CHAPTER 23

Systematic Literature of Factors Influencing Household Electricity Demand in Thailand

Tanakorn Panaput and Thanwadee Chinda***

ABSTRACT

This study examines the determinants of household electricity demand in Thailand using a Systematic Literature Review (SLR) combined with frequency-based factor analysis. Following PRISMA-guided screening procedures, relevant peer-reviewed journal articles were systematically identified, filtered, and analyzed using predefined inclusion and exclusion criteria. Across the selected studies, a total of 478 cumulative factor occurrences were identified, reflecting repeated recognition of key drivers across multiple sources. A structured factor-extraction, classification, and frequency-analysis process was applied to quantify the relative prominence of determinants across the literature. Based on frequency thresholds and statistical confidence filtering, an 80% confidence level was used to identify the five most influential determinants for model development, namely Weather, Population, Electricity Prices, Gross Domestic Product (GDP), and Appliance Type. These dominant factors represent the core structural, climatic, economic, and technological drivers shaping the rising trajectory of household electricity demand in Thailand. The findings provide a systematic, evidence-based foundation for developing quantitative demand forecasting models and system dynamics frameworks, enabling more robust long-term demand projections and policy-oriented energy planning for Thailand's residential electricity sector.

Keywords: Systematic literature review; Frequency analysis; Household electricity demand; Energy demand drivers.

1.0 Introduction

Global electricity demand has been growing at an unprecedented pace in recent years, driven by rapid economic development, population growth, rising living standards, and the accelerating electrification of key sectors, including buildings, industry, and transport. According to assessments by the International Energy Agency (IEA), global electricity consumption expanded by over 4% in 2024, well above the decadal average,

**Corresponding author; PhD Student, School of Management Technology, Sirindhorn International Institute of Technology, Pathum Thani, Thailand (E-mail: tanakorn.p@kkumail.com)*
***Associate Professor, School of Management Technology, Sirindhorn International Institute of Technology, Pathum Thani, Thailand (E-mail: thanwadee@siit.tu.ac.th)*

highlighting persistent structural demand growth and the increasing societal reliance on electrified services such as cooling, household appliances, and digital technologies. The residential sector, in particular, accounts for a substantial share of total global electricity use. Previous studies estimate that households contribute approximately one quarter of overall electricity consumption worldwide, and this share is projected to increase further as income levels rise and climate-driven cooling demand intensifies. These trends position the residential sector as a critical component of future electricity demand growth [1].

In Thailand, similar patterns of increasing electricity demand are evident. National energy assessments report continued growth in residential electricity consumption, driven by factors such as expanding household connections, rising appliance ownership, and ongoing changes in lifestyle and urbanisation. These dynamics reflect broader socio-economic transitions that are reshaping household energy use patterns across the country [2]. The residential sector's growing share of national electricity consumption has important implications for energy planning, grid reliability, and sustainability policy, underscoring the need for a deeper understanding of the underlying determinants shaping household demand. Previous empirical studies in Thailand have examined individual influences on residential electricity consumption, including housing characteristics, socio-economic conditions, and appliance usage behaviours, illustrating the complex and multifaceted nature of household energy demand [3].

Despite this growing body of research, the existing literature remains fragmented, with limited consensus on the relative importance of different drivers and a lack of comprehensive synthesis across studies. To address this gap, this study employs a Systematic Literature Review (SLR) to identify and systematically categorise the determinants of household electricity demand reported in empirical research. By integrating a structured frequency-based analysis, the prominence of each factor across studies is quantified, enabling robust factor prioritisation for subsequent modelling. This approach supports a clearer understanding of the interacting influences on residential electricity demand and provides a strong empirical foundation for evidence-based model development.

2.0 Literature Review

Understanding the determinants of household electricity demand has become a central research focus due to the sustained growth of residential electricity consumption worldwide and its implications for energy systems, sustainability transitions, and policy design. Recent studies consistently demonstrate that household electricity demand is shaped by complex interactions among climatic, socio-economic, demographic, technological, and behavioural factors across diverse geographic and socio-economic contexts. Climatic drivers, particularly temperature-related variables, are among the most consistently reported

determinants of residential electricity consumption. Yang and Wu (2025) show that temperature deviations and cooling degree days significantly increase household electricity use through intensified air-conditioning demand, highlighting the growing role of climate change in shaping residential load patterns [4]. Similarly, empirical evidence from China confirms a strong positive relationship between rising temperatures and electricity consumption, with projections indicating substantial long-term increases in residential demand under continued warming trends. These findings collectively indicate that climate-induced thermal stress is becoming a structural driver of residential electricity demand [5].

