant predictors of personal energy value and attitude towards energy.	No nudge. Survey only.
Italy	This study used an experiment to evaluate how environmental awareness influences the larger scale effects of information nudging that requires sustained efforts. The authors merged data on consumption with survey data of 4835 consumers in order to investigate probable origins of the messages' diverse effects.	The program typically results in a 0.9% decrease in electricity use. The authors offered hints that targeting particular sub-groups might increase the effectiveness of boosting environmental awareness.	Information nudge: weekly emails.
Italy	Authors examined the impact of integrating financial reward with social nudges using a structured online experiment. Participants optimized their virtual electricity use on a simulated washing machine in a novel incentive-compatible electricity saving assignment suggested by the authors. A total of 566 participants took part in the study.	Electricity saving of 0.148% by the nudge approach and 0.156% electricity saving by the combined approach (nudge and reward) was achieved for the washing machine simulation.	Nudging on virtual study.

Japan	This field study aimed to test the effectiveness of energy efficiency guidance in the residential sector using a message pop-up feature in a mobile app. The app was distributed to approximately 1700 households that voluntarily enrolled in the program. Researchers conducted randomized controlled trials to assess the impact of message pop-ups containing energy efficiency advice. The advice included information about power usage and characteristics, as well as a social nudge approach.	Energy-saving recommendations decreased power use by 1.3%.	Information nudge: energy efficiency guidance via mobile app. Information was given on a daily, weekly, and monthly basis for five months.
Japan	This study is a large-scale randomized experiment of 62,400 homes, investigating the behavioral characteristics of energy-use feedback programs. The work includes social comparison-based home energy reports (HER), and categorization based on peer comparison. The authors used a randomized controlled experiment to analyze data from 62400 homes. There were two different sorts of home energy reports: one with hourly energy use comparisons and the other with yearly comparisons of monthly energy consumption.	The social comparison of HER reports with hourly data to HER with monthly data showed 1.4% lower energy consumption, which is 0.8% higher than the results obtained by historic comparison.	Information nudge: social comparison treatment through HER reports by monthly emails.
Kuwait	This study investigates the impact of the COVID-19 pandemic on energy literacy and conservation behavior in academic buildings in Kuwait. Employing a mixed-methods approach, it combines quantitative surveys with qualitative data collection methods such as questionnaires, focus groups, and interviews. The research included 158 engineering students, 67 faculty members, and 52 administrative staff, totaling 277 participants. Education, awareness, personal motivation, values, religiosity, and culture were identified as crucial factors influencing energy literacy and conservation behaviors.	The study found that COVID-19 had a significant impact on participants' attitudes, intentions, and behavior related to energy conservation in academic buildings in Kuwait. Specifically, the student group experienced a significant increase in the relationship between their intentions and behavior, while the faculty group exhibited a strong correlation between intention and behavior.	No nudge. Survey of impact of COVID-19 on energy literacy.

Lithuania	This study performed an experiment on 2927 apartments to investigate how solely descriptive information, provided via online portals, may be a successful means of achieving energy savings in housing applications. The customized hourly energy demand data was presented on their individual online portals. The installation of new smart energy meters allowed for the availability of hourly energy data for the treatment group.	The outcomes revealed that providing descriptive information decreased electricity usage by 8.6%.	Information nudge: information on own hourly energy consumption data via a web portal.
Middle East	The authors conducted a large-scale field study including around 200,000 families in the Middle East, sending each family periodic messages on their water and power usage. The research was focused on finding whether giving such information on the usage of the two resources jointly may result in decreases in both sectors, as use of this strategy to encourage resource savings spreads.	For this social nudge, there was a reduction in electricity use of about 1.2%, keeping water utilization unaffected.	Information nudge: monthly emails.
Monaco	In this work, the authors investigated the relation between social nudge and the household's environmental awareness. Data from 77 families were gathered and divided into four groups. Ex-ante survey questions included the socio-demographics of the home, ecological dedication and considerations, power usage, heating system, and curtailing practices.	The difference in average energy consumption was noticed in the range of 7% to 31% among the groups.	Information nudging by email for six months.
Poland	This study investigated the preferences for demand-side management (DSM) programs in the electricity consumption of 1000 households. A web-based survey, conducted by a polling agency, was used for data collection. The researchers assessed the willingness to embrace changes in power consumption, and also explored how the social analysis of households' energy use affected their acceptance of DSM.	A majority, i.e., 85.4% of respondents, agreed to perform DSM, but they wanted payment for altering their behavior.	No nudging. Only a survey that supported financial incentives for behavioral change.
Portugal	An empirical experiment was conducted for a system with 20 customers to assess the power exchange cost for local participants. The study incorporated behavioral interventions for energy conservation and the adoption of renewable energy sources. The model followed a simulation-based study for the local	Considering a 3% to 5% electricity saving, a cost savings of 5.60% to 19.26% was obtained.	Results from a simulation tool.

	electricity market.		
Sweden	This study used an experiment of 525 homes to determine the causal effects of social comparison on water and electricity use. The control and treatment groups were randomly assigned.	The daily domestic power usage was reduced by 6.7% on average by the social comparison treatment, while the household's water use remained unaffected.	Information nudge: real-time display for 12 months.
Switzerland	In this study, households in two Swiss neighborhoods (N = 177) participated in an energy conservation program. They were randomly assigned to receive either a concrete intervention or one including abstract environmental information.	Six months later, households exposed to the abstract message paid significantly more attention to energy consumption, with 12–15% more energy saving compared to the group which received concrete information.	Information nudge: comparing concrete and abstract information.

9. Acknowledgments

The author would like to thank Dr. Aivaliotis and Daryn Howland for their guidance and feedback throughout this project. Gratitude is also extended to the authors of the original field experiments and datasets referenced in this study, whose publicly available work made this analysis possible.

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Efficiency of Behavioral Interventions on Cross-Cultural Domestic Energy Use

Impact of Cultural Context on Behavioral Energy Conservation Policy

Abstract

Energy efficiency policy programs are among the most widely adopted policy instruments for reducing household energy consumption, valued by governments for their cost-effectiveness. However, policy uptake remains underused in cases where households perceive the costs of engagement to outweigh the expected benefits. We hypothesize that cultural context mediates the effectiveness and cost-efficiency of behavioral energy interventions across countries. To analyze the specific effects of cultural identity, this study conducted a secondary cross-cultural analysis of existing energy efficiency field trials in advanced economies, focusing on social comparison feedback mechanisms, specifically the Home Energy Report (HER), in Japan and Germany. The analysis compared Average Treatment Effect (ATE) and Cost-Effective Ratio (CER). Mean ATEs differ by 1.38 percentage points between Japan (2.61%) and Germany (1.23%). In addition, estimated cost-effectiveness ranges from approximately 18–45 kWh saved per dollar spent in Japan and 11–27 kWh saved per dollar in Germany. The patterns suggest that aligning energy transition initiatives with prevailing social norms and social identities could enhance public acceptance and the overall effectiveness of behavioral energy policies.

1. Introduction

This paper examines the importance of understanding how cultural values influence the effectiveness of policy adaptation through a comparative meta-analysis of Home Energy Report (HER) initiatives between 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). The economic value of increased efficiency is underscored by the immense costs associated with wasted energy. For instance, 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%. The remaining policy gaps could be substantially reduced by "raising the ambition of existing policies" (IEA, 2025) through behavioral load shifting. The Home Energy Report (HER) trials (ex. Figure 1 and Figure 2), for example, reported an average of 2–3% of energy preservation through behavioral nudges such as social comparison. Given this potential,

individual efforts can reduce consumption. Since consumption itself heavily affects economic and environmental savings, the optimization of policy interventions becomes more of a necessity.

Despite substantial global investment, approximately \$800 billion USD is currently being invested annually in energy efficiency technologies and programs, yet global progress remains below the 4% annual improvement target agreed upon at COP28, currently at around 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.

Behavioral interventions such as Home Energy Reports (HER) 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) demonstrate an average of 2–3% energy savings through behavioral nudges. However, the effectiveness of such interventions varies across regions, raising questions about the conditions under which they succeed.

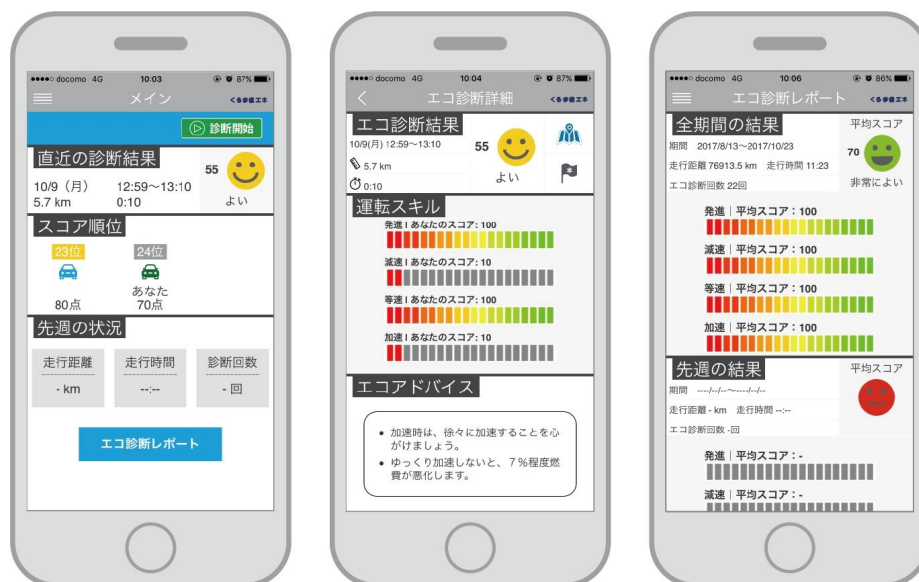


Figure 1. An example of the layout of the home energy reports used in Japanese Energy Trials
(Automotive Media Response, 2018)

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

Berechneter Energiebedarf des Gebäudes Registriernummer 2
(oder „Registriernummer wurde beantragt am...“)

Primärenergiebedarf

CO₂-Emissionen³ kg/(m²·a)

Primärenergiebedarf dieses Gebäudes kWh/(m²·a)

0 100 200 300 400 500 600 700 800 900 ≥1000

EnEV-Anforderungswert Neubau (Vergleichswert) ↑ EnEV-Anforderungswert modernisierter Altbau (Vergleichswert) ↑

Anforderungen gemäß EnEV⁴

Primärenergiebedarf kWh/(m²·a) Anforderungswert kWh/(m²·a)

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

Mittlere Wärmedurchgangskoeffizienten ☐ eingehalten ☐ eingehalten

Sommerlicher Wärmeschutz (bei Neubau) ☐ eingehalten ☐ eingehalten

Für Energiebedarfsberechnungen verwendete 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	Heizung	Warmwasser	Jährlicher Endenergiebedarf in kWh/(m ² ·a) für:	Gebäude insgesamt
			Eingebaute Beleuchtung Lüftung 5 Kühlung einschl. Lüftung 5	

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

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

Angaben zum EEWärmeG⁵

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

Art: Deckungsanteil: %

Ersatzmaßnahmen⁷

Die Anforderungen des EEWärmeG werden durch die Ersatzmaßnahmen 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 § 9 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 beizufügen Angabe

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

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)

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).—behavioral insights from economics and psychology used to influence decision-making—has become a widely adopted cost-effective policy tool (Thaler & Sunstein, 2008). However, the efficiency effectiveness of these tools, seen in the widely implemented HER trials, exhibits certain variabilities depending on the country due to the challenges social nudges pose, as illustrated in Figure 3. varies across regions. 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. heterogeneous responses to social information. This variability is further supported by Grønhøj and Thøgersen (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, Alberini, and Longo (2013) demonstrate that the impact of feedback technologies such as smart meters varies significantly depending on user engagement and contextual factors. The global diffusion of identical policy policies interventions 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), shape how individuals interpret and respond to policy information; however, this effect can be mitigated through debiasing strategies. When information is framed in ways that align with rather than challenge existing cultural values, individuals are more likely to accept and act upon it (Kahan & Braman, 2006).

Figure 3. Social nudge framework for energy conservation (Mochi, et al, 2025)

This paper examines the importance of understanding how cultural values influence policy adaptation through a quantitative cross-cultural analysis of past energy conservation initiatives. We focus specifically on the effectiveness of HER in two distinct high-income economies, Japan and Germany. By systematically aggregating and comparing the Average Treatment Effect (ATE) and Cost-Effectiveness Ratio (CER) of the HER across trials in both countries, the study highlights the pivotal role of cultural identity in shaping public engagement with sustainable energy policies utilizing behavioral interventions. The overarching aim is to best optimize public policy with a cultural-contingent incentive design. This environmental design should activate the lowest-cost informal incentive mechanism available in each society.

This study argues that cultural context is a key factor shaping variation in policy effectiveness. Differences in social norms, communication styles, and collective behavior may influence how individuals respond to normative feedback, leading to divergent outcomes across countries. To investigate this, the study focuses on Japan and Germany, two highly industrialized, energy-dependent economies with similar structural constraints but contrasting cultural profiles. Empirical evidence suggests that Japanese populations exhibit more uniform behavioral responses across social groups compared to Germany, where greater individual variation is observed. For example, Schmidt-Petri et al. report higher levels of cooperative behavior in Japan during the COVID-19 pandemic across demographic groups, whereas Germany shows more heterogeneous responses.

To examine this relationship, this paper employs a comparative meta-analysis of existing randomized controlled trials in Japan and Germany, systematically comparing the Average Treatment Effect (ATE) and Cost-Effectiveness Ratio (CER) of HER interventions.

By integrating cultural theory with empirical synthesis, the study aims to provide a theoretically grounded explanation for cross-national differences in policy effectiveness.

To gain insight into the factors behind the gaps in energy conservation policies, this study adopts a mixed-methods approach that integrates qualitative theory-driven analysis with quantitative empirical evaluation to compare the different outcomes of the same policies across countries. In the first section, the paper develops a cultural argument grounded in established frameworks through the psychological and behavioral economics lens to explain why identical Social Norm Feedback (HER) interventions may activate different psychological mechanisms across societies. This theoretical lens is used to generate testable hypotheses regarding cultural moderation effects. Later, the study conducts a cross-cultural comparative meta-analysis of existing randomized controlled trials in Japan and Germany, synthesizing the reported Average Treatment Effects (ATEs) and Cost-Effectiveness Ratios (CERs). The empirical analysis evaluates whether observed differences in energy savings and costs are consistent with the proposed cultural mechanisms. Together, this mixed-methods design allows the study to move beyond descriptive comparisons and provide a theoretically informed, evidence-based assessment of how cultural context shapes policy effectiveness.

Ultimately, the study seeks to address this gap by conducting a comparative review of HER trials in Japan and Germany. Rather than establishing causal proof, it uses cultural theory as an interpretive framework to examine whether observed differences in intervention outcomes are consistent with broader cross-cultural behavioral patterns. However, findings drawn from heterogeneous trials conducted under varying conditions should be interpreted with caution, as they do not constitute strictly controlled comparisons.

2. Background on Culture and Energy Policy

2.1. The Effectiveness and Variability of Social Norm Nudges

Social Norm Feedback (HER) operates on the principle of descriptive and injunctive norms, typically yielding an average 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, M. 2025).

However, this comprehensive figure masks significant 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 a full list of each

of the 23 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 can 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. Hofstede's dimension of Individualism vs. Collectivism (IDV) provides a clear theoretical lens, particularly Hofstede's dimension of Individualism vs. Collectivism (IDV) dimension and Hall's theory of communication context.

