



# Bridging Energy Justice and Participatory Governance in Residential Energy Policy Under Climate Change

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## Abstract

Residential energy efficiency (EE) policies are increasingly recognized not only as instruments of climate mitigation but also as vehicles for social justice. Yet in many countries, including Thailand, such policies remain technocratic and economically framed, neglecting issues of equity, participation, and vulnerability. This paper advances a conceptual framework that bridges energy justice with its distributive, procedural, and recognition dimensions and participatory governance, analyzed through Fung's Democracy Cube. By integrating these perspectives with comparative evidence from Germany, Japan, Singapore, and Thailand, the study explores how inclusive design and participatory mechanisms can enhance both the legitimacy and effectiveness of EE policy under climate change. Findings from the comparative review reveal that Thailand's current policy architecture, dominated by technical measures such as appliance labeling and building codes, fails to systematically address the needs of low-income, elderly, and disabled populations. In contrast, Germany's Social Climate Fund, Japan's senior-focused outreach, and Singapore's housing upgrade schemes demonstrate how equity-oriented mechanisms expand participation and improve uptake. Using the Democracy Cube, this study shows how broadening the range of participants, deepening modes of deliberation, and strengthening citizen influence can address persistent gaps in Thailand's policy process. The paper contributes theoretically by proposing a justice-governance nexus framework that situates residential EE as both a climate mitigation and adaptation strategy. Practically, it outlines pathways for embedding inclusive participation into policy cycles, thereby enhancing resilience and social legitimacy. Beyond Thailand, the framework offers transferable lessons for middle-income countries navigating the twin challenges of climate change and demographic transition.

**Keywords:** climate governance, democracy cube, energy justice, policy design, justice-based design

## **1. Introduction**

Residential energy efficiency (EE) has emerged as one of the most critical levers for addressing the dual challenge of climate mitigation and climate adaptation in the built environment (IEA, 2023). As global temperatures rise and extreme weather events intensify, the residential sector, responsible for a significant share of total final energy consumption, plays an increasingly pivotal role in shaping national climate trajectories, household energy burdens, and social vulnerabilities (United Nations, 2015). Beyond its technical contributions to reducing greenhouse gas emissions, EE policy directly intersects with public welfare, equity, and justice, particularly in societies facing demographic aging, widening socio-economic inequality, and spatial disparities in climate risk (Jenkins et al., 2016).

In many countries, however, residential EE remains narrowly framed as a technical or economic agenda rather than a governance or justice issue. Policy instruments such as appliance labeling, voluntary building codes, and incentives for high-efficiency technologies have often been designed without adequate consideration for procedural equity, differentiated household needs, or participatory decision-making (Asuka & Jin, 2022).

As a result, EE programs frequently fail to reach populations most in need: low-income households, older adults, rural residents, and persons with disabilities. These groups experience disproportionate exposure to heat stress, energy poverty, and limited access to digital technologies, conditions that directly heighten their climate vulnerability (NESDC, 2021; Odyssee-Mure, 2023). Thailand exemplifies these challenges. Although the residential sector accounts for nearly 12% of national final energy use and represents a major opportunity for reducing peak electricity demand, existing policies remain technocratic and urban-centric (EPPO, 2024). The Energy Efficiency Plan 2018 (EEP2018) and the draft Energy Efficiency Plan 2024 (EEP2024) prioritize technical measures such as smart appliances, monitoring devices, and voluntary building codes, but provide limited mechanisms for citizen participation, equity-oriented targeting, or community-based program delivery (DEDE, 2024; ONEP, 2021). Consequently, participation in EE programs remains low, particularly among vulnerable groups, resulting in missed opportunities for both emissions reduction and climate resilience (Vivatpinyo & Pharino, 2019).

Meanwhile, comparative evidence from Germany, Japan, and Singapore demonstrates that socially inclusive and participatory EE governance yields significantly higher rates of public uptake and more equitable outcomes. Germany's Social Climate Fund provides targeted assistance for energy-poor households. Japan's senior-focused outreach programs address the needs of an aging population (Asuka & Jin, 2022). Singapore integrates EE into public housing upgrades, ensuring accessibility for lower-income and disabled residents (Housing & Development Board, 2024). These cases illustrate that residential EE policy, when designed with justice and participation at its core, can function simultaneously as climate mitigation and climate adaptation.

