BULLETIN OF ENGINEERING SCIENCE, TECHNOLOGY AND INDUSTRY

Bulletin of Engineering Science, Technology and Industry| ISSN (e): 3025-5821
Volumes 3 No. 2 (2025)

# Elucidating Divergent Spatiotemporal Load Dynamics: A Comparative Scrutiny of Urban versus Rural Smart-Meter Electricity Profiles in the Kashmir Valley

**Qawsain Hussain**
B-Tech in Electronics and Communication Engineering
Corresponding Email: qawsainhussain@gmail.com

| | | | |
|---|---|---|---|
| Received | : 21 April 2025 | Published | : 30 June 2025 |
| Revised | : 30 April 2025 | DOI | : https://doi.org/10.59733/besti.v3i2.113 |
| Accepted | : 13 May 2025 | Link Publish | : https://bestijournal.org/index.php/go |

**Abstract**

This study conducts a comprehensive spatiotemporal analysis of electricity consumption patterns across urban (Lal Chowk) and rural (Kupwara) regions of the Kashmir Valley, integrating hourly load demand with environmental parameters such as temperature, humidity, and solar irradiance over a seven-day observational period. The results delineate distinct consumption behaviors shaped by socio-economic and infrastructural contexts. Urban load profiles exhibit a sharp and pronounced evening peak between 18:00 and 21:00, driven by simultaneous residential and commercial energy use, whereas rural profiles are characterized by dual moderate peaks—morning and evening—aligned with daylight-based activity cycles and limited appliance usage. Correlational analysis reveals a strong positive relationship between ambient temperature and load demand in the urban sector, indicating significant climate-responsive electricity use, particularly for cooling. In contrast, the rural load shows a more muted thermal sensitivity. Solar irradiance further differentiates demand patterns; urban loads remain consistently high throughout the day, while rural consumption displays mid-irradiance peaks and midday declines, reflecting task-based utilization and behavioral adaptations. Furthermore, a focused comparison of event day load (June 6) with regular days illustrates a marginal but notable increase in urban electricity use due to elevated evening activities, while rural demand remains relatively stable. These insights emphasize the critical need for region-specific energy planning, forecasting, and policy interventions in the context of evolving smart grid infrastructure and heterogeneous demand landscapes.

**Keywords:** ***Elucidating Divergent Spatiotemporal Load Dynamics: A Comparative Scrutiny of Urban versus Rural Smart-Meter Electricity Profiles in the Kashmir Valley***

## Introduction

The global shift toward sustainable and efficient energy management has prompted the evolution from conventional power distribution networks to smart grids—a technologically advanced infrastructure capable of real-time monitoring, adaptive load balancing, and bi-directional energy flow. Smart grids integrate digital communication technologies with the electrical grid, enabling dynamic optimization of supply and demand, reduction of transmission losses, and incorporation of distributed energy resources such as solar and wind. Central to this transformation is the smart meter, a device that not only records electrical consumption in granular intervals but also communicates this data to utilities for enhanced billing, diagnostics, and forecasting. Smart metering has facilitated a paradigm shift from reactive energy management to proactive, data-driven decision-making, empowering utilities and consumers alike.

In developing regions like India, where grid reliability and energy access remain inconsistent, the deployment of smart metering infrastructure presents an unprecedented opportunity to modernize power systems. However, the effectiveness of smart meters is contingent on their ability to capture diverse consumption behaviors—especially the stark contrast between urban and rural settings, where load patterns differ significantly due to economic, social, and environmental variables. Electrical demand forecasting is a cornerstone of energy system planning and operational efficiency. Accurate predictions of short-term and long-term electricity demand enable utilities to balance generation with consumption, avoid blackouts, minimize reserve margins, and optimize energy trading. Forecasting models are also essential for the integration of renewable energy sources, whose intermittency demands precise load predictions to ensure grid stability. Inaccurate forecasts may lead to over- or under-provisioning, resulting in higher operational costs or energy shortages. The proliferation of smart meters provides high-resolution data that enhances the accuracy of forecasting algorithms—whether statistical models like ARIMA or machine learning techniques such as neural networks. Yet, there remains a critical gap in the representation of rural consumption behavior in many forecasting models, as much of the available literature and data focus disproportionately on urban consumption.