While **Collectivist Societies** (Low IDV) emphasize group loyalty and cohesive in-groups (e.g., Hong Kong, Japan), **Individualist Societies** (High IDV) emphasize personal achievements and individual rights (e.g., the US, Germany). 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 influence how strongly individuals respond to social comparison and normative pressure.

Furthermore, Edward T. Hall's distinction between **High-Context** (Japan) and **Low-Context** (Germany) communication is an important factor in 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. 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). This difference in communication styles further emphasizes how the HER is framed to target collectivist high-context societies due to the usage of social comparison. Together, these frameworks further emphasizes how the HER is framed to target collectivist high-context societies, which rely on social comparison and implicit normative cues, due to the inherent effectiveness of social nudges in collectivist, high-context societies than in individualist, low-context ones.

2.3 Energy Trials and Policy in Japan and Germany

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

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 Germany, energy policy is often driven by rational incentives~~ 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 ~~may be lower, as the individualistic culture may place less value on conforming to an anonymous neighbor's behavior.~~ appears dependent on cultural context, in which certain demographics are less responsive to anonymous social comparisons.

3. ~~Theoretical Framework and Hypotheses~~ Conceptual Framework and Analytical Expectations

3.1. Framework

~~The core theoretical framework proposes that the effectiveness of the Social Norm Feedback (HER) is mediated by the dominant cultural orientation of the target population. Specifically, the HER's implicit social pressure will be highly potent in the collectivist context of Japan, but less so in the individualistic context of Germany, where rational economic incentives and direct regulation are likely to be more effective motivators. Certain limitations will occur due to the small sample size and variabilities in methodology, measurement, context, and reporting.~~

This study uses cultural and behavioral frameworks as interpretive lenses to understand observed cross-national variation in HER outcomes. 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 significant 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 how 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 is likely to 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.

Accordingly, this framework does not seek to establish a deterministic causal relationship between national culture and HER effectiveness. Rather, it provides a theoretically grounded lens for interpreting whether observed differences in HER outcomes between Japan and Germany are broadly consistent with prior research on cultural moderation in behavioral policy interventions.

Instead of testing a formal causal theory, the study examines whether observed differences in intervention outcomes are consistent with established theories of social norms, collective behavior, and communication context. HER interventions have a myriad of behavioral mechanisms: social comparison, norm salience, reputational concern, avoidance of perceived deviance.

3.2. ~~Testable Hypotheses~~ Analytical Expectations

Based on the synthesis of cultural and behavioral theory, ~~we derive the following testable hypotheses for the cross-cultural analysis of past energy trial data:~~ this study develops the following analytical expectations to guide interpretation of the comparative evidence.

Baseline expectation: The implementation of Social Norm Feedback (HER) trials ~~will be associated with a statistically significant mean reduction in household energy consumption in both Japan and Germany.~~ are expected to reduce household energy consumption in both Japan and Germany.

~~Cultural Magnitude~~ Comparative expectation: The mean percentage reduction in energy consumption achieved by the Social Norm Feedback (HER) intervention ~~will be significantly larger in Japan (a collectivist, high-context culture) than in Germany (an individualist, low-context culture).~~ may show significantly stronger average behavioral responses in Japan than in Germany.

Policy ~~Efficacy~~ expectation: The ratio of energy savings achieved per dollar spent on the HER intervention (Cost-Effectiveness Ratio) ~~will be higher in Japan than in Germany, confirming that the HER intervention is a lower-cost incentive mechanism in the collectivist context.~~ 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 cost-effective in Japan.

4. ~~Quantitative Cross-Cultural Analysis~~ Comparative Meta-Analysis

4.1. Research Design

This study employs a cross-cultural comparative meta-analytic synthesis of previously published randomized controlled trials (RCTs) to evaluate the effectiveness of Social Norm Feedback interventions (Home Energy Reports; HER) in Japan and Germany. Rather than conducting a new field experiment, the analysis draws on existing trials to examine whether cultural context moderates the magnitude and cost-effectiveness of behavioral energy interventions.

A comparative synthesis is appropriate because HER interventions are highly standardized in structure (peer comparison feedback delivered through periodic reports) but implemented in distinct cultural, regulatory, and infrastructural contexts. This approach allows for exploratory assessment of cultural moderation while maintaining external validity. 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 were aggregated from publicly available and credible sources, including:

Peer-reviewed academic journals

Government and ministry reports (e.g., METI, BMWK)

Utility company evaluations and white papers

NGO and policy institute reports

Only studies reporting original empirical results from field trials were considered.

Inclusion Criteria

Studies were included if they met all of the following conditions:

The intervention incorporated a Social Norm Feedback component, such as peer comparison or normative ranking.

The study reported a quantifiable treatment effect, expressed as a percentage change in energy consumption, along with a measure of statistical uncertainty (e.g., p-value, standard error, or confidence interval).

The trial was conducted among a representative sample of residential households in either Japan or Germany through the use of Randomized Controlled Trials (RCTs).

The study provided cost information or a proxy for intervention cost (e.g., printing, distribution, or total program budget).

The post-intervention period lasted at least one billing cycle.

Exclusion Criteria

Households with zero monthly electricity usage, identified through smart meter data, were excluded to avoid distortion of percentage change estimates. Additionally, extreme outliers in monthly energy consumption were removed using the Smirnov–Grubbs test, ensuring that treatment effects were not driven by anomalous observations.

4.3. Data Synthesis and Analytical Strategy

Outcome Variable

The primary outcome variable is the Average Treatment Effect (ATE), defined as the mean percentage change in household electricity consumption for treated households relative to control households.

Effect Size Handling

Reported ATEs were extracted directly from each study. When effects were reported in alternative units (e.g., kWh), they were converted to percentage changes using reported baseline consumption levels. No additional pooling weights were applied.

Given the small number of trials and heterogeneity in study design, country-level averages were calculated using simple unweighted means. This approach prioritizes transparency and avoids imposing assumptions about comparability or variance structures that cannot be reliably verified. This choice is treated as a methodological limitation.

Cross-Country Comparison

Differences between Japan and Germany are reported descriptively, using country-level means and ranges. Formal hypothesis testing is avoided due to:

Small numbers of trials per country, potential non-independence across estimates, and substantial heterogeneity in duration, delivery frequency, and population characteristics.

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{((s_1^2 / N_1) + (s_2^2 / N_2))}}$$

Where heterogeneity was detected, a meta-regression with country dummy variables was used as a robustness check.

Cost-Effectiveness Analysis

For trials reporting cost data, a Cost-Effectiveness Ratio (CER) was calculated 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, reflecting variation across trials rather than a pooled estimate.

5. Results

5.1. Trial Summary and Baseline Effects

A total of 10 HER trials met the inclusion criteria: 6 conducted in Japan and 4 conducted in Germany. Across both countries, Social Norm Feedback interventions were consistently associated with reductions in residential electricity consumption, supporting the baseline hypothesis that HERs reduce energy use on average.

Japan (n = 6):

Mean ATE = 2.61% reduction

Range = 1.30% to 7.50%

Germany (n = 4):

Mean ATE = 1.23% reduction

Range = 0% to 3.50%

These results indicate that HER interventions produced energy savings in both cultural contexts, though with substantial variation across individual trials. Figure 4 illustrates the cross-cultural mean ATEs.

Country	Mean ATE (%)
Japan	1.59%
Japan	1.40%
Japan	1.85%
Japan	7.50%
Japan	1.30%
Japan	2.00%
Japan Average	2.61%

Table 1. Japan Mean ATE (%) Results

Country ▼	Mean ATE (%)
Germany	0.70%
Germany	0.70%
Germany	3.50%
Germany	0%
German Average	1.23%

Table 2. German Mean ATE (%) Results

Average Treatment Effect (%)

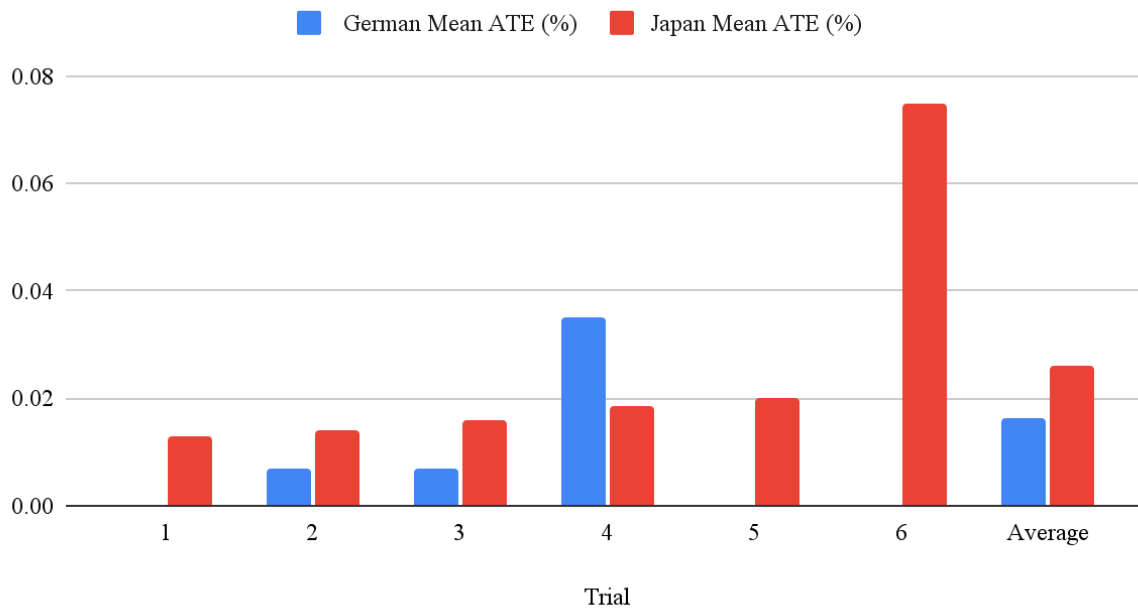


Figure 4. Average Treatment Effect Japan vs Germany

5.2. Cultural Magnitude Comparison

Japanese trials exhibited larger average reductions in electricity consumption than German trials (difference in means: 1.38 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 Ratios (CER) were derived from Table 3 reported cost per kilowatt-hour saved in column 3 (“Cost in Cent/ kWh Saved”). For clarity, values were converted to kWh saved per \$1 spent:

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 3. International Cost-Effectiveness Comparison of HER Interventions

	(1)	(2)	(3)	(4)	(5)
Country	Average Electricity Consumption in kWh	CO ₂ Emissions in g / kWh	Cost in Cent / kWh Saved	Abatement Cost in \$ / t CO ₂	CO ₂ Abatement Cost Relative to US
Canada	11,379	158	1.1 – 2.6	67 – 162	3.3
United States	12,293	489	1.0 – 2.4	20 – 49	1.0
France	5,859	64	2.1 – 5.0	323 – 779	16.0
Germany	3,304	486	3.7 – 8.8	75 – 182	3.7
Italy	2,542	343	4.8 – 11.5	139 – 335	6.9
Poland	1,935	769	6.3 – 15.1	81 – 196	4.0
Spain	4,040	247	3.0 – 7.2	121 – 293	6.0
Sweden	8,025	13	1.5 – 3.6	1,162 – 2,799	57.6
United Kingdom	4,145	459	2.9 – 7.0	64 – 153	3.2
Japan	5,434	572	2.2 – 5.4	39 – 94	1.9
South Korea	3,489	536	3.5 – 8.4	65 – 156	3.2
Australia	6,959	798	1.7 – 4.2	22 – 53	1.1

Notes: Our calculations assume printing and mailing cost of 1 US\$ per report, four reports per year and average electricity reductions of 1.37–3.30%. Average electricity consumption and CO₂ intensities of electricity generation correspond to the most recently available data (for 2013), as documented in WEC (2016) and IEA (2015), respectively.

(Andor, Gerster, Ankel-Peters, & Schmidt, 2018)

5.4. Significance

These figures indicate that, for comparable implementation costs, ~~social norm feedback interventions in Japan achieve higher energy savings per dollar spent than those in Germany.~~ HER interventions may deliver higher energy savings per dollar spent in Japan than in Germany. This pattern is consistent with the observed differences in mean ATEs across the two countries, although, as noted, these differences are not statistically significant. Overall, these findings illustrate that cultural and contextual factors may influence both the effectiveness and cost-efficiency of behavioral energy policies, even if formal statistical testing does not confirm a significant cross-country difference.

6. Discussion

6.1. Interpretation of Findings

The results of the second analysis are consistent with the central hypothesis that culture may function as an important mediator of behavioral intervention efficacy. The greater observed effect size of the Social Norm Feedback (HER) in Japan may be partly attributable to its collectivist, high-context cultural orientation. The intervention effectively leverages the deep-seated value of social harmony and the implicit pressure to conform to group behavior. Conversely, the comparatively smaller response in Germany suggests that in a more individualistic, low-context culture, the implicit social pressure of the HER may be less potent than clear, rational, and individualistic incentives. This varying effectiveness of social nudging strategies can often be traced to psychological mechanisms such as social norm activation, identity alignment, and salience of feedback. For instance, peer comparison is particularly effective when individuals identify closely with the reference group, which enhances internalization of the behavior. Personalized feedback increases engagement by enhancing relevance and perceived control. In contrast, generic or infrequent nudges may fail to create a sense of urgency or personal connection. Environmental awareness, cultural context, and baseline consumption behavior also mediate nudge effectiveness. These factors highlight the need for tailoring nudges to fit the specific behavioral, social, and infrastructural context of the target audience.

6.2. The Culture-Contingent Environmental Incentive Design

Based on the cost-effectiveness analysis, the higher CER observed in Japan indicates 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 certain limitations. First, while we aimed for a structured literature synthesis, the included studies vary widely in terms of methodology, measurement, context, and reporting, which makes direct comparisons difficult. 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, culture remains analytically central to this study because Social Norm Feedback operates primarily through psychological mechanisms rather than material incentives. Structural factors shape the external conditions under which households consume energy, but norm-based interventions depend on how individuals interpret social comparison, internalize group expectations, and respond to perceived conformity pressures. These processes are deeply embedded in cultural orientations such as collectivism, communication context, and uncertainty avoidance. Thus, while regulatory and infrastructural variables may moderate overall outcomes, cultural context directly influences the mechanism through which the intervention exerts its effect.

~~Second, while we focused on recent field studies with reported positive outcomes, this may introduce publication bias, as unsuccessful or neutral interventions are less frequently reported. Lastly, the limited sampling causes uncertainty in the correlations between cultural context and behavioral energy policy outcomes. While the observed patterns are consistent with cultural theory, the present analysis cannot definitively isolate culture from regulatory, infrastructural, or economic confounders. Future research should involve an identical, contemporaneous field experiment across both nations to control for external variables and more clearly distinguish cultural effects from structural policy differences.~~

Importantly, Germany's comparatively lower HER effects 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 exhibit institutional signals, financial incentives, or formal regulations.

7. Conclusion

This study provides evidence suggesting that the effectiveness of behavioral energy interventions is influenced by cultural context. The overall effectiveness of behavioral energy interventions is likely to be influenced by cultural context. By analyzing evidence from randomized controlled trials in Japan and Germany, reports show that collectivist, high-context societies such as Japan respond more strongly to social nudges than individualist, low-context societies like Germany. The findings are broadly consistent with existing literature suggesting that collectivist, high-context societies such as Japan may respond more strongly to social norm-based interventions than individualistic, low-context societies such as Germany. Japanese trials not only achieved larger reductions in household energy consumption (Mean ATE = 2.61% vs. 1.23% in Germany) but also delivered higher returns on investment, as reflected in the cost-effectiveness ratio (18–45 kWh saved per \$1 spent in Japan vs. 11–27 kWh in Germany). These findings are consistent with the interpretation that culture may act as an important moderator of behavioral policy efficacy.