Yet despite this international progress, there remains a conceptual gap in linking energy justice with its distributive, procedural, and recognition dimensions (Jenkins et al., 2016) to participatory governance frameworks, particularly Fung's Democracy Cube (Fung, 2006). While prior comparative studies shed light on policy instruments and program outcomes, few attempts have been made to systematically conceptualize how inclusive participation mechanisms can reshape the governance of residential EE under climate change.

This paper addresses that gap. It advances a justice–governance nexus framework that integrates energy justice principles with the participatory dimensions of the Democracy Cube, and applies this integrated lens to comparative evidence from Germany, Japan, Singapore,

and Thailand. By doing so, the study provides both a theoretical advancement in climate governance and practical guidance for redesigning Thailand's residential EE policy toward greater inclusivity, legitimacy, and climate resilience. The framework also offers transferable insights for other middle-income countries navigating the intertwined challenges of decarbonization, demographic aging, and socio-economic vulnerability.

## **2. Literature Review**

This study is grounded in four major bodies of scholarship: energy justice, participatory governance via Fung's Democracy Cube, comparative energy policy design, and the Multiple Streams Framework (MSF). Together, these theoretical lenses provide the conceptual foundation for developing an integrated justice-governance nexus for residential energy efficiency (EE) under climate change.

### **2.1 Energy Justice: Distributive, Procedural, and Recognition Dimensions**

Energy justice has emerged as a central normative framework within the fields of climate governance and energy transition studies. Jenkins et al. (2016) conceptualize energy justice through three interrelated dimensions: distributive justice, emphasizing the fair allocation of costs, benefits, and risks; procedural justice, focusing on equitable participation and transparent decision-making; and recognition justice, which requires acknowledging and addressing the differentiated needs, identities, and vulnerabilities of diverse social groups. Within the residential sector, these principles are especially salient because energy use intersects with daily living conditions, household welfare, and exposure to climate risks. Research consistently demonstrates that energy efficiency policies, when narrowly designed around technological or economic metrics, tend to exclude low-income households, older adults, people with disabilities, and rural populations (Sovacool et al., 2019). Barriers such as upfront costs, limited digital access, housing tenure constraints, or low policy awareness disproportionately affect these groups, even though they are most vulnerable to climate-induced heat stress, rising electricity costs, and energy poverty (NESDC, 2021).

Moreover, scholars increasingly recognize energy efficiency not only as a mitigation instrument but also as a form of climate adaptation. For example, improved building insulation, access to efficient cooling appliances, and housing retrofits can reduce household exposure to extreme temperatures, particularly among the elderly and chronically ill (IEA, 2023). Yet despite this adaptive potential, many national EE frameworks still ignore recognition justice, resulting in one-size-fits-all interventions that inadequately protect vulnerable populations. Thus, energy justice literature highlights a significant gap: vulnerable groups remain structurally marginalized in the design and implementation of EE policy, a problem that this paper addresses by proposing a governance model that explicitly incorporates justice considerations.

### **2.2 Participatory Governance and Fung's Democracy Cube**

Participation has long been regarded as a cornerstone of democratic governance, but its role in climate and energy policymaking has become increasingly critical amid rising social inequalities and declining public trust. Fung's (2006) Democracy Cube provides one of the most influential analytical frameworks for evaluating the design and quality of participatory processes. It consists of three dimensions:

- 1) Who participates? – ranging from expert-driven processes to inclusive citizen participation
- 2) How do participants communicate and make decisions? – from passive consultation to deliberation and co-creation
- 3) How much authority or influence do participants have? – from symbolic input to direct decision-making power

Applying the Democracy Cube to energy governance reveals major shortcomings in many countries, particularly in Southeast Asia. In Thailand, for example, participatory processes in energy policymaking frequently rely on public hearings that are symbolic, late-stage, information-heavy, and dominated by technical actors, providing minimal opportunities for meaningful public deliberation or influence (Vivatpinyo & Pharino, 2019). Climate governance scholarship argues that genuine participation not only enhances legitimacy but also improves policy effectiveness by integrating experiential knowledge, strengthening accountability, and aligning interventions with the lived realities of households and communities (Sovacool et al., 2017). In the context of residential EE, participatory mechanisms can facilitate co-design of retrofit programs, improve trust and uptake, and ensure that policies reflect differentiated needs, key concerns under recognition justice. Therefore, applying Democracy Cube provides a rigorous and systematic way to diagnose weaknesses in existing EE policy processes and to propose participatory pathways that advance both justice and climate resilience.