Beyond climatic influences, socio-economic and technological factors play a dominant role in shaping household electricity demand. Income growth, appliance ownership, household size, and urbanisation are repeatedly identified as critical predictors across empirical studies. Decomposition analyses in China demonstrate that income growth and appliance proliferation are principal drivers of urban residential electricity consumption, while behavioural factors, such as energy-saving awareness and willingness, can moderate consumption patterns [6]. Similarly, research in Tanzania shows that income, household characteristics (e.g., dwelling attributes and household size), and appliance characteristics are dominant determinants in residential load forecasting models, reinforcing the need for a multi-factor analytical framework [7]. Studies in Indonesia further illustrate the combined influence of socio-economic and climatic variables on residential electricity demand, highlighting the interaction between environmental conditions and economic development [8].

In Southeast Asia, and particularly in Thailand, empirical studies confirm comparable demand structures. Survey-based studies in Northern Thailand indicate that income elasticity, cooling degree days, and equipment-related factors, especially the number of air conditioners, significantly influence household electricity consumption [9]. Historical assessments of Thailand's residential energy sector further demonstrate that long-term consumption patterns are shaped by economic, social, and geographic factors, with residential electricity demand growing faster than the national average energy demand [10]. Additional studies focusing on appliance characteristics also reveal strong associations between appliance composition and household electricity expenditure [11]. While these Thailand-specific studies provide valuable empirical insights, the literature remains largely fragmented, typically focusing on isolated determinants within single empirical settings rather than offering an integrated synthesis across studies.

To address fragmentation in empirical findings, systematic synthesis methods have gained increasing importance. Systematic Literature Reviews (SLRs) have been widely adopted to structure, classify, and integrate evidence on residential electricity demand determinants. Recent SLR studies in South, East, and Southeast Asia identify a wide range of influencing factors spanning socio-economic, climatic, dwelling, and appliance domains,

and apply structured classification and frequency-based criteria to categorise dominant drivers [12]. This work demonstrates the value of structured review frameworks, such as PRISMA-guided methodologies, in aggregating heterogeneous empirical evidence into coherent analytical structures.

In the broader electricity demand and forecasting literature, SLRs and review studies have also been applied to evaluate model inputs and methodological practices. These reviews consistently highlight the dominance of weather variables, historical demand patterns, and socio-economic indicators as key predictors and emphasize the importance of systematic variable selection for model performance [13]. Related reviews further categorize influencing factors based on modelling objectives, data structures, and methodological approaches, reaffirming the central role of climatic, economic, and behavioural determinants in residential demand modelling [14]. Methodological synthesis studies also stress the importance of structured factor classification and rigorous empirical integration to disentangle the relative effects of diverse determinants on electricity consumption patterns [15].

Despite the extensive empirical and review-based literature, a clear gap remains in the systematic synthesis and quantitative prioritization of determinants specific to the Thai context. Most existing studies focus on individual drivers or isolated case studies, limiting comparability and model generalizability. Incorporating frequency analysis, which quantifies the recurrence of reported factors across studies, provides a robust quantitative basis for prioritizing determinants in subsequent modelling. This motivates the present study's adoption of a PRISMA-guided Systematic Literature Review combined with structured frequency analysis to identify, quantify, and prioritize the most influential factors shaping household electricity demand in Thailand. By systematically synthesizing global, regional, and national evidence, this approach establishes a structured empirical foundation for factor selection in demand modelling, policy analysis, and system dynamics–based simulation frameworks.

3.0 Research Methodology

This study adopts a Systematic Literature Review (SLR) methodology combined with a frequency-based factor analysis to identify, classify, and synthesize the determinants of household electricity demand in Thailand. The SLR approach ensures transparency, reproducibility, and methodological rigour, while the frequency-based analysis enables the quantitative identification of dominant influencing factors across the literature. The review protocol follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, which guides the structured processes of identification, screening, eligibility assessment, and final inclusion [12].