The implications for policymakers suggest that energy conservation strategies should be cautious about relying on a one-size-fits-all approach. In collectivist contexts, low-cost, socially framed incentives can achieve substantial energy savings, while in individualist settings, interventions should be coupled with rational, financially oriented incentives to maximize impact. This culture-contingent approach offers a pathway to more efficient, context-sensitive energy policy design, enhancing both environmental and economic outcomes.

Future research should aim to implement simultaneous, cross-national field experiments to control for extraneous factors and further isolate cultural mechanisms. Additionally, exploring hybrid interventions that integrate social, financial, and technological components could provide actionable insights for global energy policy, ensuring interventions are both culturally appropriate and cost-effective. By aligning behavioral strategies with cultural norms, policymakers can more effectively mobilize households toward sustainable energy use, contributing to the broader goal of global emissions reduction.

8. Appendix

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

Region	Related Work	Outcome	Social Nudge
California	High-frequency smart meter data was used to give occasional data information on electricity consumption to 237 individual loft units situated inside two different private buildings. The authors assessed the impact of information on the household's individual way of behaving.	Apartments receiving personal information on energy data decreased their power use throughout the experiment by roughly 6% more than units not receiving the treatment, compared to their average consumption before the intervention.	Information nudge: weekly emails.
California	The paper investigates the consumption and conservation behaviors of residents in low-income housing in Southern California through a questionnaire-based survey conducted across four housing facilities. It explores factors such as energy burden, satisfaction with building services, and drivers of conservation behaviors among low-income households. Additionally, the study identifies potential intervention strategies aimed at reducing utility bills and improving residents' quality of life, including educational programs and PV installation.	The findings reveal a strong inclination towards energy and water conservation, with 16% of respondents reporting a reduction in electricity bills compared to the preceding year, averaging a drop of 34 USD.	No nudging: survey only.
China	The study conducted a survey among rural residents to assess their willingness to adjust energy use behaviors in response to three virtual electricity pricing scenarios: Peak-valley rate (PVR), Photovoltaic systems (PVS) and original flat rate (OFR). A multi-group analysis was conducted to identify factors influencing residents' willingness to adjust energy consumption, utilizing an extended Theory of Planned Behavior (TPB) framework incorporating social capital and policy variables.	The study revealed varying preferences among rural residents, with 45.22% choosing PVR, 22.89% opting for PVS, and 31.89% selecting OFR. Attitudes significantly influenced residents' willingness to adjust washing machine usage time, while social network presence affected attitude and perceived behavioral control for certain scenarios. Policies and regulations notably impacted the willingness of residents selecting scenario PVS to adjust energy use.	No nudge. Investigating price incentives for DSM.

China	This study investigated the effectiveness of social norm interventions in promoting sustainable behaviors in the context of energy conservation. The research involved a field experiment conducted in university dormitories, with 584 students randomly assigned to control and treatment groups. These groups received social norm information varying in terms of group identification. Data collection included daily electricity meter readings before and after the intervention. Exclusion criteria were applied to participants reporting events that could significantly impact energy usage, resulting in a final sample size of 1027 individuals from 603 rooms.	The results of the study indicate that social norm information about a high identification group led to an 11% reduction in energy consumption, highlighting the importance of group identification in the efficacy of social norms interventions. The findings suggest that identification is a crucial factor in effectiveness for promoting energy-conservation behavior.	Information nudge: daily text message for 18 days.
Europe	The study investigates the motivation behind employee energy conservation and assesses the impact of an IoT-enabled gamified intervention in three workplaces across Europe. It aims to unravel individual energy-saving behavior factors and understand their influence on organizational energy conservation. Through multiple regression analysis, the study evaluates the predictive ability of various factors, including self-determination, personal norms, and organizational profiles, on energy-related behavioral outcomes at work.	Findings from the study reveal significant insight into energy-saving behavior and the effectiveness of the gamified intervention. The intervention led to a statistically significant increase in participants' intention to conserve electricity at work with a moderate effect size. Additionally, participants reported a positive change in their personal energy-saving habits with large effect size. The intervention resulted in a conservatively estimated energy saving of 6413 kWh during the intervention period, equivalent to 12.99% compared to baseline consumption.	Gamified nudge: personal feedback through an IoT device in the office.
Finland	By utilizing a clever overview and real month-to-month power utilization information, this study is aimed to analyze how aware people are about their power bills, costs, and expenses among a few Finnish families. Six inquiries were performed to examine whether more elevated levels of energy mindfulness are related to power investment funds. The web-based poll was sent to 244 individuals, of whom 184 completed it.	As per the results, only 27.7% of the respondents accurately addressed the six inquiries. Also, 20.8% of total respondents agreed to receive information nudge to improve their power consumption.	Information nudge: once, by email.

Finland	This research included peer comparisons and energy-saving advice while concentrating on nudging and home power consumption. A total of 528 families received emails with energy-saving advice for lowering winter electricity usage. Researchers looked at the relationship between power use and nudge effectiveness.	The key finding is the possibility that households that are more engaged in monitoring their power use may experience lower energy use. During the test period, an energy-saving nudge lowered the energy consumption by 10%.	Information nudge: social comparison treatment, and energy-saving advice. Information was given by monthly emails.
Germany	This research investigates the main finding of the Opower trials in the US—the cost-effectiveness of social resemblance Home Energy Reports (HER) as a climate policy tool. In a descriptive study, they demonstrate that, apart from Australia, lower energy usage levels and emissions levels of power production significantly limit the cost effectiveness potentials of HER. In a German case study, 11,630 residents were sent HER interventions.	Due to the information from the HER reports, power usage was, on average, reduced by 0.7%, which is half of what was seen at the lower end of the 1.4–3.3 percent effect size range in the US.	Information nudge: comparing HER reports between households. The information to the households was given monthly for six months.
Germany	The study conducted a field experiment on resource conservation, specifically focusing on the everyday activity of showering in a student dormitory, known for its energy and water intensity. With 351 participants, two interventions were implemented. The interventions targeted biases arising from imperfect information and limited attention. The experiment involved a three-month duration and tested the effects of each intervention alone and in combination.	The findings revealed a remarkable complementarity between the two interventions. While each intervention individually had limited effectiveness in inducing conservation, the combined implementation yielded significant conservation effects.	Information nudge: daily/monthly information on energy use and real-time feedback, given via email.
Germany	A field experiment was conducted with 111 households equipped with rooftop photovoltaics to test the effectiveness of three sequentially applied behavioral nudges (feedback, benchmark and default) delivered through digital tools. The experiment employed a control group design, baseline measurements and high-frequency smart meter data to assess the causal effects of each intervention on increasing self-consumption.	The study revealed that while feedback and benchmark interventions resulted in a 3–4% in self-consumption, the default intervention led to a substantial 16% increase for active participants. Notably, households with controllable EVs showed stronger effects than those without.	Information nudge: Information (feedback, benchmark, or default) provided through digital tools, i.e., web portal and smart charging app.

Ghana	The study investigates the relationship between energy literacy (EL), attitude towards energy, personal energy value, and energy-savings behavior (ESB) within the context of a lower middle-income country, specifically focusing on hydro-electricity power in Ghana. A survey-based questionnaire was administered to 250 professional workers in Ghana to collect data.	The study found that energy literacy has a positive effect on energy-saving behavior, with attitude towards energy and personal energy value significantly mediating this relationship. Specifically, cognitive skills and affective outcomes of energy literacy were identified as significant predictors of personal energy value and attitude towards energy.	No nudge. Survey only.
Italy	This study used an experiment to evaluate how environmental awareness influences the larger scale effects of information nudging that requires sustained efforts. The authors merged data on consumption with survey data of 4835 consumers in order to investigate probable origins of the messages' diverse effects.	The program typically results in a 0.9% decrease in electricity use. The authors offered hints that targeting particular sub-groups might increase the effectiveness of boosting environmental awareness.	Information nudge: weekly emails.
Italy	Authors examined the impact of integrating financial reward with social nudges using a structured online experiment. Participants optimized their virtual electricity use on a simulated washing machine in a novel incentive-compatible electricity saving assignment suggested by the authors. A total of 566 participants took part in the study.	Electricity saving of 0.148% by the nudge approach and 0.156% electricity saving by the combined approach (nudge and reward) was achieved for the washing machine simulation.	Nudging on virtual study.
Japan	This field study aimed to test the effectiveness of energy efficiency guidance in the residential sector using a message pop-up feature in a mobile app. The app was distributed to approximately 1700 households that voluntarily enrolled in the program. Researchers conducted randomized controlled trials to assess the impact of message pop-ups containing energy efficiency advice. The advice included information about power usage and characteristics, as well as a social nudge approach.	Energy-saving recommendations decreased power use by 1.3%.	Information nudge: energy efficiency guidance via mobile app. Information was given on a daily, weekly, and monthly basis for five months.

Japan	This study is a large-scale randomized experiment of 62,400 homes, investigating the behavioral characteristics of energy-use feedback programs. The work includes social comparison-based home energy reports (HER), and categorization based on peer comparison. The authors used a randomized controlled experiment to analyze data from 62400 homes. There were two different sorts of home energy reports: one with hourly energy use comparisons and the other with yearly comparisons of monthly energy consumption.	The social comparison of HER reports with hourly data to HER with monthly data showed 1.4% lower energy consumption, which is 0.8% higher than the results obtained by historic comparison.	Information nudge: social comparison treatment through HER reports by monthly emails.
Kuwait	This study investigates the impact of the COVID-19 pandemic on energy literacy and conservation behavior in academic buildings in Kuwait. Employing a mixed-methods approach, it combines quantitative surveys with qualitative data collection methods such as questionnaires, focus groups, and interviews. The research included 158 engineering students, 67 faculty members, and 52 administrative staff, totaling 277 participants. Education, awareness, personal motivation, values, religiosity, and culture were identified as crucial factors influencing energy literacy and conservation behaviors.	The study found that COVID-19 had a significant impact on participants' attitudes, intentions, and behavior related to energy conservation in academic buildings in Kuwait. Specifically, the student group experienced a significant increase in the relationship between their intentions and behavior, while the faculty group exhibited a strong correlation between intention and behavior.	No nudge. Survey of impact of COVID-19 on energy literacy.
Lithuania	This study performed an experiment on 2927 apartments to investigate how solely descriptive information, provided via online portals, may be a successful means of achieving energy savings in housing applications. The customized hourly energy demand data was presented on their individual online portals. The installation of new smart energy meters allowed for the availability of hourly energy data for the treatment group.	The outcomes revealed that providing descriptive information decreased electricity usage by 8.6%.	Information nudge: information on own hourly energy consumption data via a web portal.
Middle East	The authors conducted a large-scale field study including around 200,000 families in the Middle East, sending each family periodic messages on their water and power usage. The research was focused on finding whether giving such information on the usage of the two resources jointly may result in decreases in both sectors, as use of this strategy to encourage resource savings spreads.	For this social nudge, there was a reduction in electricity use of about 1.2%, keeping water utilization unaffected.	Information nudge: monthly emails.

Monaco	In this work, the authors investigated the relation between social nudge and the household's environmental awareness. Data from 77 families were gathered and divided into four groups. Ex-ante survey questions included the socio-demographics of the home, ecological dedication and considerations, power usage, heating system, and curtailing practices.	The difference in average energy consumption was noticed in the range of 7% to 31% among the groups.	Information nudging by email for six months.
Poland	This study investigated the preferences for demand-side management (DSM) programs in the electricity consumption of 1000 households. A web-based survey, conducted by a polling agency, was used for data collection. The researchers assessed the willingness to embrace changes in power consumption, and also explored how the social analysis of households' energy use affected their acceptance of DSM.	A majority, i.e., 85.4% of respondents, agreed to perform DSM, but they wanted payment for altering their behavior.	No nudging. Only a survey that supported financial incentives for behavioral change.
Portugal	An empirical experiment was conducted for a system with 20 customers to assess the power exchange cost for local participants. The study incorporated behavioral interventions for energy conservation and the adoption of renewable energy sources. The model followed a simulation-based study for the local electricity market.	Considering a 3% to 5% electricity saving, a cost savings of 5.60% to 19.26% was obtained.	Results from a simulation tool.
Sweden	This study used an experiment of 525 homes to determine the causal effects of social comparison on water and electricity use. The control and treatment groups were randomly assigned.	The daily domestic power usage was reduced by 6.7% on average by the social comparison treatment, while the household's water use remained unaffected.	Information nudge: real-time display for 12 months.
Switzerland	In this study, households in two Swiss neighborhoods (N = 177) participated in an energy conservation program. They were randomly assigned to receive either a concrete intervention or one including abstract environmental information.	Six months later, households exposed to the abstract message paid significantly more attention to energy consumption, with 12–15% more energy saving compared to the group which received concrete information.	Information nudge: comparing concrete and abstract information.

9. Acknowledgments

The author would like to thank Dr. Aivaliotis and Daryn Howland for their guidance and feedback throughout this project. Gratitude is also extended to the authors of the original field experiments and datasets referenced in this study, whose publicly available work made this analysis possible.

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I sincerely thank the reviewer for their careful reading of my work and for the thoughtful, constructive feedback provided. The comments have been extremely helpful in strengthening the clarity, structure, and methodological consistency of the paper.

In response to the feedback, I have made several substantive revisions throughout the manuscript.

First, I have added an abstract directly into the manuscript to ensure accessibility and clarity for readers. This addresses the issue of limited visibility in the original submission format.

Second, I have revised the introduction to provide a clearer early-stage overview of the study. The opening now explicitly outlines the research objective, comparative focus, and methodological approach, allowing readers to better understand the relationship between the theoretical framework and the subsequent analysis.

Third, I have substantially restructured the theoretical framework section. In response to concerns regarding the presentation of hypotheses, I have reframed them as analytically grounded expectations derived from prior literature rather than as isolated testable statements. I have also strengthened the integration between theory and empirical expectations to ensure clearer conceptual continuity throughout the paper. In addition, I have streamlined this section by removing unnecessary figures and reducing redundancy.

Fourth, I have corrected and standardized the methodological description throughout the manuscript. The study is now consistently described as a comparative meta-analysis, ensuring conceptual accuracy and avoiding any misinterpretation of the work as a primary quantitative or mixed-methods study.

Fifth, I have clarified the interpretive limits of cross-national comparisons. I now explicitly emphasize that the analysis does not assume direct comparability across contexts, and that observed differences between Japan and Germany should be understood as contextual patterns rather than causal or deterministic cultural effects. A dedicated discussion of these limitations has been expanded in the manuscript.

Finally, I have revised the language throughout the paper to ensure a more cautious and academically appropriate tone. Strong causal claims have been softened, and findings are now consistently framed as suggestive and consistent with existing literature rather than definitive conclusions.

I believe these revisions have significantly improved the rigor, clarity, and academic positioning of the manuscript. Most importantly, they ensure that the study is presented in a way that is consistent with its methodological scope as a comparative meta-analytic investigation rather than a causal empirical study.

I am sincerely appreciative of the reviewer's insights, which have played an important role in refining the manuscript. I thank the editorial board for their time and consideration, and I hope the revised version is now suitable for publication.