### **2.3 Comparative Energy Policy Design**

Comparative policy studies underscore the importance of policy mixes, combinations of regulatory, financial, informational, and participatory instruments, in determining the social and technical outcomes of residential energy efficiency programs (Howlett & Ramesh, 1995; IEA, 2023).

The experiences of Germany, Japan, and Singapore offer valuable lessons in how instrument design can advance social inclusion. Germany employs a comprehensive package integrating mandatory building efficiency codes, appliance standards, generous KfW loans and grants, and its Social Climate Fund, which targets low-income and elderly households (Odyssee-Mure, 2023). Japan's Top Runner Program, senior-focused outreach strategies, and municipal energy advisory programs illustrate how EE policy can be aligned with the needs of an aging society (Asuka & Jin, 2022). Singapore's public housing upgrades through its Home Improvement Programme (HIP) and targeted rebates demonstrate how state-led housing policy can embed energy efficiency into inclusive urban development (Housing & Development Board, 2024).

Across these countries, successful EE outcomes are strongly associated with the following:

- 1) Integrated regulatory and financial measures
- 2) Simplified access for vulnerable groups
- 3) Active community engagement and advisory systems
- 4) Continuous policy adaptation and monitoring

In contrast, Thailand's Energy Efficiency framework, dominated by voluntary codes and information campaigns, exhibits low participation rates among vulnerable groups due to limited financial accessibility, fragmented governance, and weak participatory channels (DEDE, 2024; EPPO, 2024). Comparative evidence, therefore, reveals a central insight: inclusive governance structures significantly shape both the technical performance and justice outcomes of EE policy.

## **2.4 Public Policy Theory: Multiple Streams Framework (MSF)**

To conceptualize the dynamics of policy change and the potential for integrating energy justice into the national agenda, this study employs Kingdon's Multiple Streams Framework (MSF). The MSF posits that significant policy shifts occur not through linear progression, but through the fortuitous coupling of three independent streams as problems, policies, and politics, which converge to open a "policy window" (Kingdon, 2011; Herweg et al., 2023). In the contemporary landscape of Thailand's residential Energy Efficiency (EE) sector, the convergence of these streams is increasingly evident:

**1) The Problem Stream:** The urgency is driven by a polycrisis of intensifying climate risks and socio-economic shifts. In 2024, Thailand experienced record-breaking heatwaves that underscored the lethal intersection of inadequate housing insulation and heat-related mortality among vulnerable groups (NESDC, 2024). This is compounded by persistent energy poverty, where fluctuating global fuel prices disproportionately burden low-income households, and a rapidly aging society that requires specialized residential thermal comfort (Asuka & Jin, 2022)

**2) The Policy Stream:** There is a growing inventory of proven alternatives. Internationally, the success of Germany's Social Climate Fund and Singapore's Green Manpower Plan provides robust evidence that equity-oriented EE programs are technically feasible (HDB, 2024). Domestically, the draft Energy Efficiency Plan 2024 (EEP2024) reflects an incipient recognition of smart technologies, yet a soft policy gap remains regarding how to democratize these tools through participatory governance.

**3) The Politics Stream:** The political climate is characterized by Thailand's heightened international commitments, including the target of Carbon Neutrality and Net Zero Emissions by 2050. The ongoing deliberation of the Thailand Climate Change Act (as of late 2024/2025) represents a significant "national mood" shift toward institutionalizing climate action (ONEP, 2024). There is increasing societal pressure on the government to ensure that the Green Transition does not exacerbate existing inequalities, thereby demanding a move toward welfare-centric energy reforms.

The MSF suggests that Thailand is currently situated within a critical policy window. However, as Kingdon notes, the opening of a window does not guarantee change; it requires policy entrepreneurs to bridge the gap between abstract justice principles and actionable governance structures. By advancing the justice-governance nexus framework, this study provides the necessary conceptual "coupling" to ensure that when this window opens, the resulting policy is not merely a technical adjustment but a socially legitimate and transformative instrument for climate resilience. Consequently, the MSF serves as a vital theoretical anchor, justifying the timeliness of this research and its practical utility in navigating the complex political economy of Thailand's energy transition.