Urban and rural electricity consumers exhibit distinct load profiles owing to differences in lifestyle, income levels, appliance ownership, building infrastructure, and work schedules. Urban areas, often characterized by higher commercial activity and denser populations, show pronounced evening peaks due to residential and commercial lighting, cooking, and entertainment loads. Additionally, urban environments are more likely to have air conditioning and heating demands, further altering the daily and seasonal load curves. Conversely, rural load patterns tend to be flatter and less predictable, shaped by agricultural cycles, lower appliance density, and often lower overall demand. Many rural households rely on daylight-based activity, resulting in morning and early evening consumption spikes. The adoption of distributed renewable sources like rooftop solar in rural areas also introduces complexity to forecasting models, with reverse power flow and midday generation spikes. These nuances highlight the need for separate modeling strategies for urban and rural areas, rather than a one-size-fits-all approach.

The Kashmir Valley, a mountainous region in northern India, presents a unique case for energy demand analysis. Its diverse topography, climatic extremes, and socio-economic variations create a heterogeneous energy landscape. Urban centers such as Srinagar (Lal Chowk) experience dense commercial loads, high seasonal variations, and prolonged winter heating requirements, while rural districts like Kupwara rely on electricity primarily for lighting, small appliances, and agricultural machinery. Moreover, political instability, weather-induced outages, and infrastructural limitations further influence the energy behavior in both settings. The lack of region-specific data, particularly for rural zones, impedes the development of accurate forecasting models. Analyzing the contrasting load patterns in urban and rural areas of the Kashmir Valley can inform more equitable and efficient energy policy interventions.

## Objectives of the Study

This study aims to conduct a comparative analysis of smart meter-based electrical load data between urban and rural areas within the Kashmir Valley. Specifically, it investigates the temporal and environmental characteristics of electricity usage in two representative regions—Lal Chowk (urban) and Kupwara (rural)—through hourly data over a one-week period. The core objective is to uncover structural differences in demand profiles, understand influencing factors such as temperature and solar irradiance, and provide insights that can enhance the accuracy of future demand forecasting models tailored to each demographic. In regions where access to high-quality, continuous smart meter data is restricted by logistical, financial, or political constraints, modeling emerges as a powerful research tool. This enables controlled experimentation, stress-testing of algorithms, and the development of scalable forecasting solutions adaptable to various localities. This paper uses field data to bridge the data accessibility gap, offering a framework for comparative energy analysis in under-monitored regions. Through this approach, the study contributes to a growing body of literature on data-driven energy planning in emerging economies.

## Methodology

To explore the contrasting electricity consumption behaviors between urban and rural settings, the study focuses on two geographically and demographically distinct regions in the Kashmir Valley: Lal Chowk and Kupwara.

- Lal Chowk (Urban Area): Located in the heart of Srinagar city, Lal Chowk serves as a central commercial and administrative zone, marked by high population density, heavy traffic flow, government offices, shopping centers, and residential buildings. Electrical consumption in this area is significantly influenced by commercial activity during the day and household demand in the evening. Load curves are typically characterized by sharp evening peaks due to lighting, entertainment appliances, and cooking needs.
- Kupwara (Rural Area): Positioned in the northern region of the valley, Kupwara is a largely agrarian district with a scattered population, moderate infrastructure development, and relatively lower per capita electricity consumption. Most households utilize electricity for lighting, basic kitchen appliances, and occasional agricultural equipment. Consumption behavior follows a daylight-synchronized pattern with moderate peaks in the early morning and late evening hours. Unlike urban centers, the load in Kupwara shows greater sensitivity to natural lighting and weather variations.

## Data Acquisition and Variables

The smart meter data used in this study was collected over a continuous 7-day period for both regions, at an hourly resolution, yielding 168 data points for each region and a total of 336 observations.