I sincerely appreciate the time and effort taken to review my manuscript and for the constructive and detailed feedback provided. I have carefully considered each comment and revised the manuscript accordingly to improve clarity, methodological transparency, and academic rigor. Below, I respond to each point in turn.

1. Contribution to the Field

I appreciate the recognition that the topic is relevant and has potential for future contribution. In response, I have refined the manuscript to better emphasize its positioning as a comparative, theory-informed meta-analytic synthesis rather than a primary empirical study. I have also softened interpretive claims throughout the paper to ensure that findings are presented as suggestive patterns rather than definitive causal conclusions.

2. Clarity & Structure

I agree with the concern regarding the delayed introduction of the research question. I have now introduced the research question and study aim in the opening paragraph of the introduction to improve clarity and reader orientation.

In addition, I have revised the structure of the introduction to follow a clearer logical progression, ensuring that each paragraph directly supports the research question. Redundant or tangential material has been reduced, and the narrative now moves more consistently from the global energy challenge → behavioral interventions → cultural variation → research gap.

I also reviewed citation use carefully. In particular, I replaced or supplemented references where arguments were insufficiently supported by household-level evidence. For example, I incorporated more directly relevant literature such as Grønhøj & Thøgersen (2011) and Gans et al. (2013), which provide stronger empirical grounding for household energy feedback mechanisms.

3. Use of Evidence & Research Methods

I acknowledge the concern regarding methodological clarity and the perceived mismatch between research design and theoretical framing.

To address this, I have:

Clarified that the study is a cross-cultural comparative meta-analytic synthesis, not a mixed-methods study

Removed ambiguous references to qualitative analysis where no systematic qualitative method was applied

Strengthened the methodological justification for using descriptive, unweighted cross-country comparisons given the limited number and heterogeneity of available trials

I have also revised the methodology section to explicitly state the limitations of comparability across studies and to avoid implying statistical equivalence where it does not exist.

Finally, I have made it clearer that the cultural framework is used as an interpretive lens rather than a causal identification strategy, ensuring alignment between method and theoretical claims.

4. Engagement with Literature

I appreciate the recommendation to expand engagement with literature on culture and behavioral interventions. Following your suggestion, I have incorporated additional relevant works, including:

Austin et al. (2022) on culture-based intervention effectiveness
Davidson (2017) on cultural embeddedness of energy behavior
De Mooij & Hofstede (2011) on cross-cultural consumer behavior
Talhelm (2025) on culturally adaptive interventions
Tverskoi et al. (2022) on innovation diffusion and cultural interaction

These additions strengthen the theoretical grounding of the manuscript and improve integration with existing scholarship.

5. Interpretation of Findings

I agree with the concern that the comparative interpretation of Japan and Germany required greater nuance. I have revised this section to:

Avoid overgeneralizing cultural traits at the national level
Explicitly acknowledge that Germany also demonstrates strong rule adherence and environmental norms in prior literature
Reframe findings as contextual and directional patterns rather than culturally deterministic conclusions

I have also revised language throughout the discussion to ensure that claims remain proportionate to the evidence presented.

6. Methodological Alignment and Theoretical Framing

I appreciate the suggestion to reconsider the alignment between theoretical framing and research design. In response, I have clarified that:

The study does not aim to test causal cultural theory
Instead, it evaluates whether observed variation in HER outcomes is consistent with prior cultural-behavioral literature

I have also revised the theoretical framework section to better integrate hypotheses as analytical expectations grounded in prior research, rather than as testable predictions.

7. Grammar, Tone, and Academic Style

I have revised the manuscript to improve readability and coherence. Specifically, I have:

Reduced sentence complexity in several sections where multiple ideas were previously combined

Adopted a more neutral and cautious academic tone throughout

Increased emphasis on evidence-based interpretation rather than assertive causal language

Improved transitions between conceptual and empirical sections for better flow

8. Title Revision

I agree with the recommendation regarding the title. I have revised it to more clearly reflect the research focus:

Revised Title:

Impact of Cultural Context on Behavioral Energy Conservation Policy

Once again, I sincerely thank the reviewers for their thoughtful and constructive feedback. The comments have significantly strengthened the clarity, methodological precision, and theoretical coherence of the manuscript. I hope the revised version addresses the concerns raised and improves the suitability of the paper for publication in the journal.

Review: Author 100171 - Submission 100162

This paper examines how cultural context may influence the effectiveness of behavioral energy conservation policies, specifically Home Energy Report interventions in Germany and Japan. This manuscript does a wonderful job incorporating behavioral economics, cultural theory, and environmental policy analysis. The author explains the contrast between Japan and Germany very well, explaining the difference between collectivism and individualism in both countries. The topic is very important and relevant to the modern world as there is increasing global interest in low-cost behavioral approaches to energy conservation. Overall, the paper is easy to follow and ideas are clearly presented.

A major strength of this paper is its engagement with the literature in the introduction section. The author cites multiple papers and demonstrates a very good understanding of the existing literature on social norm feedback interventions. The author also discusses policy implications, which makes the paper practically meaningful. I also appreciate how the author acknowledges several limitations in the manuscript, which ultimately strengthens the paper's overall credibility.

A limitation to this paper is the methodological framing of the study. The author mentions that this manuscript is a comparative meta-analysis, however I believe that this paper is a comparative review. Moreover, the author does not use formal meta-analytic statistical techniques. The paper also only incorporates ten papers total, six from Japan and four from Germany in the analysis. I recommend the author to either clearly justify why this methodological approach is appropriate or change the terminology used in the study. I believe that reframing the paper as an exploratory review is more appropriate with the methods used.

In section 4, the author can further explain how studies were identified and screened. Be more specific in section 4.2; what databases or search strategies were used? Were any studies excluded due to missing data?

Another important thing to mention is although observed differences between Japan and Germany are consistent with cultural theory, there are other factors that can influence outcomes. These include energy prices, housing infrastructure, environmental awareness, baseline electricity consumptions among others. The paper does note these factors but presents culture as the dominant explanation.

Lastly, the writing is clear and professional, however, I suggest that the author carefully proofread and look over the paper for any grammatical errors. I noticed small wording errors throughout the paper. For example, section 1, page 4: "casual proof" should be changed to "causal proof". Moreover, the figures and tables are not sufficiently explained. Please expand on the explanation for Figure 1-3 and Table 1-3. The citations also need to be formatted correctly.

Overall, this is a promising manuscript. I believe this paper could make a valuable contribution to discussions around culturally adaptive energy policy and behavioral interventions.

I recommend **accept with major revisions**.

Decision: revise and resubmit (major revisions required, acceptance not guaranteed)

Review: This manuscript examines whether cultural context moderates the effectiveness of behavioral energy conservation interventions, in particular Home Energy Reports (HERs), through a comparative synthesis of studies conducted in Japan and Germany. The paper addresses a timely and policy-relevant topic at the intersection of behavioral economics, energy policy, and cross-cultural analysis. The manuscript is ambitious, intriguing, and displays commendable engagement with interdisciplinary literature. The author also appropriately acknowledges many limitations and avoids stronger causal claims that would not be justified by the evidence.

At the same time, I believe the manuscript requires substantial revision before it is suitable for publication. My primary concern is not necessarily with the direction of the argument, but rather with the framing of the paper, alignment between the research question and methodology, the unconventional methodology employed, and the strength of the conclusions being drawn. I also encourage the author to not merely dismiss these as limitations but actually try to reframe the paper to accurately present its intellectual merits and content.

Major Concern 1:

My central concern is regarding the alignment between the research design and the research question. The manuscript investigates whether cultural contexts may moderate the effectiveness of HER interventions between Japan and Germany. However, the study relies on a relatively small and *heterogeneous* collection of previously published studies conducted under substantially different conditions. The included studies vary in intervention structure, duration, frequency of feedback, target population, technological infrastructure, etc. Because of this heterogeneity, it is difficult to isolate culture as the principal explanatory variable. The current evidence base is more appropriate for an exploratory comparative synthesis than for drawing strong conclusions about cultural mediation.

However, I do not believe the above invalidates the project. **Rather, I believe the manuscript would be significantly strengthened by reframing itself more explicitly as an exploratory comparative review or a theory-informed comparative literature analysis.** The manuscript itself already acknowledges many methodological limitations, and leaning further into a more interpretive framing would improve the coherence and methodological transparency of the paper substantially.

Major Concern 2:

Related to the above, I remain concerned about how the manuscript treats published empirical studies as directly comparable observations. The issue is not the inclusion of peer-reviewed literature itself, but that the included studies were not originally designed as components of a unified dataset. Between different studies, there are unavoidable differences in effect-size

estimation, intervention design, statistical reporting, household selection, implementation context, and outcome measurement.

The manuscript would benefit from much greater transparency regarding the study selection, inclusion/exclusion procedures, search strategy, and data extraction methodology. **At a minimum, please include a detailed study table listing:**

- author/year,
- country,
- sample size,
- intervention structure,
- duration,
- reported ATE,
- uncertainty/statistical information,
- and cost assumptions.

If the manuscript wishes to retain the designation as a “meta-analysis,” additional methodological justification would be necessary beyond the above. Thus, perhaps you should consider not even using this term, since...

Major Concern 3:

..at present, **I do not believe the study fully satisfies conventional expectations associated with a formal meta-analysis.** The manuscript primarily reports descriptive averages and qualitative interpretation rather than pooled weighted effect sizes, heterogeneity estimation, and publication bias assessment. Reframing the paper as a comparative synthesis or exploratory review would better align your methodology with your claims and likely reduce reviewer concerns regarding overstatement.

Major Concern 4:

The manuscript appropriately draws upon theories on collectivism vs. individualism and communication styles to interpret observed differences between Japan and Germany. **However, culture should be presented more consistently within one interpretive framework amongst several competing explanations.** Several alternative structural variables may also contribute to the observed differences, including energy pricing, housing stock, environmental regulations and policy structure, and baseline conservation behavior. The manuscript already acknowledges many of these factors in the limitations section, but nevertheless, the discussion section occasionally still implies stronger explanatory weight for culture than the evidence can definitively support.

I encourage the author to continue softening causal language and emphasize that the findings are broadly consistent with more abstract cultural theories rather than evidence of definitive cultural mechanisms.

Major Concern 5:

The manuscript repeatedly notes that observed differences are not statistically significant, but how is the statistical significance being conceptualized or assessed? This seems unclear to me, since the analysis involves only a small number of heterogeneous studies and does not appear to conduct formal pooled inference. Hence, **the manuscript should clarify whether formal significance testing was conducted, whether the phrase is being used descriptively, and what assumptions underlie the comparison between studies.**

- Relevantly, **the use of simple unweighted means should be further justified or even corrected with appropriate reweighting, especially given the likely variation in sample sizes across studies.**

Minor concerns:

- The manuscript would benefit from additional copyediting and stylistic revision, particularly towards making the writing more concise and clear. There are several instances of awkward phrasing, repetitive wording, grammatical inconsistency, and formatting irregularities.
- Figures and tables should be reformatted for readability and consistency.
- The appendix is useful but could be streamlined and made more readable.
- The literature review could engage more directly with the critiques and limitations of Hofstede-style cultural frameworks.

Impact of Cultural Context on Behavioral Energy Conservation Policy

Abstract

Energy efficiency policy programs are among the most widely adopted policy instruments for reducing household energy consumption, valued by governments for their cost-effectiveness. However, policy uptake remains underused in cases where households perceive the costs of engagement to outweigh the expected benefits. This study examines whether cultural context may help explain variation in the effectiveness of Home Energy Report (HER) interventions across countries. Using an exploratory comparative review of published HER field trials in Japan and Germany, the paper compares reported Average Treatment Effects (ATEs) and Cost-Effectiveness Ratios (CERs) across studies. The comparison is intentionally descriptive rather than meta-analytic in a formal statistical sense, as the included trials differ in intervention design, sample composition, duration, and reporting conventions. Across the reviewed HER studies, mean reported ATEs differ by 0.64 percentage points between Japan (2.95%) and Germany (2.31%). Estimated cost-effectiveness ranges from approximately 18–45 kWh saved per dollar spent in Japan and 11–27 kWh saved per dollar in Germany. While these differences should not be interpreted as statistically conclusive, they are broadly consistent with the possibility that social-comparison feedback may generate stronger average behavioral responses in Japan than in Germany. The findings suggest that aligning energy-conservation policies with local social norms and behavioral contexts may improve the effectiveness and cost-efficiency of HER-style interventions.

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.

Behavioral interventions such as Home Energy Report (HER) have emerged as a promising tool to address these gaps. By leveraging social norms and comparison, HER trials (ex. 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.

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.

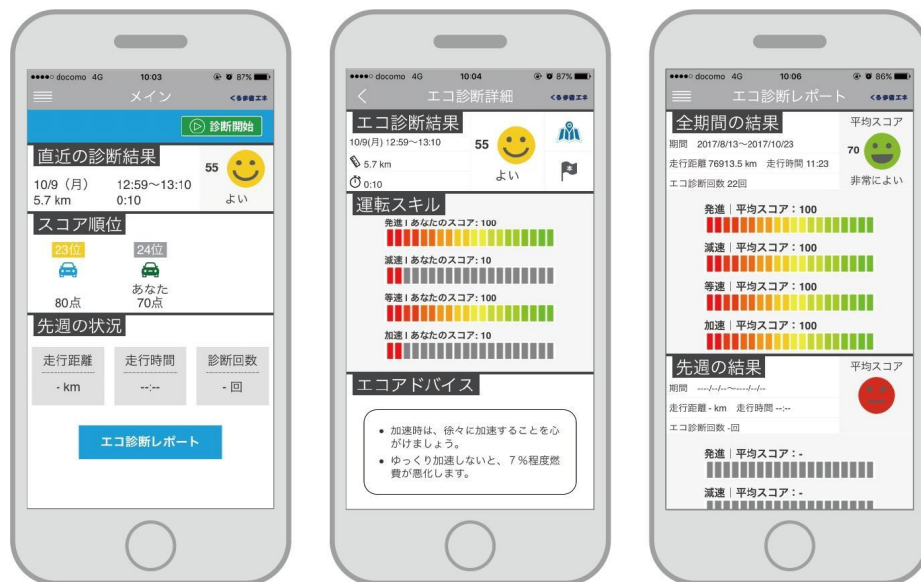


Figure 1. An example of the layout of the home energy reports used in Japanese Energy Trials.

(Automotive Media Response, 2018)

ENERGIEAUSWEIS für Nichtwohngebäude

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

Berechneter Energiebedarf des Gebäudes
(oder: Registriernummer wurde beantragt am...)

Registriernummer ²
(oder: Registriernummer wurde beantragt am...)

2

Primärenergiebedarf

CO₂-Emissionen ³ kg/(m²·a)

Primärenergiebedarf dieses Gebäudes
 kWh/(m²·a)

EnEV-Anforderungswert
Neubau (Vergleichswert)

EnEV-Anforderungswert
modernisierter Altbau (Vergleichswert)

Anforderungen gemäß EnEV ⁴
 Primärenergiebedarf kWh/(m²·a) Anforderungswert kWh/(m²·a)
 Mithras-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	Heizung	Warmwasser	Jährlicher Endenergiebedarf in kWh/(m ² ·a) für			Gebäude insgesamt
			Eingebaute Beleuchtung	Luftung ⁵	Kühlung einschl. Beleuchtung	

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-Wärmegesetzes (EEWärmeG)
 Art: Deckungsanteil: %
☐ Die Anforderungen des EEWärmeG werden durch die Ersatzmaßnahmen nach § 7 Absatz 1 Nummer 2 EEWärmeG erfüllt.
 Verschärfter Anforderungswert Primärenergiebedarf: kWh/(m²·a)
☐ Die in Verbindung mit § 8 EEWärmeG um % verschärften Anforderungswerte der EnEV sind eingehalten.
 Verschärfter Anforderungswert 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 Netto-Grundfläche.