Taken together, the bodies of literature on energy justice, participatory governance, and the Multiple Streams Framework (MSF) converge to reveal a fundamental insight: technical approaches alone are insufficient for transforming residential energy efficiency (EE) into an effective climate governance instrument in Thailand. Existing frameworks such as EEP2018 and the forthcoming EEP2024 remain grounded primarily in technology adoption, information campaigns, and voluntary standards, reflecting a policy logic centered on market readiness and administrative convenience rather than societal needs, distributive fairness, or democratic legitimacy (DEDE, 2024; EPPO, 2024).

By synthesizing these theoretical frameworks, this study argues that redesigning the Energy Efficiency Plan (EEP) must transition from a technocratic instrument to a justice-oriented governance structure where equity and participation serve as foundational pillars. Energy justice provides the normative imperative by revealing how current frameworks exacerbate inequities by neglecting the lived realities and differentiated vulnerabilities of low-income, elderly, and disabled populations; thus, reform must move beyond technical benchmarks to embrace distributive and recognition justice. To operationalize this, Fung's Democracy Cube offers a structural roadmap for transforming Thailand's currently passive participatory mechanisms, shifting from tokenistic public hearings toward deep deliberation and co-design processes that empower civil society and vulnerable households with genuine decision-making authority. Ultimately, the Multiple Streams Framework (MSF) confirms the strategic viability of this redesign, suggesting that the current convergence of intensifying climate-induced heat stress (problem stream), the availability of inclusive international models (policy stream), and Thailand's Net-Zero 2065 commitments (politics stream) has opened a critical policy window. Collectively, these perspectives suggest that embedding justice-governance principles into the EEP is no longer a theoretical preference but a timely and essential requirement for enhancing both the social legitimacy and the adaptive resilience of Thailand's climate policy.

### **3. Methods**

This study adopts a qualitative, multi-source analytical approach that integrates documentary analysis, comparative policy review, and conceptual framework synthesis. The methodology is designed to align with the study's objective: to develop a justice-governance nexus for redesigning Thailand's residential energy efficiency (EE) policy under climate change. The methodological choices reflect the nature of the research questions, which focus not on measuring quantitative impacts but on understanding governance structures, policy design logics, and justice implications across different national contexts.

#### **3.1 Research Design**

The research employs a three-stage analytical design:

Documentary and policy analysis of Thailand's existing EE frameworks, including relevant laws, administrative plans, and climate strategies.

Comparative case review of energy efficiency policies in Germany, Japan, and Singapore, focusing on their policy mixes, participatory mechanisms, and the treatment of vulnerable groups.

Conceptual integration using the analytical lenses of Energy Justice, the Democracy Cube, and the Multiple Streams Framework (MSF) to generate a transferable model for EE policy redesign.

This design is particularly suitable for the research aim because it enables the study to connect normative claims (justice), procedural claims (participation), and institutional feasibility (MSF) with empirical policy practices in multiple countries.

#### **3.2 Data Sources**

Policy and Institutional Documents as primary sources include national policy plans, legislative documents, ministerial reports, and official guidelines such as Thailand's Energy Efficiency Plan (EEP) 2018 and a draft of EEP2024, Climate Change Master Plan (ONEP), Germany's Social Climate Fund documentation, Japan's Top Runner policy and senior-

focused outreach programs, Singapore's HDB Home Improvement Program (HIP). These documents provide information on policy goals, program design, financing mechanisms, governance arrangements, and stated or implied equity and participation strategies.

Secondary Literature in academic journals, policy briefs, and comparative energy governance studies were systematically reviewed to triangulate interpretations of policy design and to contextualize case evidence. Key strands include energy justice (Jenkins et al., 2016), participatory climate governance (Fung, 2006), energy poverty and vulnerability (Sovacool et al., 2019), and policy mix theory (IEA, 2023).

Cross-National Data and Indicators from various international organization such as IEA, Odyssee-Mure, APERC, and national statistical agencies were used to benchmark policy emphasis, implementation patterns, and institutional configurations across the four countries.

### **3.3 Analytical Strategy**

Documentary Analysis followed the framework, emphasizing systematic coding, classification, and thematic extraction. Policy documents were coded according to treatment of vulnerable groups, participatory mechanisms, policy instruments (regulatory, financial, informational), institutional arrangements, and climate adaptation and mitigation elements. This coding enabled assessment of both explicit policy design and implicit governance assumptions embedded in the EEP frameworks.