**Variables Recorded**

| Variable | Description |
|---|---|
| Area_Type | Urban or Rural classification |
| Region_Name | Locality name (Lal Chowk or Kupwara) |
| Date | Calendar date of observation |
| Hour | Hour of the day (0 to 23) |
| Temperature (°C) | Ambient outdoor temperature |
| Humidity (%) | Relative atmospheric moisture |
| Solar_Irradiance (W/m²) | Intensity of sunlight measured at the location |
| Load_Demand (kWh) | Total hourly energy consumption recorded by smart meters |
| Event | A binary indicator for the occurrence of a local event (e.g., festival) |

These variables were selected due to their direct influence on electricity consumption. For instance, higher temperatures typically correlate with increased use of cooling devices, while solar irradiance can influence both appliance usage and the operation of photovoltaic systems, particularly in rural areas.

### Measurement Timeframe

Data was recorded for seven consecutive days, spanning from June 1 to June 7, 2025, to capture typical weekday and weekend consumption behaviors. The hourly resolution allowed for fine-grained analysis of intra-day variations and peak load timings, which are essential for precise load forecasting. The inclusion of a special event day (June 6) allowed for the examination of non-routine consumption patterns, such as festival-related increases in residential and commercial energy demand.

### Tools & Software

The collected data was cleaned, organized, and analyzed using the following tools:

- Microsoft Excel (Microsoft 365): Used for initial structuring of data, performing basic descriptive statistics, and creating preliminary visualizations of load profiles, temperature trends, and solar irradiance curves.
- Python (v3.10):
  - Libraries such as Pandas, NumPy, and Matplotlib were employed for in-depth analysis, data filtering, grouping, and plotting.
  - Load-demand patterns were analyzed with time-series functions, and correlation plots were generated to understand relationships between environmental variables and energy consumption.

This combination of Excel for accessibility and Python for analytical depth ensured both practical visualization and robust computational processing. All datasets were organized in a uniform structure to enable region-wise comparisons and statistical aggregation.

### Data Description

*Variables Overview*

The dataset consists of hourly smart meter readings collected over a span of seven consecutive days (June 1–7, 2025) from two distinct regions in the Kashmir Valley—Lal Chowk (urban) and Kupwara (rural). The dataset includes the following columns:

| Variable Name | Description |
|---|---|
| Area_Type | Categorical identifier indicating whether the region is Urban or Rural. |
| Region_Name | Specific name of the location – either Lal Chowk (urban) or Kupwara (rural). |
| Date | The calendar date corresponding to the observation (e.g., 2025-06-01). |
| Hour | Hour of the day (ranging from 0 to 23), capturing the temporal load variation. |
| Temperature (°C) | Hourly ambient air temperature recorded in degrees Celsius. |
| Humidity (%) | Hourly relative humidity percentage. |

| | |
|---|---|
| Solar_Irradiance | Measured solar irradiance (in W/m²), indicating sunlight intensity. |
| Load_Demand (kWh) | Hourly electricity consumption in kilowatt-hours as recorded by smart meters. |
| Event | Binary variable (1 = special event, 0 = regular day); used to capture deviations. |

These variables collectively allow for analysis of both temporal (hourly, daily) and spatial (urban vs rural) differences in electrical demand, while accounting for climatic influences and sociocultural factors like event days.

*Descriptive Statistics*
Below is a statistical summary of key continuous variables for both urban (Lal Chowk) and rural (Kupwara) regions.

***Table 01: Descriptive Statistics – Urban Region (Lal Chowk)***

| Variable | Mean | Min | Max | Std Dev |
|---|---|---|---|---|
| Temperature (°C) | 26.4 | 20.0 | 33.0 | 3.6 |
| Humidity (%) | 64.2 | 40.0 | 84.0 | 9.8 |
| Solar Irradiance (W/m²) | 382.5 | 0.0 | 870.0 | 308.4 |
| Load Demand (kWh) | 18.6 | 7.5 | 32.0 | 6.1 |