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)

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 & Senstein, 2008). However, the efficiency of these tools exhibits certain variabilities 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 argues that cultural context is a key factor shaping 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, M. 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 a full list of each of the 23 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 Mooji & 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 assessment of cultural moderation while maintaining external validity. 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.

Title	Author (Year)	Country	Sample Size	Intervention Structure	Duration	Reported ATE	Uncertainty / Statistical Information	Total Cost Assumption
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)
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)
HER Persistence Study	Hirayama et al./2021	Japan	N=180,000 households (80,000 prior HER recipients; 100,000 control)	Follow-up evaluation of persistence after HER program ended	12 months post-treatment	-1.7% to -2.0% annual energy consumption	Persistence-year savings retained 87–109% of Year-2 effect; no p-values reported	US\$0 incremental intervention cost
Hirayama et al./2021	Oracle Japan, Jyukankyo Research Institute & Ministry of the Environment	Japan	N=300,000 households	Personalized HERs delivered through paper reports and digital channels with normative feedback and tailored recommendations	4 years	-2.0% average energy consumption	No SE, CI, or p-values reported	US\$7.2M–12.0M (estimated)

	(2021)							
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% average winter electricity use; -5.4% among high users	Random-effects panel regression; winter effect significant; no SE or CI reported	US\$12,000–19,200 (estimated)
N=180,000 households (80,000 prior HER recipients; 100,000 control)	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	-7.5% electricity consumption	Panel regression with cluster-robust standard errors; treatment coefficients tested for significance	US\$360 (estimated)
Follow-up evaluation of persistence after HER program ended	Matsumoto & Osakabe (2022)	Japan	N=74 households (Treatment =36; Control=38)	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)
12 months post-treatment	Schleicher et al. (2015)	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)
-1.7% to -2.0% annual energy consumption	Pelka et al. (2024)	Germany	N=111 households	Sequential feedback, benchmark, and smart-charging-default interventions delivered through app and web portal	18 months	3–4% 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 incremental intervention cost	Andor et al. (2020)	Germany	~84,000 households	Utility-delivered social-norm feedback comparing household consumption with neighbors	6–12 months	-1.4% to -2.7% electricity consumption	Large-scale field experiment; fixed-effects and Difference-in-Differences models; p<0.01	US\$90,000–270,000 (estimated)

US\$0/kWh	Meub, Runst & von der Leyen (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)
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4.3. Data Synthesis and Analytical Strategy

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 3, 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, a Cost-Effectiveness Ratio (CER) was calculated 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 interventions were consistently associated with reductions in residential electricity consumption, consistent with the baseline analytical expectation that HER interventions reduce energy use on average.

Japan (n = 7):

Mean ATE = 2.95% reduction

Range = 1.0% to 7.5%

Germany (n = 4):

Mean ATE = 2.31 % reduction

Range = 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.

Tables 1 and 2 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.

	Japan Mean ATE (%)
	1.30%
	1.00%
	1.85%
	2.00%
	7.50%
	5.40%
	1.59%
Average	2.95%

Table 1. Japan Mean ATE (%) Results

	Germany Mean ATE (%)
	3.70%
	3.50%
	2.05%
	0%
Average	2.31%

Table 2. German Mean ATE (%) Results

5.2. Cultural Magnitude Comparison

Japanese trials exhibited larger average reductions in electricity consumption than German trials (difference in means: 1.38 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 comparisons were derived from the international cost-comparison table reported by Andor et al. (2018). Reported cost-per-kWh values were converted into kWh saved per US dollar to facilitate comparison between Japan and Germany.

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 3. International Cost-Effectiveness Comparison of HER Interventions

	(1)	(2)	(3)	(4)	(5)
Country	Average Electricity Consumption in kWh	CO ₂ Emissions in g / kWh	Cost in Cent / kWh Saved	Abatement Cost in \$ / t CO ₂	CO ₂ Abatement Cost Relative to US
Canada	11,379	158	1.1 – 2.6	67 – 162	3.3
United States	12,293	489	1.0 – 2.4	20 – 49	1.0
France	5,859	64	2.1 – 5.0	323 – 779	16.0
Germany	3,304	486	3.7 – 8.8	75 – 182	3.7
Italy	2,542	343	4.8 – 11.5	139 – 335	6.9
Poland	1,935	769	6.3 – 15.1	81 – 196	4.0
Spain	4,040	247	3.0 – 7.2	121 – 293	6.0
Sweden	8,025	13	1.5 – 3.6	1,162 – 2,799	57.6
United Kingdom	4,145	459	2.9 – 7.0	64 – 153	3.2
Japan	5,434	572	2.2 – 5.4	39 – 94	1.9
South Korea	3,489	536	3.5 – 8.4	65 – 156	3.2
Australia	6,959	798	1.7 – 4.2	22 – 53	1.1

(Andor, Gerster, Ankel-Peters, & Schmidt, 2018)

Table 3 provides the cost-effectiveness comparison used to contextualize the policy-efficiency analysis. Rather than estimating a new pooled CER from the reviewed studies, this paper draws on published cost-per-kWh-saved figures reported by Andor et al. (2018) and converts them into kWh saved per US\$1 spent for interpretive clarity. The table is therefore used as a comparative benchmark for discussing whether HER interventions appear more cost-effective in one context than another, not as a standalone causal estimate derived from the present review sample.

The published comparative CER benchmarks reported by Andor et al. (2018) suggest that HER interventions may achieve higher electricity savings per dollar spent in Japan than in Germany.

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

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 (**2.66% vs. 2.31%**), 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 CER observed in Japan indicates 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, culture remains analytically central to this study because Social Norm Feedback operates primarily through psychological mechanisms rather than material incentives. Structural factors shape the external conditions under which households consume energy, but norm-based interventions depend on how individuals interpret social comparison, internalize group expectations, and respond to perceived conformity pressures. These processes are deeply embedded in cultural orientations such as collectivism, communication context, and uncertainty avoidance. Thus, while regulatory and infrastructural variables may moderate overall outcomes, cultural context directly influences the mechanism through which the intervention exerts its effect.

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 2.66%, compared with 2.31% 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
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

9. Acknowledgments

The author would like to thank Dr. Aivaliotis and Daryn Howland for their guidance and feedback throughout this project. Gratitude is also extended to the authors of the original field experiments and datasets referenced in this study, whose publicly available work made this review possible.

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Impact of Cultural Context on Behavioral Energy Conservation Policy

Abstract

Energy efficiency policy programs are among the most widely adopted policy instruments for reducing household energy consumption, valued by governments for their cost-effectiveness. However, policy uptake remains underused in cases where households perceive the costs of engagement to outweigh the expected benefits. This study examines whether cultural context may help explain variation in the effectiveness of Home Energy Report (HER) interventions across countries. Using an exploratory comparative review of published HER field trials in Japan and Germany, the paper compares reported Average Treatment Effects (ATEs) and Cost-Effectiveness Ratios (CERs) across studies. The comparison is intentionally descriptive rather than meta-analytic in a formal statistical sense, as the included trials differ in intervention design, sample composition, duration, and reporting conventions. Across the reviewed HER studies, mean reported ATEs differ by 0.64 percentage points between Japan (2.95%) and Germany (2.31%). Estimated cost-effectiveness ranges from approximately 18–45 kWh saved per dollar spent in Japan and 11–27 kWh saved per dollar in Germany. While these differences should not be interpreted as statistically conclusive, they are broadly consistent with the possibility that social-comparison feedback may generate stronger average behavioral responses in Japan than in Germany. The findings suggest that aligning energy-conservation policies with local social norms and behavioral contexts may improve the effectiveness and cost-efficiency of HER-style interventions. ~~We hypothesize that cultural context mediates the effectiveness and cost-efficiency of behavioral energy interventions across countries. To analyze the theories behind the specific effects of cultural identity, this study conducted an exploratory comparative reviewsecondary cross-cultural analysis of existing energy efficiency field trials in advanced economies, focusing on social comparison feedback mechanisms, specifically the Home Energy Report (HER), in Japan and Germany. The review analysis compared Average Treatment Effect(ATE) and Cost Effective Ratio (CER). Mean ATEs differ by 1.38 percentage points between Japan (2.61%) and Germany (1.23%). In addition, estimated cost-effectiveness ranges from approximately 18–45 kWh saved per dollar spent in Japan and 11–27 kWh saved per dollar in Germany. The patterns suggest that aligning energy transition initiatives with prevailing social norms and social identities could enhance public acceptance and the overall effectiveness of behavioral energy policies.~~

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. ~~This paper examines the importance of understanding how cultural values influence the effectiveness of~~

~~policy adaptation through a comparative meta-review analysis of Home Energy Report (HER) initiatives between 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.

Behavioral interventions such as Home Energy Report (HER) have emerged as a promising tool to address these gaps. By leveraging social norms and comparison, HER trials (ex. 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.

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.

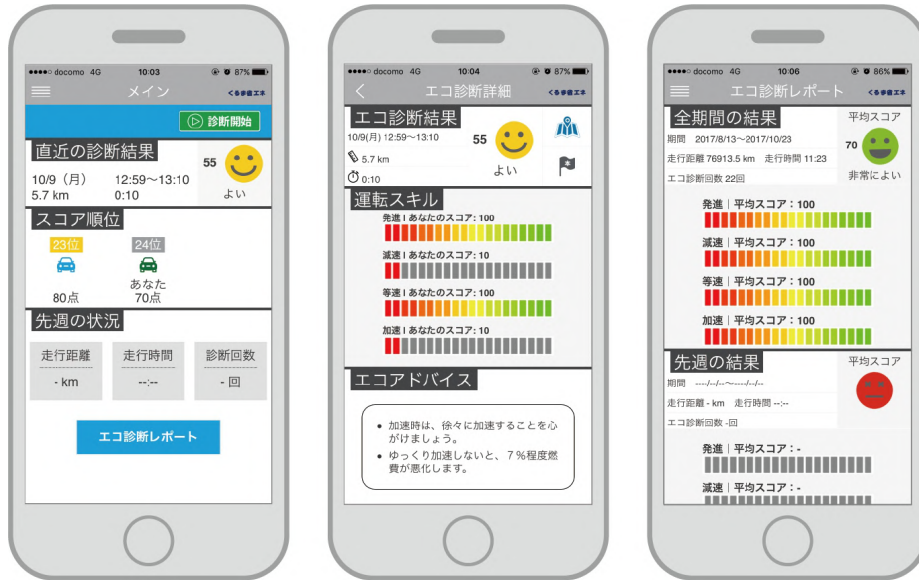


Figure 1. An example of the layout of the home energy reports used in Japanese Energy Trials.
(Automotive Media Response, 2018)

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) kWh/(m²·a)

EnEV-Anforderungswert modernisierter Altbau (Vergleichswert) kWh/(m²·a)

Anforderungen gemäß EnEV ⁴

Mittlere Wärmedurchgangskoeffizienten

Sommerlicher Wärmeschutz (bei Neubauten)

Registrierungsnummer ² (oder „Registrierungsnummer wurde beantragt am...“)

2

Endenergiebedarf

Energieträger	Heizung	Warmwasser	Eingebaute Beleuchtung	Lüftung ⁵	Kühlung einschl. Befehlskühlung	Gebäude insgesamt

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 Ersatzmaßnahmen nach § 7 Absatz 1 Nummer 2 EEWärmeG erfüllt.

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

Verschärfter Anforderungswert Primärenergiebedarf: ... kWh/(m²·a)

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

Verschärfter Anforderungswert 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)

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 & Senstein, 2008). However, the efficiency of these tools exhibits certain variabilities depending on ~~the~~ 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 ~~significantly~~ 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 argues that cultural context is a key factor shaping 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~~ ~~meta-review~~ ~~analysis~~ of ~~published HER trials in Japan and Germany~~ ~~existing randomized controlled trials, specifically in Japan and Germany~~ ~~respectively, systematically comparing~~ ~~reported~~ the Average Treatment Effect (ATE) and Cost-Effectiveness Ratio (CER) ~~across studies of HER interventions in both countries.~~

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. ~~By integrating cultural theory with empirical synthesis, the paper aims to provide a theoretically grounded explanation for cross-national differences in policy effectiveness.~~

~~Ultimately, the study seeks to address this gap by conducting a comparative review of HER trials in Japan and Germany. Rather than seeking to establish causal proof, the paper uses cultural theory as an interpretive framework to examine whether observed differences in intervention outcomes are consistent with broader cross-cultural behavioral patterns. However, findings drawn from heterogeneous trials conducted under varying conditions should be interpreted with caution, as they do not constitute strictly controlled comparisons.~~

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, M. 2025).

However, this comprehensive figure masks ~~significant~~ 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 a full list of each of the 23 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 can~~ 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) dimension 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 influence how strongly 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 is another important factor in 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. Together, these frameworks suggests further emphasizes how the HER is framed to be particularly effective in target collectivist high-context societies, which rely on social comparison and implicit normative cues, due to the inherent effectiveness of social nudges in collectivist, high-context societies than in individualist, low-context ones. 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~~ reflected 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~~ ~~significant~~ 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 ~~suggests~~ ~~suggests~~ 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~~ ~~how~~ 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 ~~s~~ that collectivist societies ~~place~~ ~~places~~ greater emphasis on relational interdependence, whereas individualist societies prioritize self directed decision-making (De Mooji & Hofstede, 2011). Accordingly, in the context of HER interventions, comparative feedback ~~may~~ ~~is likely to~~ 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.¶

~~Accordingly, this framework does not seek to establish a deterministic causal relationship between national culture and HER effectiveness. Rather, it provides a theoretically grounded lens for interpreting whether observed differences in HER outcomes between Japan and Germany are broadly consistent with prior research on cultural moderation in behavioral policy interventions.¶~~

~~Instead of testing a formal causal theory, the study examines whether observed differences in intervention outcomes are consistent with established theories of social norms, collective behavior, and communication context. HER interventions have a~~

myriad of behavioral mechanisms: social comparison, norm salience, reputational concern, and avoidance of perceived deviance. ¶

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 ~~are~~ 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 ~~achieved by~~ the Social Norm Feedback (HER) intervention may show ~~significantly~~ 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 cost-effective~~ 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 ~~Meta-Analysis~~

4.1. Research Design

This study employs an ~~exploratory cross-cultural comparative~~ ~~comparative review~~ ~~meta-analytic synthesis~~ 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~~ ~~cultural context moderates~~ 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,~~ ~~(peer-comparison feedback delivered through periodic~~

reports) but are implemented in distinct cultural, regulatory, and infrastructural contexts. This approach allows for exploratory assessment of cultural moderation while maintaining external validity. 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.