Comparative Case Analysis focused comparison was conducted across the cases of Germany, Japan, Singapore, and Thailand. Each case was analyzed through four identical dimensions: Policy instrument mix, Governance and institutional architecture, Equity and vulnerability targeting, and Citizen participation mechanisms. This method (George & Bennett, 2005) allows cross-case learning by ensuring consistency and comparability while preserving contextual richness. The cross-case lessons were then mapped onto the emerging conceptual model to examine which elements of inclusive and justice-oriented governance are transferable to Thailand's institutional context.

### **3.4 Theory-Guided Integration: Bridging Energy Justice, Democracy Cube, MSF**

The final stage of analysis involved theory-guided integration across the three major frameworks:

Energy Justice provided evaluative criteria for identifying gaps in fairness, recognition, and distributional burdens in Thailand's EE policy.

Democracy Cube provided a structured tool for analyzing and redesigning participatory mechanisms across deliberative depth, inclusiveness, and decision authority.

Multiple Streams Framework (MSF) offered a way to explain the institutional feasibility and timing of reform by examining the convergence of climate risks (problem stream), availability of justice-oriented policy designs (policy stream), and increasing political commitment to climate governance (politics stream).

This integration produced the Justice-Governance Nexus Model, which serves as the conceptual foundation for redesigning Thailand's EEP framework.

### **3.5 Limitations**

The methodological approach is constrained by the availability of cross-national documents and the absence of primary fieldwork (e.g., interviews, focus groups) due to the nature of a conceptual paper. However, these limitations do not undermine the analytical aim of framework development, as the study focuses on constructing a theoretically grounded,

evidence-informed model rather than measuring program impacts. Future research may validate the model through empirical co-design workshops, household surveys, or participatory pilots.

#### **4. Results**

Building on the comparative evidence presented above, this section further elaborates the cross-case analytical results by examining how justice orientation, participatory governance, and institutional coordination jointly shape residential energy efficiency (EE) policy performance. The findings demonstrate that variations in EE outcomes across countries are not random but reflect distinct governance logics embedded in policy design and implementation structures.

The comparative analysis reveals that Germany, Japan, Singapore, and Thailand operate under fundamentally different governance logics when addressing residential EE. These logics influence not only policy instruments but also the distribution of benefits, participation patterns, and institutional effectiveness.

Table 1 presents a comparative synthesis of residential energy efficiency (EE) governance across Germany, Japan, Singapore, and Thailand, highlighting how differences in governance models, justice orientation, and participatory design shape policy uptake and equity outcomes. The comparison reveals that higher-performing systems systematically integrate distributive and recognition justice into core policy instruments, either through explicit vulnerability targeting, as in Germany and Japan, or through structural inclusion mechanisms, as in Singapore's public housing model. These justice-oriented designs are accompanied by more structured participatory arrangements, which, while varying in depth, provide greater opportunities for citizen engagement than Thailand's predominantly symbolic public hearings. In contrast, Thailand's technocratic and market-oriented governance model exhibits weak justice integration, minimal participatory influence, and correspondingly low uptake among vulnerable households. Overall, the table illustrates that justice-oriented governance and participatory design function as critical enabling conditions for effective residential EE policy implementation. Across the three higher-performing cases, a clear pattern emerges: policy effectiveness correlates strongly with the presence of justice-oriented design features. While these features vary in form, they consistently address unequal capacities, differentiated vulnerabilities, and barriers to participation. Distributive justice instruments play a critical role in Germany and Singapore. Targeted subsidies, retrofit grants, and affordability mechanisms reduce upfront costs and ensure that low-income households can participate in EE transitions. These instruments transform EE from a market-driven option into an accessible public good. In Thailand, the absence of comparable financial mechanisms effectively excludes households that lack capital or credit access, resulting in uneven benefit distribution. Recognition justice practices further distinguish high-performing systems. Japan's elderly-focused programs acknowledge age-related vulnerabilities, while Germany's income-based vulnerability mapping explicitly recognizes differential exposure to energy and climate risks. Singapore's automatic inclusion of lower-income households in HDB upgrades eliminates the need for self-identification or administrative navigation. Thailand's EE framework, by contrast, treats households as a homogeneous group, ignoring social, demographic, and spatial differences that shape energy needs and capacities. Taken together, the findings indicate that justice-oriented design is not merely a normative preference but a functional determinant of EE policy uptake and performance.