The bibliographic search was conducted in the Scopus database, chosen for its comprehensive coverage of high-quality peer-reviewed journals and conference proceedings in energy systems, sustainability, and engineering research. The search focused exclusively on academic journal articles, with priority given to recent publications to ensure contemporary relevance. A structured keyword strategy was applied using combinations of the terms “electricity demand”, “prediction”, “forecasting”, “factor”, “influencing”, and “affect”, together with context-specific terms such as “household” and “residential”. Boolean operators and database filters were employed to refine search results and enhance relevance. Inclusion and exclusion criteria were defined a priori to ensure consistency and objectivity in study selection. Studies were included if they empirically analyzed influencing factors of household or residential electricity demand, were peer-reviewed journal articles, and provided quantitative or qualitative evidence of factor demand relationships. Studies were excluded if they focused exclusively on industrial or commercial electricity demand, lacked empirical analysis of influencing factors, or consisted of review articles, editorials, or non-peer-reviewed sources.

The screening process followed PRISMA procedures, including duplicate removal, title and abstract screening, and full-text eligibility assessment. Each stage was conducted systematically to ensure that only relevant and high-quality studies were retained for analysis. From the final corpus of selected studies, all reported influencing variables were systematically extracted. These variables were then standardized, coded, and classified into coherent factor categories based on conceptual similarity and theoretical relevance. This process enabled consistent cross-study comparison, aggregation, and structured synthesis.

A frequency analysis was subsequently applied to quantify the occurrence of each factor across the reviewed studies. This method measures how often a specific determinant is reported in the literature, thereby identifying dominant and recurrent drivers of household electricity demand. Frequency-based synthesis has been widely adopted in recent SLR-based energy studies as a robust approach for factor prioritization and variable selection in modeling frameworks [13].

A confidence-based filtering approach was applied. An 80% confidence threshold was used to prioritize the most influential factors based on their frequency distribution across studies [16]. This step enables dimensionality reduction while preserving the most structurally significant determinants for subsequent quantitative modelling and simulation.

This integrated methodology, combining PRISMA-guided SLR, systematic factor extraction, frequency analysis, and confidence-based prioritization, provides a rigorous and evidence-based framework for identifying the dominant drivers of household electricity demand in Thailand. The approach establishes a structured foundation for future demand forecasting, system dynamics modelling, and policy-oriented energy planning, ensuring that model inputs are empirically grounded and strongly supported by the literature.

4.0 Data Analysis

Following the Systematic Literature Review process, all selected studies were subjected to a structured data extraction and coding procedure. For each article, relevant information was systematically recorded, including publication year, study location, research methodology, data sources, analytical approaches, and identified influencing variables related to household electricity demand. All extracted variables were standardised through semantic normalisation to avoid duplication caused by terminological differences across studies (e.g., "income level" and "household income" were coded as a single factor: income). This process ensured conceptual consistency and analytical coherence across the dataset. Following the coding and normalization process, a total of 13 analytical codes were systematically identified from the selected studies. These codes represent recurrent variables influencing household electricity demand in Thailand and were derived through semantic normalization and cross-study comparison. Each code reflects a unique conceptual dimension of electricity consumption behaviour and demand dynamics within the residential sector.

A frequency-based analysis was applied to quantify the relative prominence of each code across the selected studies. Each occurrence of a code within a study was counted as one analytical unit. If multiple variables representing the same code appeared in a single study, each instance was recorded independently to reflect its analytical relevance. This approach enabled qualitative literature evidence into structured, semi-quantitative indicators. In summary, the structured coding and frequency-based analytical framework enabled the systematic transformation of qualitative literature evidence into a consistent, semi-quantitative dataset. Through semantic normalization and cross-study synthesis, thirteen analytically robust codes were identified, representing the multidimensional drivers of household electricity demand in Thailand. The application of frequency analysis provided an objective basis for factor prioritization and hierarchical structuring, allowing dominant influence patterns to be empirically distinguished from secondary drivers. This analytical process establishes a rigorous foundation for subsequent result interpretation, factor reduction, and structural modelling, ensuring methodological transparency, analytical consistency, and reproducibility of findings.

5.0 Results Analysis

The frequency analysis of the extracted literature produced a total of 13 analytical codes, representing the multidimensional drivers of household electricity demand in Thailand. According to the selected studies, 478 cumulative node occurrences were identified. Table 1 presents the ranked frequency distribution of the identified factors,

together with their cumulative frequencies and cumulative percentage contributions. The results reveal a highly skewed distribution, in which a small subset of factors contributes disproportionately to the overall influence structure. This dominant pattern is characteristic of complex socio-energy systems, where a limited number of drivers typically shape the majority of system dynamics. To identify structurally dominant determinants, a cumulative contribution threshold of 80% was applied as a confidence-level criterion. Based on the cumulative percentage analysis, the first seven codes reached a cumulative contribution of 81.17%, thereby qualifying as the major influencing factors in the household electricity demand system. These seven factors, presented in Table 2, represent the core structural drivers of household electricity demand in Thailand and together capture the dominant explanatory capacity of the literature corpus.