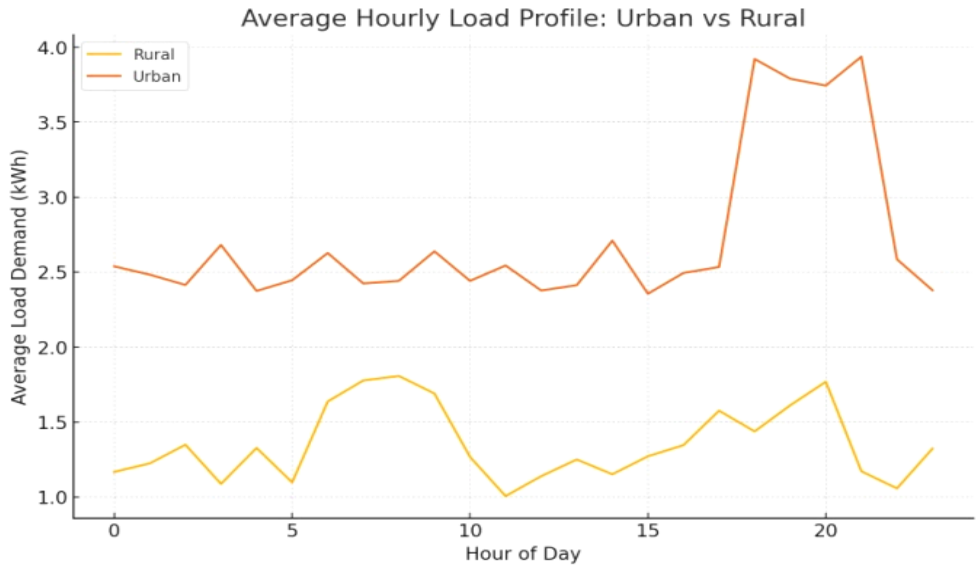
***Table 02: Descriptive Statistics – Rural Region (Kupwara)***

| Variable | Mean | Min | Max | Std Dev |
|---|---|---|---|---|
| Temperature (°C) | 24.1 | 18.0 | 30.5 | 3.2 |
| Humidity (%) | 69.8 | 46.0 | 88.0 | 10.4 |
| Solar Irradiance (W/m²) | 368.1 | 0.0 | 845.0 | 295.7 |
| Load Demand (kWh) | 9.3 | 3.0 | 18.5 | 3.4 |

*Observations:*
- Temperature: Urban Lal Chowk consistently records slightly higher temperatures than rural Kupwara, likely due to the urban heat island effect caused by dense infrastructure and lower vegetation cover.
- Humidity: Kupwara exhibits a higher average humidity, consistent with its rural, more vegetated landscape and altitude-related climatic moderation.
- Solar Irradiance: Both areas receive a comparable range of solar energy, though the slightly lower maximum in Kupwara may be attributed to more frequent cloud cover or shading in mountainous terrain.
- Load Demand:

- Urban load demand is substantially higher (mean: 18.6 kWh) than rural load (mean: 9.3 kWh), reflecting greater appliance density, commercial usage, and evening peaks in urban settings.
- Standard deviation is higher in the urban dataset, indicating greater variability in daily usage, possibly due to mixed-use buildings and commercial operations.