Table 1. Comparative Governance Logics and Justice Orientation in Residential Energy Efficiency Policies

Analytical Dimension	Germany	Japan	Singapore	Thailand
<i>Governance Logic</i>	Social protection–integrated efficiency governance	Demographically responsive efficiency governance	Housing-integrated efficiency governance	Technocratic, market-oriented efficiency governance
<i>Primary Policy Instruments</i>	Mandatory building codes; grants and soft loans (KfW); Social Climate Fund	Top Runner Program; municipal EE advisory services; senior-focused outreach	Public housing retrofits (HIP), targeted rebates, and mandatory standards in HDB flats	Appliance labeling; voluntary building codes; information campaigns
<i>Targeting of Vulnerable Groups</i>	Explicit income-based targeting (low-income, elderly households)	Age-based recognition (elderly households); municipal-level tailoring	Structural inclusion via public housing (low-income, disabled residents)	No explicit vulnerability targeting; households treated as homogeneous
<i>Distributive Justice</i>	Strong: transition costs are redistributed through subsidies and social funds	Moderate: indirect cost reduction through tailored programs	Strong: universal access within the public housing system	Weak: reliance on private investment and individual affordability
<i>Recognition Justice</i>	Moderate–strong: income and energy poverty mapping	Strong: policies recognize age-related and health vulnerabilities	Moderate: vulnerability addressed through housing status	Weak: limited recognition of socio-demographic differences
<i>Participatory Mechanisms</i>	Municipal consultations; energy advisory centers	Community intermediaries; local outreach via trusted actors	Resident committees; neighborhood-level consultations	Late-stage public hearings are dominated by technical experts
<i>Depth of Participation</i>	Deliberative consultation with advisory influence	Consultative and community-mediated engagement	Consultative participation embedded in housing governance	Minimal, symbolic participation
<i>Citizen Influence on Decisions</i>	Medium: feedback informs program design and implementation	Low–medium: influence mediated through local institutions	Low: participation supports acceptance rather than co-decision	Very low: limited influence on policy outcomes
<i>Policy Uptake and Effectiveness</i>	High uptake; strong equity outcomes	Moderate–high uptake among elderly households	High uptake due to automatic inclusion	Low uptake, especially among vulnerable groups
<i>Justice–Governance Alignment</i>	High alignment between justice principles and governance structures	Moderate–high alignment through recognition-based design	High structural alignment via housing integration	Low alignment; technocratic design weakens justice outcomes

The results further demonstrate that participation operates as a mediating mechanism between policy design and real-world outcomes. Countries with deeper and more structured participatory arrangements exhibit higher levels of program uptake, stronger public trust, and more sustained behavioral change. In Germany, municipal consultations and advisory bodies provide structured opportunities for citizen input, enabling local knowledge to inform implementation strategies. In Singapore, resident committees and neighborhood consultations normalize participation as part

of everyday governance, fostering compliance and collective ownership of EE upgrades. Japan relies on trusted community intermediaries such as local leaders and senior associations to reach elderly households in culturally appropriate ways.

Thailand's participatory mechanisms, in contrast, are largely confined to late-stage public hearings. These hearings are dominated by technical experts, lack deliberative depth, and offer minimal influence over policy decisions. Vulnerable and marginalized populations are rarely represented, and feedback mechanisms are weak or nonexistent. The result is low social acceptance, limited behavioral change, and weak household-level adoption of EE measures. This cross-case evidence confirms that participation is not simply a democratic ideal but a practical governance tool that enhances policy effectiveness.

Synthesizing these findings, the results suggest that residential EE policy performance is best explained by the interaction of justice orientation, participatory governance, and institutional integration. Countries that align these dimensions achieve more equitable distribution of benefits, higher policy uptake, and stronger climate co-benefits. Thailand's comparatively weaker performance reflects predictable outcomes of a governance model that excludes these dimensions. These results provide empirical grounding for the proposed Justice–Governance Nexus, which explains why technocratic EE approaches underperform in socially and climatically vulnerable contexts and underscores the necessity of governance reform in Thailand's residential EE framework.

## **5. Discussion**

The findings of this study demonstrate that Thailand's residential energy efficiency (EE) governance is constrained not primarily by technical limitations but by systemic governance gaps related to justice, participation, and institutional coordination. This section synthesizes these findings into a broader theoretical and policy discussion, drawing on Energy Justice, the Democracy Cube, and the Multiple Streams Framework (MSF). The discussion highlights (1) why Thailand's current EE structure underperforms, (2) how the comparative cases illuminate alternative governance pathways, and (3) why the present moment represents a critical policy window for reform.