Title	Author (Year)	Country	Sample Size	Intervention Structure	Duration	Reported ATE	Uncertainty / Statistical Information	Total Cost Assumption
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)
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)
HER Persistence Study	Hirayama et al./2021	Japan	N=180,000 households (80,000 prior HER recipients; 100,000 control)	Follow-up evaluation of persistence after HER program ended	12 months post-treatment	-1.7% to -2.0% annual energy consumption	Persistence-year savings retained 87–109% of Year-2 effect; no p-values reported	US\$0 incremental intervention cost

Hirayama et al./2021	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	-2.0% average energy consumption	No SE, CI, or p-values reported	US\$7.2M–12.0M (estimated)
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% average winter electricity use; -5.4% among high users	Random-effects panel regression; winter effect significant; no SE or CI reported	US\$12,000–19,200 (estimated)
N=180,000 households (80,000 prior HER recipients; 100,000 control)	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	-7.5% electricity consumption	Panel regression with cluster-robust standard errors; treatment coefficients tested for significance	US\$360 (estimated)
Follow-up evaluation of persistence after HER program ended	Matsumoto & Osakabe (2022)	Japan	N=74 households (Treatment=36; Control=38)	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)
12 months post-treatment	Schleicher et al. (2015)	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)
-1.7% to -2.0% annual energy consumption	Pelka et al. (2024)	Germany	N=111 households	Sequential feedback, benchmark, and smart-charging-default interventions delivered through app and web portal	18 months	3–4% 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 incremental intervention cost	Andor et al. (2020)	Germany	N≈84,000 households	Utility-delivered social-norm feedback comparing household consumption with neighbors	6–12 months	–1.4% to –2.7% electricity consumption	Large-scale field experiment; fixed-effects and Difference-in-Differences models; $p < 0.01$	US\$90,000–270,000 (estimated)
US\$0/kWh	Meub, Runst & von der Leyen (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)

~~Data were aggregated from publicly available and credible sources from Google Scholars, including:~~

~~Peer-reviewed academic journals~~

~~Government and ministry reports (e.g., METI, BMWK)~~

~~Utility company evaluations and white papers~~

~~NGO and policy institute reports~~

~~Only studies reporting original empirical results from field trials were considered.~~

~~Inclusion Criteria~~

~~Studies were included if they met all of the following conditions:~~

~~The intervention incorporated a Social Norm Feedback component, such as peer comparison or normative ranking.~~

~~The study reported a quantifiable treatment effect, expressed as a percentage change in energy consumption, along with a measure of statistical uncertainty (e.g., p-value, standard error, or confidence interval).~~

~~The trial was conducted among a representative sample of residential households in either Japan or Germany through the use of Randomized Controlled Trials (RCTs).~~

~~The study provided cost information or a proxy for intervention cost (e.g., printing, distribution, or total program budget).~~

~~The post-intervention period lasted at least one billing cycle.~~

~~Exclusion Criteria~~

~~Households with zero monthly electricity usage, identified through smart meter data, were excluded to avoid distortion of percentage change estimates. Additionally, extreme outliers in monthly energy consumption were removed using the Smirnov-Grubbs test, ensuring that treatment effects were not driven by anomalous observations.~~

4.3. Data Synthesis and Analytical Strategy

Outcome Variable

The primary outcome variable is the **reported** Average Treatment Effect (ATE), defined as the **reported mean** percentage change in household electricity consumption associated with the intervention relative to a comparison group or baseline ~~for treated households relative to control households,~~ 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.~~Reported ATEs were extracted directly from each study. When effects were reported in alternative units (e.g., kWh), they were converted to percentage changes using reported baseline consumption levels. No additional pooling weights were applied.~~

Given the small number of trials and heterogeneity ~~in intervention~~ **intervention** structure, duration, delivery frequency, sample composition, and statistical reporting, ~~study design,~~ 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.~~prioritizes transparency and avoids imposing assumptions about comparability or variance structures that cannot be reliably verified. This choice is treated as a methodological limitation.~~

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** ~~on a consistent basis~~. 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.

~~Country-level means were calculated as simple unweighted averages of study-level ATEs. A sample-size weighted average was considered, but not adopted as the primary estimator because the reviewed studies differ substantially in intervention design, duration, target outcome, and the specific treatment effect reported (e.g., overall treatment effects, subgroup effects, or persistence estimates). Weighting by sample size alone could therefore create a misleading appearance of precision by allowing very large but methodologically distinct studies to dominate the comparison. The unweighted mean is used here as a descriptive summary of the reviewed evidence rather than as a pooled estimate of a common underlying effect.~~

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. Because the review synthesizes a small number of heterogeneous studies that were not designed as a common dataset, cross-country differences are interpreted descriptively rather than inferentially. Formal hypothesis testing is avoided due to:~~

¶¶

~~Small numbers of trials per country, potential non-independence across estimates, and substantial heterogeneity in duration, delivery frequency, and population characteristics. ¶¶~~

~~Given the small sample size of trials and substantial heterogeneity in study design, duration, delivery frequency, and sample composition, cross-country comparisons are presented descriptively using country-level means and ranges. This approach prioritizes transparency while avoiding unwarranted statistical assumptions.~~

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 3, 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, a Cost-Effectiveness Ratio (CER) was calculated as:

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

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 110 HER studies met the inclusion criteria: 76 conducted in Japan and 4 conducted in Germany. Across both countries, Social Norm Feedback interventions were consistently associated with reductions in residential electricity consumption, consistent with the baseline analytical expectation that HER interventions reduce energy use on average.

Japan (n = 76):

Mean ATE = 2.95% reduction

Range = 1.30% to 7.50%

Germany (n = 4):

Mean ATE = 2.31% reduction

Range = 0% to 3.75%

These results indicate that feedback-based residential energy HER interventions produced energy savings in both cultural contexts, though with substantial variation across individual trials. Figure 3 illustrates the cross-cultural mean ATEs of each of the 7 trials conducted in Japan. 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.

Tables 1 and 2 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.

	Japan Mean ATE (%)
	1.30%
	1.00%
	1.85%
	2.00%
	7.50%
	5.40%
	1.59%
Average	2.95%

Country	Mean ATE (%)
Japan	1.59%
Japan	1.40%
Japan	1.85%
Japan	7.50%
Japan	1.30%
Japan	2.00%
Japan Average	2.61%

Table 1. Japan Mean ATE (%) Results

	Germany Mean ATE (%)
	3.70%
	3.50%
	2.05%
	0%
Average	2.31%

Country ▼	Mean ATE (%)
Germany	0.70%
Germany	0.70%
Germany	3.50%
Germany	0%
German Average	1.23%

Table 2. German Mean ATE (%) Results

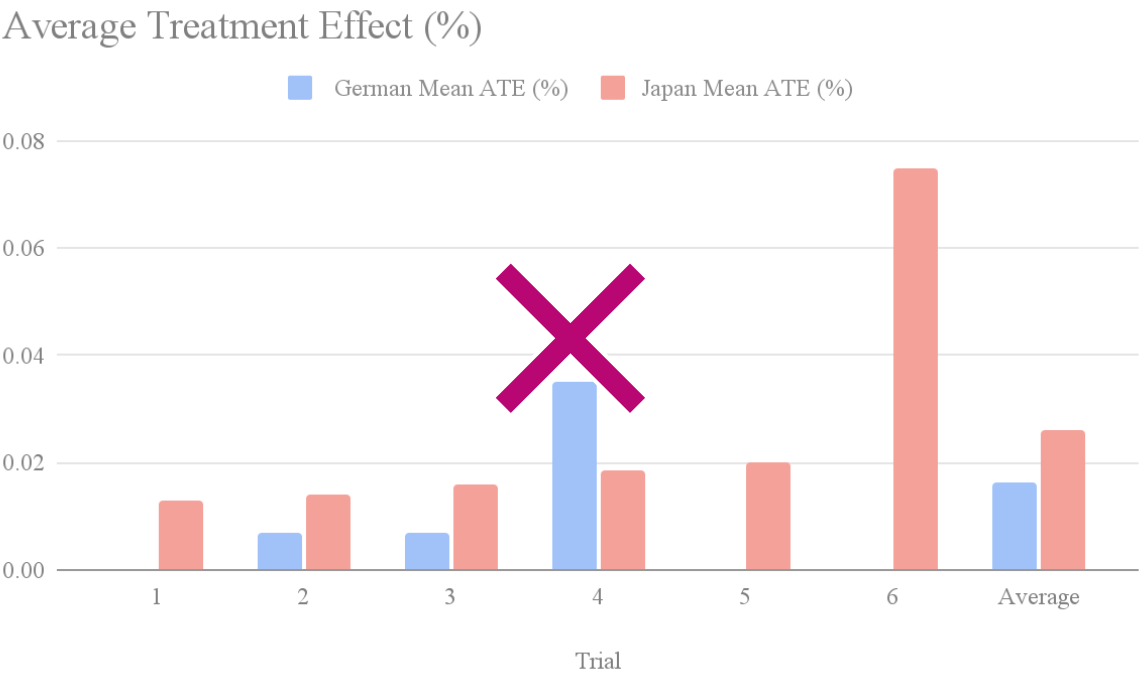


Figure 3. Average Treatment Effect Japan vs Germany

5.2. Cultural Magnitude Comparison

Japanese trials exhibited larger average reductions in electricity consumption than German trials (difference in means: 1.38 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 comparisons were derived from the international cost-comparison table reported by Andor et al. (2018). Reported cost-per-kWh values were converted into kWh saved per US dollar to facilitate comparison between Japan and Germany. Cost-Effectiveness Ratios (CER) were derived from Table 3 reported cost per kilowatt-hour saved in column 3 (“Cost in Cent/ kWh Saved”). For clarity, values were converted to kWh saved per \$1 spent:

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 3. International Cost-Effectiveness Comparison of HER Interventions

	(1)	(2)	(3)	(4)	(5)
Country	Average Electricity Consumption in kWh	CO ₂ Emissions in g / kWh	Cost in Cent / kWh Saved	Abatement Cost in \$ / t CO ₂	CO ₂ Abatement Cost Relative to US
Canada	11,379	158	1.1 – 2.6	67 – 162	3.3
United States	12,293	489	1.0 – 2.4	20 – 49	1.0
France	5,859	64	2.1 – 5.0	323 – 779	16.0
Germany	3,304	486	3.7 – 8.8	75 – 182	3.7
Italy	2,542	343	4.8 – 11.5	139 – 335	6.9
Poland	1,935	769	6.3 – 15.1	81 – 196	4.0
Spain	4,040	247	3.0 – 7.2	121 – 293	6.0
Sweden	8,025	13	1.5 – 3.6	1,162 – 2,799	57.6
United Kingdom	4,145	459	2.9 – 7.0	64 – 153	3.2
Japan	5,434	572	2.2 – 5.4	39 – 94	1.9
South Korea	3,489	536	3.5 – 8.4	65 – 156	3.2
Australia	6,959	798	1.7 – 4.2	22 – 53	1.1

Notes: Our calculations assume printing and mailing cost of 1 US\$ per report, four reports per year and average electricity reductions of 1.37–3.30%. Average electricity consumption and CO₂ intensities of electricity generation correspond to the most recently available data (for 2013), as documented in WEC (2016) and IEA (2015), respectively.

(Andor, Gerster, Ankel-Peters, & Schmidt, 2018)

Table 3 provides the cost-effectiveness comparison used to contextualize the policy-efficiency analysis. Rather than estimating a new pooled CER from the reviewed studies, this paper draws on published cost-per-kWh-saved figures reported by Andor et al. (2018) and converts them into kWh saved per US\$1 spent for interpretive clarity. The table is therefore used as a comparative benchmark for discussing whether HER interventions appear more cost-effective in one context than another, not as a standalone causal estimate derived from the present review sample. The published comparative CER benchmarks reported by Andor et al. (2018) suggest that HER interventions may achieve higher electricity savings per dollar spent in Japan than in Germany.

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. ~~These figures indicate that, for comparable implementation costs, HER interventions may deliver higher energy savings per dollar spent in Japan than in Germany. This pattern is consistent with the observed differences in mean ATEs across the two countries, although, as noted, these differences are not statistically significant. Overall, these findings illustrate that cultural and contextual factors may influence both the effectiveness and cost efficiency of behavioral energy policies, even if formal statistical testing does not confirm a significant cross-country difference.~~

6. Discussion

6.1. Interpretation of Findings

The results of the second analysis are consistent with the central ~~argument hypothesis~~ that cultural ~~contexte~~ 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 (2.66% vs. 2.31%), 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.

~~The greater observed effect size of the Social Norm Feedback (HER) in Japan may be partly attributable to its collectivist, high context cultural orientation. The intervention effectively leverages the deep seated value of social harmony and the implicit pressure to conform to group behavior. Conversely, the comparatively smaller response in Germany suggests that in a more individualistic, low context culture, the implicit social pressure of the HER may be less potent than clear, rational, and individualistic incentives. This varying effectiveness of social nudging strategies can often be traced to psychological mechanisms such as social norm activation, identity alignment, and salience of feedback. For instance, peer comparison is particularly effective when individuals identify closely with the reference group, which enhances internalization of the behavior. Personalized feedback increases engagement by enhancing relevance and perceived control. In contrast, generic or infrequent nudges may fail to create a sense of urgency or personal connection. Environmental awareness, cultural context, and baseline consumption behavior also mediate nudge effectiveness. These factors highlight the need for tailoring nudges to fit the specific behavioral, social, and infrastructural context of the target audience.~~

6.2. The Culture-Contingent Environmental Incentive Design

Based on the cost-effectiveness analysis, the higher CER observed in Japan indicates 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~~^{certain} 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.~~^{the included studies vary widely in terms of methodology, measurement, context, and reporting, which makes direct comparisons difficult.} 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, culture remains analytically central to this study because Social Norm Feedback operates primarily through psychological mechanisms rather than material incentives. Structural factors shape the external conditions under which households consume energy, but norm-based interventions depend on how individuals interpret social comparison, internalize group expectations, and respond to perceived conformity pressures. These processes are deeply embedded in cultural orientations such as collectivism, communication context, and uncertainty avoidance. Thus, while regulatory and infrastructural variables may moderate overall outcomes, cultural context directly influences the mechanism through which the intervention exerts its effect.

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. ~~while we focused on recent field studies with reported positive outcomes, this may introduce publication bias, as unsuccessful or neutral interventions are less frequently reported. Lastly, the limited sampling causes uncertainty in the correlations between cultural context and behavioral energy policy outcomes. While the observed patterns are consistent with cultural theory, the present review analysis cannot definitively isolate culture from regulatory, infrastructural, or economic confounders. Future research should involve an identical, contemporaneous field experiment across both nations to control for external variables and more clearly distinguish cultural effects from structural policy differences.~~

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. ~~The overall effectiveness of behavioral energy interventions is likely to be influenced by cultural context, although the evidence should be interpreted cautiously. By reviewing 11 residential feedback trials, 7 from Japan and 4 from Germany—analyzing evidence from randomized controlled trials in Japan and Germany, this study finds patterns that~~ the findings are broadly consistent with existing literature, suggesting that collectivist, high-context societies such as Japan may respond somewhat more ~~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 2.66%, compared with 2.31% 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. ~~Japanese trials not only achieved larger reductions in household energy consumption (Mean ATE = 2.61% vs. 1.23% in Germany) but also delivered higher returns on investment, as reflected in the cost-effectiveness ratio (18–45 kWh saved per \$1 spent in Japan vs. 11–27 kWh in Germany). These findings reinforce the view in the literature that culture may act as an important moderator of behavioral policy efficacy.~~

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. can achieve substantial energy savings, While in~~ While in individualist settings, however, behavioral feedback may be more effective when paired with clearer information, financial incentives, technological support, or institutional signals. ~~interventions should be coupled with rational, financially oriented incentives to maximize impact.~~ 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. Future research should aim to implement simultaneous, cross-national field experiments to control for extraneous factors and further isolate cultural mechanisms. Additionally, exploring hybrid interventions that integrate social, financial, and technological components could provide actionable insights for global energy policy, ensuring interventions are both culturally appropriate and cost-effective. By aligning behavioral strategies with cultural norms, policymakers can more effectively mobilize households toward sustainable energy use, contributing to the broader goal of global emissions reduction.