## Analysis and Results



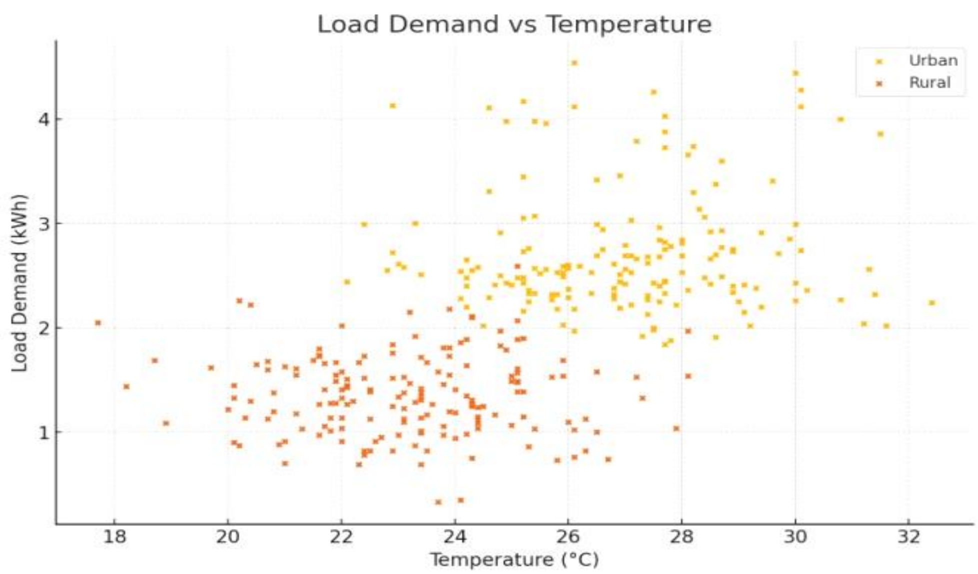




***Figure 1*** *illustrates the average hourly electricity load profiles for the urban region of Lal Chowk and the rural region of Kupwara over a continuous seven-day period. The urban profile exhibits a distinct evening peak, reflective of post-work residential and commercial energy usage, while the rural profile demonstrates two moderate peaks—morning and evening—aligned with daylight-synchronized activities and limited appliance penetration.*

***Figure 2*** *presents a scatter plot of hourly load demand against ambient temperature for both study regions. In the urban dataset, a strong positive correlation is evident, particularly beyond 26 °C, indicating the influence of cooling appliances on load behavior. In contrast, the rural profile displays a flatter relationship, with only marginal increases in load beyond 24 °C, suggesting lower responsiveness to temperature variations.*

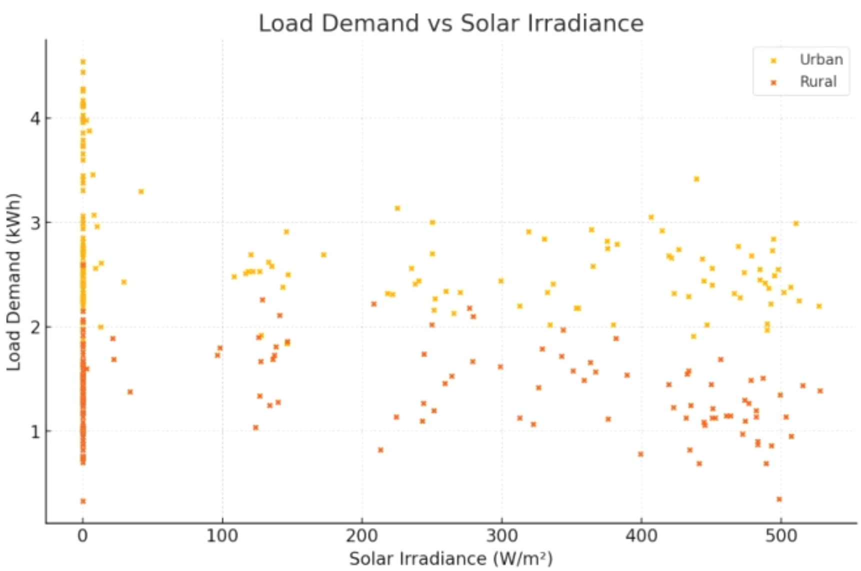



***Figure 3*** *maps load demand as a function of solar irradiance levels. In both urban and rural settings, lower irradiance values (typically at dawn and dusk) correspond to reduced electricity consumption. However, while urban demand remains relatively high throughout the day due to continuous commercial activity, rural demand shows moderate peaks during mid-irradiance periods, hinting at solar-synchronized tasks such as irrigation or small-scale processing, followed by a dip during high irradiance hours due to inactivity or passive cooling practices.*