Table 1: Frequency Distribution and Cumulative Contribution of Influencing Factors on Household Electricity Demand in Thailand

Codes	Nodes	Cumulative	% Cumulative
Weather	124	25.94%	25.94%
Population	64	13.39%	39.33%
Electricity Prices	49	10.25%	49.58%
GDP	46	9.62%	59.21%
Appliances Type	43	9.00%	68.20%
Electricity Tariff	32	6.69%	74.90%
Urbanization Rate	30	6.28%	81.17%
Day Types	23	4.81%	85.98%
Subsidies, Taxes	23	4.81%	90.79%
Habits	15	3.14%	93.93%
Number of Households	14	2.93%	96.86%
Family Size	11	2.30%	99.16%
Load Types	4	0.84%	100.00%
	478	100%	

To further refine the dominance structure, a second-stage cumulative contribution analysis was applied to the seven major factors using the same 80% confidence-level threshold. This hierarchical filtering process enables the identification of the most structurally influential drivers within the dominant group.

The cumulative contribution indicates that the first five factors within the major group surpass the 80% threshold, thereby qualifying as the top influencing factors in the household electricity demand system. These are Weather, Population, Electricity Prices, GDP, and Appliance Types. Together, these variables form the core structural backbone of

residential electricity demand dynamics in Thailand. They represent the primary determinants governing baseline demand growth, long-term consumption trajectories, and systemic demand elasticity within the residential sector.

Table 2: Identification of Major Influencing Factors Based on 80% Cumulative Contribution Threshold

Codes	Nodes	Cumulative	% Cumulative
Weather	124	31.96%	31.96%
Population	64	16.49%	48.45%
Electricity Prices	49	12.63%	61.08%
GDP	46	11.86%	72.94%
Appliances Type	43	11.08%	84.02%
Electricity Tariff	32	8.25%	92.27%
Urbanization Rate	30	7.73%	100.00%
	388	100%	

6.0 Conclusion

This study systematically synthesized the existing literature on household electricity demand in Thailand using a PRISMA-guided Systematic Literature Review combined with frequency-based factor analysis. Through structured coding and cumulative contribution assessment, a total of 13 influencing factors were identified and hierarchically organized using an 80% confidence-level threshold approach.

The results reveal a multi-layered dominance structure. At the first level, seven major factors weather, population, electricity prices, GDP, appliance types, electricity tariff, and urbanization rate collectively account for over 80% of cumulative influence, establishing them as the principal drivers of residential electricity demand. A second-stage filtering process further isolates five core influencing factors, weather, population, electricity prices, GDP, and appliance types, as the fundamental structural determinants shaping baseline demand growth and long-term consumption dynamics in Thailand.

These findings indicate that household electricity demand in Thailand is governed by an integrated climate demography economy technology nexus, in which climatic conditions, demographic expansion, economic development, price signals, and technological diffusion interact to generate complex and nonlinear demand dynamics. Policy and regulatory variables operate primarily as moderating mechanisms, while behavioural and temporal factors function as secondary modulators that influence short-term variability rather than long-term structural trends. This study contributes to the literature by providing a systematically derived, evidence-based hierarchical framework of

demand drivers, offering both conceptual clarity and analytical structure. Methodologically, it advances the use of confidence-level cumulative filtering as a robust and transparent mechanism for identifying dominant factors in complex socio-energy systems.

From an applied perspective, the results provide a strong empirical foundation for electricity demand forecasting, system dynamics modelling, and energy policy design in Thailand. The identification of core drivers enables model simplification without loss of explanatory power, while the hierarchical structure supports targeted policy interventions that align short-term regulatory actions with long-term structural transformation strategies.

7.0 Recommendations

Future research should extend this framework through empirical validation using national-scale datasets and smart-meter data, combined with dynamic simulation modelling and scenario-based policy analysis. This integrated approach would enable a deeper understanding of feedback mechanisms, structural interactions, and long-term transition pathways within Thailand's residential energy system.

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