8. Appendix

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

Country	Study Focus	Main Finding	Reason Excluded
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



Region	Related Work	Outcome	Social Nudge
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California	High frequency smart meter data was used to give occasional data information on electricity consumption to 237 individual loft units situated inside two different private buildings. The authors assessed the impact of information on the household's individual way of behaving.	Apartments receiving personal information on energy data decreased their power use throughout the experiment by roughly 6% more than units not receiving the treatment, compared to their average consumption before the intervention.	Information nudge: weekly emails.
California	The paper investigates the consumption and conservation behaviors of residents in low income housing in Southern California through a questionnaire based survey conducted across four housing facilities. It explores factors such as energy burden, satisfaction with building services, and drivers of conservation behaviors among low income households. Additionally, the study identifies potential intervention strategies aimed at reducing utility bills and improving residents' quality of life, including educational programs and PV installation.	The findings reveal a strong inclination towards energy and water conservation, with 16% of respondents reporting a reduction in electricity bills compared to the preceding year, averaging a drop of 34 USD.	No nudging: survey only.
China	The study conducted a survey among rural residents to assess their willingness to adjust energy use behaviors in response to three virtual electricity pricing scenarios: Peak valley rate (PVR), Photovoltaic systems (PVS) and original flat rate (OFR). A multi-group analysis was conducted to identify factors influencing residents' willingness to adjust energy consumption, utilizing an extended Theory of Planned Behavior (TPB) framework incorporating social capital and policy variables.	The study revealed varying preferences among rural residents, with 45.22% choosing PVR, 22.89% opting for PVS, and 31.89% selecting OFR. Attitudes significantly influenced residents' willingness to adjust washing machine usage time, while social network presence affected attitude and perceived behavioral control for certain scenarios. Policies and regulations notably impacted the willingness of residents selecting scenario PVS to adjust energy use.	No nudge. Investigating price incentives for DSM.

China	This study investigated the effectiveness of social norm interventions in promoting sustainable behaviors in the context of energy conservation. The research involved a field experiment conducted in university dormitories, with 584 students randomly assigned to control and treatment groups. These groups received social norm information varying in terms of group identification. Data collection included daily electricity meter readings before and after the intervention. Exclusion criteria were applied to participants reporting events that could significantly impact energy usage, resulting in a final sample size of 1027 individuals from 603 rooms.	The results of the study indicate that social norm information about a high identification group led to an 11% reduction in energy consumption, highlighting the importance of group identification in the efficacy of social norms interventions. The findings suggest that identification is a crucial factor in effectiveness for promoting energy conservation behavior.	Information nudge: daily text message for 18 days.
Europe	The study investigates the motivation behind employee energy conservation and assesses the impact of an IoT-enabled gamified intervention in three workplaces across Europe. It aims to unravel individual energy saving behavior factors and understand their influence on organizational energy conservation. Through multiple regression analysis, the study evaluates the predictive ability of various factors, including self-determination, personal norms, and organizational profiles, on energy-related behavioral outcomes at work.	Findings from the study reveal significant insight into energy saving behavior and the effectiveness of the gamified intervention. The intervention led to a statistically significant increase in participants' intention to conserve electricity at work with a moderate effect size. Additionally, participants reported a positive change in their personal energy saving habits with large effect size. The intervention resulted in a conservatively estimated energy saving of 6413 kWh during the intervention period, equivalent to 12.99% compared to baseline consumption.	Gamified nudge: personal feedback through an IoT device in the office.
Finland	By utilizing a clever overview and real month-to-month power utilization information, this study is aimed to analyze how aware people are about their power bills, costs, and expenses among a few Finnish families. Six inquiries were performed to examine whether more elevated levels of energy mindfulness are related to power investment funds. The web-based poll was sent to 244 individuals, of whom 184 completed it.	As per the results, only 27.7% of the respondents accurately addressed the six inquiries. Also, 20.8% of total respondents agreed to receive information nudge to improve their power consumption.	Information nudge: once, by email.

Finland	This research included peer comparisons and energy-saving advice while concentrating on nudging and home power consumption. A total of 528 families received emails with energy-saving advice for lowering winter electricity usage. Researchers looked at the relationship between power use and nudge effectiveness.	The key finding is the possibility that households that are more engaged in monitoring their power use may experience lower energy use. During the test period, an energy-saving nudge lowered the energy consumption by 10%.	Information nudge: social comparison treatment, and energy-saving advice. Information was given by monthly emails.
Germany	This research investigates the main finding of the Opower trials in the US—the cost-effectiveness of social resemblance. Home Energy Reports (HER) as a climate policy tool. In a descriptive study, they demonstrate that, apart from Australia, lower energy usage levels and emissions levels of power production significantly limit the cost-effectiveness potentials of HER. In a German case study, 11,630 residents were sent HER interventions.	Due to the information from the HER reports, power usage was, on average, reduced by 0.7%, which is half of what was seen at the lower end of the 1.4–3.3 percent effect size range in the US.	Information nudge: comparing HER reports between households. The information to the households was given monthly for six months.
Germany	The study conducted a field experiment on resource conservation, specifically focusing on the everyday activity of showering in a student dormitory, known for its energy and water intensity. With 351 participants, two interventions were implemented. The interventions targeted biases arising from imperfect information and limited attention. The experiment involved a three-month duration and tested the effects of each intervention alone and in combination.	The findings revealed a remarkable complementarity between the two interventions. While each intervention individually had limited effectiveness in inducing conservation, the combined implementation yielded significant conservation effects.	Information nudge: daily/monthly information on energy use and real-time feedback, given via email.
Germany	A field experiment was conducted with 111 households equipped with rooftop photovoltaics to test the effectiveness of three sequentially applied behavioral nudges (feedback, benchmark and default) delivered through digital tools. The experiment employed a control group design, baseline measurements and high-frequency smart-meter data to assess the causal effects of each intervention on increasing self-consumption.	The study revealed that while feedback and benchmark interventions resulted in a 3–4% in self-consumption, the default intervention led to a substantial 16% increase for active participants. Notably, households with controllable EVs showed stronger effects than those without.	Information nudge: Information (feedback, benchmark, or default) provided through digital tools, i.e., web portal and smart-charging app.

Ghana	The study investigates the relationship between energy literacy (EL), attitude towards energy, personal energy value, and energy savings behavior (ESB) within the context of a lower middle income country, specifically focusing on hydro electricity power in Ghana. A survey based questionnaire was administered to 250 professional workers in Ghana to collect data.	The study found that energy literacy has a positive effect on energy saving behavior, with attitude towards energy and personal energy value significantly mediating this relationship. Specifically, cognitive skills and affective outcomes of energy literacy were identified as significant predictors of personal energy value and attitude towards energy.	No nudge. Survey only.
Italy	This study used an experiment to evaluate how environmental awareness influences the larger scale effects of information nudging that requires sustained efforts. The authors merged data on consumption with survey data of 4835 consumers in order to investigate probable origins of the messages' diverse effects.	The program typically results in a 0.9% decrease in electricity use. The authors offered hints that targeting particular sub groups might increase the effectiveness of boosting environmental awareness.	Information nudge: weekly emails.
Italy	Authors examined the impact of integrating financial reward with social nudges using a structured online experiment. Participants optimized their virtual electricity use on a simulated washing machine in a novel incentive compatible electricity saving assignment suggested by the authors. A total of 566 participants took part in the study.	Electricity saving of 0.148% by the nudge approach and 0.156% electricity saving by the combined approach (nudge and reward) was achieved for the washing machine simulation.	Nudging on virtual study.
Japan	This field study aimed to test the effectiveness of energy efficiency guidance in the residential sector using a message pop-up feature in a mobile app. The app was distributed to approximately 1700 households that voluntarily enrolled in the program. Researchers conducted randomized controlled trials to assess the impact of message pop-ups containing energy efficiency advice. The advice included information about power usage and characteristics, as well as a social nudge approach.	Energy saving recommendations decreased power use by 1.3%.	Information nudge: energy efficiency guidance via mobile app. Information was given on a daily, weekly, and monthly basis for five months.

Japan	This study is a large-scale randomized experiment of 62,400 homes, investigating the behavioral characteristics of energy use feedback programs. The work includes social comparison-based home energy reports (HER), and categorization based on peer-comparison. The authors used a randomized controlled experiment to analyze data from 62400 homes. There were two different sorts of home energy reports: one with hourly energy use comparisons and the other with yearly comparisons of monthly energy consumption.	The social comparison of HER reports with hourly data to HER with monthly data showed 1.4% lower energy consumption, which is 0.8% higher than the results obtained by historic comparison.	Information nudge: social comparison treatment through HER reports by monthly emails.
Kuwait	This study investigates the impact of the COVID-19 pandemic on energy literacy and conservation behavior in academic buildings in Kuwait. Employing a mixed-methods approach, it combines quantitative surveys with qualitative data collection methods such as questionnaires, focus groups, and interviews. The research included 158 engineering students, 67 faculty members, and 52 administrative staff, totaling 277 participants. Education, awareness, personal motivation, values, religiosity, and culture were identified as crucial factors influencing energy literacy and conservation behaviors.	The study found that COVID-19 had a significant impact on participants' attitudes, intentions, and behavior related to energy conservation in academic buildings in Kuwait. Specifically, the student group experienced a significant increase in the relationship between their intentions and behavior, while the faculty group exhibited a strong correlation between intention and behavior.	No nudge. Survey of impact of COVID-19 on energy literacy.
Lithuania	This study performed an experiment on 2927 apartments to investigate how solely descriptive information, provided via online portals, may be a successful means of achieving energy savings in housing applications. The customized hourly energy demand data was presented on their individual online portals. The installation of new smart energy meters allowed for the availability of hourly energy data for the treatment group.	The outcomes revealed that providing descriptive information decreased electricity usage by 8.6%.	Information nudge: information on own hourly energy consumption data via a web portal.
Middle East	The authors conducted a large-scale field study including around 200,000 families in the Middle East, sending each family periodic messages on their water and power usage. The research was focused on finding whether giving such information on the usage of the two resources jointly may result in decreases in both sectors, as use of this strategy to encourage resource savings spreads.	For this social nudge, there was a reduction in electricity use of about 1.2%, keeping water utilization unaffected.	Information nudge: monthly emails.

Monaco¶¶	In this work, the authors investigated the relation between social nudge and the household's environmental awareness. Data from 77 families were gathered and divided into four groups. Ex ante survey questions included the socio-demographics of the home, ecological dedication and considerations, power usage, heating system, and curtailing practices.¶¶	The difference in average energy consumption was noticed in the range of 7% to 31% among the groups.¶¶	Information nudging by email for six months.¶¶
Poland¶¶	This study investigated the preferences for demand-side management (DSM) programs in the electricity consumption of 1000 households. A web-based survey, conducted by a polling agency, was used for data collection. The researchers assessed the willingness to embrace changes in power consumption, and also explored how the social analysis of households' energy use affected their acceptance of DSM.¶¶	A majority, i.e., 85.4% of respondents, agreed to perform DSM, but they wanted payment for altering their behavior.¶¶	No nudging. Only a survey that supported financial incentives for behavioral change.¶¶
Portugal¶¶	An empirical experiment was conducted for a system with 20 customers to assess the power exchange cost for local participants. The study incorporated behavioral interventions for energy conservation and the adoption of renewable energy sources. The model followed a simulation-based study for the local electricity market.¶¶	Considering a 3% to 5% electricity saving, a cost savings of 5.60% to 10.26% was obtained.¶¶	Results from a simulation tool.¶¶
Sweden¶¶	This study used an experiment of 525 homes to determine the causal effects of social comparison on water and electricity use. The control and treatment groups were randomly assigned.¶¶	The daily domestic power usage was reduced by 6.7% on average by the social comparison treatment, while the household's water use remained unaffected.¶¶	Information nudge: real-time display for 12 months.¶¶
Switzerland¶¶	In this study, households in two Swiss neighborhoods (N = 177) participated in an energy conservation program. They were randomly assigned to receive either a concrete intervention or one including abstract environmental information.¶¶	Six months later, households exposed to the abstract message paid significantly more attention to energy consumption, with 12–15% more energy saving compared to the group which received concrete information.¶¶	Information nudge: comparing concrete and abstract information.¶¶



9. Acknowledgments

The author would like to thank Dr. Aivaliotis and Daryn Howland for their guidance and feedback throughout this project. Gratitude is also extended to the authors of the original field experiments and datasets referenced in this study, whose publicly available work made this ~~review~~ analysis possible.

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I sincerely thank the reviewers for their thoughtful, detailed, and constructive feedback. I greatly appreciate the time you took to review my manuscript and your positive comments regarding the integration of behavioral economics, cultural theory, and environmental policy. Your suggestions have significantly improved the clarity, transparency, and methodological framing of the paper. Below I respond to each of your comments.

Comment 1:

The paper is better characterized as a comparative review rather than a formal meta-analysis because it does not employ conventional meta-analytic statistical techniques.

Reply:

Thank you for this important suggestion. I have revised the manuscript throughout to consistently describe the study as an *exploratory comparative review* (or comparative synthesis where appropriate) rather than a formal meta-analysis. The research design, conceptual framework, analytical expectations, and methodology sections have all been updated to better reflect the descriptive and interpretive nature of the study.

In addition, I now explicitly state that the study does not estimate pooled effect sizes or conduct formal meta-analytic inference, but instead provides a theory-informed comparative synthesis of published HER studies.

Comment 2:

Please explain how studies were identified and screened. Be more specific regarding databases, search strategy, and whether studies were excluded.

Reply:

I expanded Section 4.2 substantially.

The revised manuscript now includes:

- databases consulted (ScienceDirect, MDPI, J-STAGE, EconStor/RePEc, and practitioner sources such as BECC Japan and Jyuri)
- the search focus (Home Energy Reports, social comparison feedback, historical comparison, HEMS-based feedback, app- and billing-based interventions, household electricity conservation)
- explicit inclusion criteria
- explicit exclusion criteria
- the information extracted from each eligible study (author, country, sample size, intervention, duration, ATE, uncertainty information, and cost assumptions)

This revision makes the study selection process considerably more transparent.

Comment 3:

The manuscript acknowledges alternative explanations but still presents culture as the dominant explanation.

Reply:

I revised multiple sections of the manuscript to present culture as one interpretive framework among several competing explanations rather than as the sole causal explanation.

Specifically, I expanded the discussion of alternative structural factors including:

- energy prices
- housing stock
- regulatory intensity
- building efficiency standards
- smart-meter penetration
- environmental awareness
- baseline electricity consumption

These revisions were incorporated into the Background, Conceptual Framework, Discussion, and Limitations sections.

Throughout the manuscript I also softened causal language by replacing stronger statements with wording such as:

- "consistent with cultural theory"
- "may partly reflect"
- "one possible interpretation"
- "suggestive rather than conclusive"
- "cannot isolate culture from structural factors"

Comment 4:

Proofread the manuscript for grammatical issues and wording errors (e.g., "casual proof" → "causal proof").

Reply:

I carefully proofread the manuscript and corrected grammatical, stylistic, and wording errors throughout.

Examples include:

- correcting "casual proof" to "causal proof"
- improving sentence flow
- removing repetitive wording
- improving consistency of terminology
- standardizing formatting across sections

Comment 5:

Figures and tables are not sufficiently explained.

Reply:

I expanded the discussion accompanying Figures 1–3 and Tables 1–3.