The analysis reveals a fundamental mismatch between Thailand's climate risks and its existing EE governance model. The dominant approach, centered on voluntary labels, awareness campaigns, and incremental standards, does not address underlying vulnerabilities or structural inequities. Unlike Germany, Japan, and Singapore, Thailand does not incorporate distributive, procedural, or recognition justice into policy design. As a result, financial barriers restrict access to EE technologies among low-income households. Elderly residents are highly vulnerable to heat-related health risks and receive limited support. Procedural mechanisms do not meaningfully capture the experiences of marginalized groups. This blind spot explains why EE adoption remains concentrated among middle and high-income households, contrary to the aims of equitable climate governance.

Thailand's reliance on public hearings, typically expert-dominated and held late in the policy cycle, fails to support procedural justice or co-production. In contrast, Singapore's resident committees, Germany's advisory bodies, and Japan's community intermediaries demonstrate that effective participation requires structured and context-sensitive governance spaces. The deficit in participation undermines legitimacy, limits feedback loops, and constrains behavioral change, key components of household-level EE transitions.

While Germany, Japan, and Singapore differ in context, their models provide actionable insights for Thailand. Germany illustrates how EE becomes equitable and politically resilient when linked to social protection tools (e.g., Social Climate Fund). Thailand can draw from this model to craft vulnerability-indexed financial support. Japan offers a blueprint for recognition justice, particularly for aging populations. Thailand's nearly identical demographic trajectory makes this lesson directly applicable. Singapore demonstrates the value of embedding EE into housing policy. Thailand's lack of integration between housing and EE institutions represents a structural barrier that must be addressed. These findings show that Thailand does not lack feasible models; rather, it lacks the governance arrangements needed to embed such principles into national policy structures.

This study contributes to the scholarship on energy policy and climate governance by demonstrating that Technocratic EE policies are insufficient for equitable climate transitions. Justice and participation are not optional; they are structural determinants of policy outcomes. Comparative insights provide practical pathways for institutional reform. Thailand is in a unique moment where reform is not only necessary but politically feasible. In sum, the discussion emphasizes that a justice-based, participatory, and institutionally coherent EEP framework is both timely and transformative with the potential to reshape Thailand's climate governance trajectory.

## **6. Conclusion**

This study examined how Thailand can redesign its residential energy efficiency (EE) policy framework under climate change by integrating principles of energy justice, participatory governance, and institutional coherence. Through a comparative analysis of Germany, Japan, Singapore, and Thailand, supported by a synthesis of Energy Justice, Fung's Democracy Cube, and the Multiple Streams Framework (MSF), the study demonstrates that the primary barriers to Thailand's EE progress are not technical but governance-related.

The findings reveal that countries with more effective EE outcomes systematically embed distributive, procedural, and recognition justice, combined with structured and empowered forms of participation and strong multi-level coordination. These elements present in differing forms across Germany's social protection architecture, Japan's demographic tailoring, and Singapore's housing-integrated model create policy systems that are inclusive, responsive, and equitable. In contrast, Thailand's technocratic, top-down EE regime lacks explicit vulnerability targeting, meaningful citizen participation, and integrated delivery structures, resulting in low uptake and weak alignment with the needs of climate-vulnerable populations.

The study introduces the Justice–Governance Nexus Framework as a conceptual foundation for redesigning Thailand's EEP. This framework situates EE not only as a mitigation tool but also as a climate adaptation and social protection mechanism, particularly for low-income households, older persons, renters, and other underserved groups. By bridging justice principles with participatory governance and leveraging the current MSF policy window shaped by intensifying climate risks, demographic shifts, and national climate commitments Thailand has a unique opportunity to pursue transformative EE reform.

Ultimately, this research argues that building a more inclusive, equitable, and participatory residential EE policy is both necessary and feasible. Doing so would enhance policy legitimacy, improve household uptake, reduce energy poverty, strengthen climate resilience, and align Thailand's energy governance with global best practices. The next generation of the EEP framework must therefore move beyond technical efficiency to embrace justice-driven

and citizen-centered governance, ensuring that Thailand's pathway toward carbon neutrality and net-zero emissions is both sustainable and socially just.

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