Specifically:

- Figures 1 and 2 are now introduced as illustrative examples of HER layouts used in Japan and Germany, with an explanation of why they are included.
- Tables 1 and 2 are now discussed as descriptive summaries of the reviewed studies rather than pooled estimates, with explanation of the reported mean ATEs and ranges.
- Figure 3 is now explicitly described as a visual comparison of country-level descriptive averages rather than a formal statistical comparison.
- Table 3 now explains that the CER values are drawn from the published international comparison by Andor et al. (2018), converted into kWh saved per US\$1 for ease of interpretation, and used as a comparative benchmark rather than newly estimated from the reviewed studies.

These additions clarify the purpose and interpretation of each figure and table.

Comment 6:

Citations should be formatted correctly.

Reply:

I reviewed and standardized citation formatting throughout the manuscript to ensure consistency with the required referencing style.

Thank you again for your valuable comments. I believe these revisions have substantially strengthened the manuscript by improving methodological transparency, clarifying the analytical scope, providing greater balance in the interpretation of the findings, and making the presentation of the results clearer for readers.

I sincerely thank the reviewers for their thoughtful, detailed, and constructive feedback. I greatly appreciate the time and effort devoted to evaluating our manuscript. The comments have been invaluable in strengthening both the methodological transparency and overall clarity of the paper.

In response to the reviewers' suggestions, I have substantially revised the manuscript. The study has been reframed as an exploratory comparative review rather than a formal meta-analysis, the methodology has been expanded to improve transparency, the interpretation of cultural theory has been made more balanced and cautious, and the presentation of results, figures, tables, and appendices has been clarified throughout. I have also carefully proofread the manuscript and addressed numerous stylistic and grammatical issues.

Below, we provide a point-by-point response to each comment and indicate how the manuscript has been revised accordingly.

Major Concern 1:

The manuscript would be strengthened by reframing itself as an exploratory comparative review rather than a comparative meta-analysis.

Reply:

Thank you for this valuable suggestion. I agreed that the original terminology overstated the analytical approach.

Accordingly, I have revised the manuscript throughout to describe the study as an exploratory comparative review rather than a formal meta-analysis.

Specifically, I revised:

- the Abstract
- the Introduction
- Section 3 (Conceptual Framework)
- Section 4 (Research Design)
- the Discussion
- the Conclusion

The revised manuscript now explicitly states that the purpose is descriptive and theory-informed comparison rather than formal pooled inference. The analytical expectations have also been rewritten to emphasize interpretation rather than hypothesis testing.

Major Concern 2:

The manuscript treats published studies as directly comparable observations and should provide greater methodological transparency regarding study selection and data extraction.

Reply:

I have substantially expanded the Methods section to improve transparency.

Section 4.2 now includes separate subsections describing:

- Data sourcing
- Search strategy
- Inclusion criteria
- Exclusion criteria
- Data extraction procedure

The manuscript now clearly specifies that studies were identified from:

- ScienceDirect
- MDPI
- J-STAGE
- EconStor/RePEc
- practitioner reports (BECC Japan, Jyukankyo Research Institute)

I also clarify the behavioral intervention keywords used during study identification.

Furthermore, I added a comprehensive study table reporting for every included study:

- author/year
- country
- sample size
- intervention structure
- duration
- reported Average Treatment Effect (ATE)
- statistical uncertainty (where available)
- implementation cost assumptions

Finally, I explicitly acknowledge that the included studies were not originally designed as components of a unified dataset, and therefore direct numerical comparison should be interpreted cautiously.

Major Concern 3:

The manuscript does not satisfy the expectations of a formal meta-analysis.

Reply:

I agree with this assessment and revised the manuscript accordingly.

The revised manuscript no longer presents the study as a formal meta-analysis.

Instead, Section 4.3 explicitly explains that:

- no pooled effect sizes were estimated
- no inverse-variance weighting was performed
- no heterogeneity statistics were calculated
- no publication bias assessment was conducted

Instead, country-level means and ranges are used solely as descriptive summaries to facilitate exploratory comparison between Japan and Germany.

The Discussion and Conclusion were also revised to ensure the claims remain proportional to the methodology employed.

Major Concern 4:

The manuscript appropriately draws upon theories on collectivism vs. individualism and communication styles to interpret observed differences between Japan and Germany. However, culture should be presented more consistently within one interpretive framework amongst several competing explanations.

Reply:

Thank you for this important suggestion. I agreed that the original manuscript occasionally placed too much explanatory emphasis on culture. To address this, I revised the manuscript so that culture is consistently presented as one interpretive framework among several plausible explanations, rather than as the dominant or sole cause of cross-country differences.

Specifically, I revised Sections 2.3 (Energy Trials and Policy in Japan and Germany), 3.1 (Conceptual Framework), 5 (Results), 6 (Discussion), and the Conclusion.

In Section 2.3, I expanded the discussion of alternative structural explanations by explicitly identifying factors such as energy pricing, housing stock, environmental regulation, policy design, and baseline conservation behavior. The revised text explains that these factors may directly influence household energy use, shape responsiveness to HER interventions, interact with cultural influences, or independently account for part of the observed variation.

Throughout the manuscript, I also softened causal language. Statements suggesting that culture explains differences in HER effectiveness were revised to more cautious wording such as "may," "suggests," "broadly consistent with," and "should not be interpreted as definitive evidence of cultural mechanisms."

Finally, the Conclusion was revised to emphasize that the findings are broadly consistent with existing cultural theories but do not establish cultural causation. The manuscript now presents cultural theory as a useful interpretive lens alongside institutional, economic, and policy-based explanations, providing a more balanced interpretation of the comparative evidence.

Major Concern 5:

Clarify statistical significance and justify the use of unweighted means.

Reply:

I substantially revised Section 4.3 to clarify both issues.

First, I now explicitly state that:

- no new statistical significance tests were conducted in this review
- references to statistical significance refer only to significance reported in the original studies

This distinction is also reiterated in the Results section.

Second, I expanded the justification for using simple unweighted means.

The manuscript now explains that weighted averaging was considered but not adopted because:

- many studies do not report comparable variance estimates
- intervention designs differ substantially
- reported treatment effects represent different quantities (overall effects, subgroup effects, persistence effects, etc.)
- weighting by sample size alone could produce misleading precision by allowing several very large but methodologically different studies to dominate the comparison

The manuscript therefore presents unweighted means solely as descriptive summaries rather than pooled national estimates.

Major Concern 6:

The manuscript should continue softening causal language and emphasize that the findings are broadly consistent with cultural theories rather than evidence of definitive cultural mechanisms.

Reply:

Thank you for this important recommendation. The manuscript has been revised to further soften causal language and clarify the interpretive role of cultural theory.

Specifically:

- Throughout the manuscript, wording has been revised to avoid implying that culture is the definitive cause of differences in HER effectiveness. Expressions such as "explains," "causes," or "demonstrates" have been replaced with more cautious language, including

"may," "suggests," "is broadly consistent with," "one possible interpretation," and "should not be interpreted as definitive evidence."

- The theoretical discussion now consistently presents collectivism-individualism and communication-context theories as interpretive frameworks rather than deterministic explanations of behavior.
- Section 2.3 (Energy Trials and Policy in Japan and Germany) has been expanded to acknowledge several alternative structural explanations—including energy pricing, housing stock, environmental regulation, policy design, and baseline conservation behavior—which may:
 - directly influence household energy consumption
 - affect responsiveness to HER interventions
 - interact with cultural context
 - independently account for part of the observed cross-country variation
- The Discussion and Conclusion have been revised to emphasize that the findings are broadly consistent with cultural theory but do not establish cultural causation or definitive cultural mechanisms. Culture is now positioned as one explanatory framework among several that may help interpret the observed patterns.

Minor Concerns:

Copyediting and writing style

Reply:

The manuscript was carefully proofread and revised to improve clarity, reduce repetition, strengthen transitions, and correct grammatical inconsistencies.

Several wording issues were corrected, including replacing "casual proof" with "causal proof."

Figures and tables

Reply:

The figures and tables have been reformatted for greater consistency.

In addition, explanatory text has been expanded throughout the Results section.

Rather than simply presenting Figures 1–2 and Tables 1–3, the manuscript now explains:

- what each figure or table contains,
- why it is included,
- and how it supports the interpretation of the findings.

Appendix

Reply:

The appendix has been reorganized into a standardized study table with consistent formatting across all included studies.

The presentation of study characteristics has been streamlined to improve readability and facilitate comparison.

Critiques of Hofstede-style cultural frameworks

Reply:

The literature review has been expanded to engage more directly with critiques of Hofstede's framework.

The manuscript now explicitly acknowledges that:

- national cultures are not homogeneous
- Hofstede's dimensions should not be interpreted deterministically
- cultural frameworks are used only as heuristic interpretive tools
- institutional, economic, generational, and situational factors also influence behavioral responses

These revisions are incorporated into both the Background section and the Conceptual Framework.

The manuscript has been substantially revised to better align the research design with the claims being made. It is now framed as an exploratory comparative review, includes a much more transparent methodology, clearly distinguishes descriptive synthesis from formal statistical inference, provides stronger justification for analytical choices, and presents culture as one interpretive framework among several possible explanations. I believe these revisions substantially improve the methodological transparency and overall coherence of the paper while preserving its central contribution.

Decision: Targeted revision before acceptance. The major conceptual revisions were impressive, substantive, and successful. Any remaining work should primarily focus on consistency, evidence handling, presentation, and careful proofreading.

Review: All in all, the author successfully reframed the manuscript from a formal “meta-analysis” to an exploratory comparative review. The revised methods section now explicitly distinguishes descriptive synthesis from pooled statistical inference. The search sources, broad search terms, inclusion/exclusion criteria, duplicate handling, and data-extraction fields are much more transparent. The manuscript now gives a reasonable rationale for not using inverse-variance or sample-size weighting. The literature review now even acknowledges criticisms of Hofstedian frameworks for national culture and recognizes several institutional, economic, and infrastructural alternatives. The results and limitations sections are much more cautious than before, and the appendix is more readable. Hence, this is a strong response to sophisticated feedback.

That being said, a minor revision is still needed to ensure the execution more closely matches the improved conceptual framing.

First of all, **double-check the evidence and quantitative results presented.** The newer manuscript contains three different and conflicting statements of the central Japan and Germany comparison:

- Abstract and Section 5.1: **2.95%** for Japan mean, 2.31% for Germany mean
- Section 5.2: You state a 1.38 difference in percentage points, which is at odds with the above
- Section 6.1 Discussion and Conclusion: **2.66%** for Japan mean, 2.31% for Germany mean

The likely source of the 2.95% versus 2.66% discrepancy is as follows:

- The 2.95% Japanese mean is obtained when the Iwafune study contributes the 5.4% high-user subgroup result.
- The 2.66% mean is obtained when that same study contributes the 3.4% overall winter-use result.

You should choose one rule for selecting the study-level effects and apply it consistently. A reasonable rule is to use the primary overall household-level percentage change in electricity consumption for the main intervention period; do not substitute a subgroup maximum when an overall estimate exists. Moreover, the 1.38-point difference is the difference between the original manuscript’s older means (2.61% and 1.23%), so that should just be replaced.

Moreover, **do not code a lack of significance as zero:** If a study reports “no statistically significant effect,” use the reported point estimate if it exists. If no comparable point estimate can be extracted, say so and do not just enter 0% without saying it.

You should explain how ranges are converted to one value. If a midpoint is used for a reported range, state that rule explicitly and apply it consistently; otherwise, use the study’s designated primary estimate.

After the above study-level inputs are fixed, **make sure to carefully recalculate and check both country means, both ranges, and the between-country difference. And of course, use those same values in the abstract, results, discussion, and conclusion.**

Please further clarify the CER analysis. The abstract currently says that the paper compares ATEs and CERs “across studies,” but Section 4.3 much more accurately explains that the Japan-Germany CER ranges are taken from the separate international comparison in Andor et al. (2018). Hence, the abstract makes the CER evidence sound more directly connected to the 11-study sample than it actually is.

- In the abstract and introduction, state explicitly that the paper synthesizes ATEs from the included Japan/Germany studies and uses Andor et al. (2018) as a separate published cost-effectiveness benchmark.
- Remove or rewrite the sentence: “For trials reporting cost data, a CER was calculated,” unless your paper actually calculates study-level CERs and uses them in the analysis.
- In Section 6.2, replace “the higher CER observed in Japan indicates...” with language such as: “The higher cost-effectiveness benchmark reported for Japan by Andor et al. (2018) suggests...”
- Do not present the Andor benchmark as confirmation of the ATE comparison from the 11-study sample; present it as contextual evidence from a different source.

The revised manuscript is substantially more cautious, but **several sentences still make stronger claims than the study’s design can support.** As some examples:

- “This study argues that cultural context is a key factor shaping this variation.” Change to something like: “This study examines cultural context as one possible factor that may help interpret this variation.”
- “exploratory assessment of cultural moderation while maintaining external validity” Use instead: “exploratory comparison of cross-country patterns.” “Moderation” implies a tested statistical relationship, and this review does not establish external validity.
- “culture remains analytically central” and “cultural context directly influences the mechanism...” try, e.g., “Cultural context remains a theoretically relevant candidate explanation because HERs rely partly on social interpretation and normative comparison. This review cannot estimate culture’s independent causal contribution relative to institutional, economic, or intervention-specific factors.”

Several citations should be corrected:

- “Thaler & Senstein” -> Sunstein; “(Jain, M. 2025)” -> “(Jain, 2025)”; “De Mooji” -> “De Mooij”; “(Peer et al, 2020)” -> “(Peer et al., 2020).” Also, narrative citations should not include all author initials.
- The body cites the U.S. EPA (2025), IEA (2024), IEA (2025), and Kahan & Braman (2006), but complete matching reference entries are not present.
- Several entries run together without paragraph breaks: Hirayama/Iwafune, Matsumoto/Meub, Mukai/Nori Yachita, and Ozawa/Wojtaszek.
- The Iwafune author list appears to be malformed.

- The table uses Schleich et al. (2015) while the reference list gives 2017; it lists Andor et al. (2020) but the bibliography appears to include only Andor et al. (2018). Verify the exact source and use one year/citation everywhere.
- The Table 3 caption uses “Ankel-Peters,” while the bibliography lists Peters. Make the author name consistent with the source.
- Check consistency with APA 7th style, keep the list alphabetized, and replace temporary download URLs with DOI or stable publisher links where available.

Carefully copyedit the manuscript, as there are several grammatical errors or awkward wordings throughout (list is non-exhaustive):

- “Home Energy Report (HER) have emerged” -> “Home Energy Reports (HERs) have emerged.”
- “the efficiency of these tools exhibits certain variabilities...” -> “The effectiveness of these interventions varies across populations and implementation contexts.”
- “interventions were consistently associated with reductions” use a more precise statement such as “most included studies reported reductions or favorable energy-related outcomes,” unless every study has a comparable negative consumption estimate.
- “11 residential feedback trails” -> “11 residential feedback studies” or “trials.”

Table 3 is a small screenshot of a larger international table. Please improve the quality and **replace it with a clean two-row table for Japan and Germany** showing the original cost-per-kWh values and the converted kWh saved per US\$1, with a note that the values come from Andor et al. (2018).

Section 2.1 says Appendix A contains a “full list” of 23 papers, but the current appendix contains 16 excluded-study rows while the main review contains 11 included studies. Where does the number 23 come from? You should **decide whether Appendix A is an exhaustive exclusion log or only an illustrative list. State this explicitly.** If it is exhaustive, report counts that add up: number screened, number included, number excluded, and how duplicates were handled.