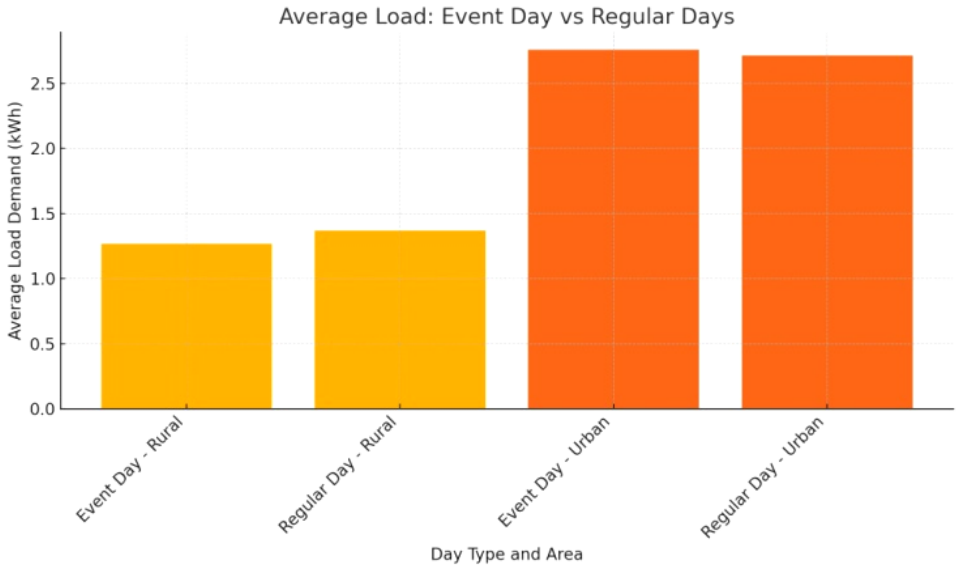



***Figure 4*** *compares the average load profiles recorded on the special event day (June 6) with the aggregated averages of all other days. In the urban region, a slight increase in overall load is observed on the event day, driven by elevated evening usage likely tied to social gatherings and additional lighting. Conversely, rural consumption remains relatively stable, with no significant deviation from typical patterns, underscoring a consistent and functionally routine energy use profile.*

## Load Profile Comparison

### *Daily and Hourly Load Trends*

The analysis of daily and hourly load demand reveals notable differences between the urban (Lal Chowk) and rural (Kupwara) regions. In urban settings, a pronounced peak in electricity consumption is observed during the evening hours, specifically between 18:00 and 21:00. The load begins to rise after midday, climbing from an average of approximately 2.5 kWh to nearly 4.0 kWh at peak times. This pattern aligns with increased residential activity, post-office commercial operations, and heightened appliance usage during evening hours, such as lighting, entertainment systems, and air-conditioning. The urban profile illustrates the typical post-workday surge in energy demand associated with a densely populated commercial-residential hub. Conversely, the rural region displays a more distributed and less intense load profile, characterized by two moderate peaks. The first occurs in the early morning, between 06:00 and 09:00, reaching around 1.8 kWh, reflecting morning household chores and preparations for agricultural activities. The second peak arises in the early evening, from 17:00 to 20:00, with average loads around 1.75 kWh. Midday consumption remains relatively low at approximately 1.2 kWh, indicative of reduced activity during the hottest part of the day. This trend suggests synchronization with daylight-dependent tasks and lower appliance saturation in rural households.

Across both regions, weekday and weekend load shapes remain broadly consistent. However, a minor elevation in weekend evening peaks is noted in the urban profile, with loads slightly exceeding 4.1 kWh, compared to approximately 3.8 kWh on weekdays. This subtle variation suggests increased leisure-time energy use during weekends in urban areas, possibly due to extended family gatherings, shopping, or entertainment-related consumption.

### *Peak Hours in Urban vs Rural Areas*

A comparison of peak demand windows further illustrates the disparity in consumption behavior. The urban area experiences a concentrated peak between 19:00 and 20:00, where the sharp increase and high magnitude of load suggest concentrated activity within a narrow timeframe. In contrast, the rural region exhibits dual peaks of lower intensity. The first occurs in the morning, around 07:00–08:00, while the second peak is in the early evening, around 18:00–19:00. These peaks are broader and flatter, indicating a more distributed and less time-constrained pattern of electricity usage, likely reflecting flexible and less electrified lifestyles.

### *Impact of Environmental Factors on Load Demand*

Environmental parameters such as temperature and solar irradiance exert a significant influence on electricity load patterns, especially in the urban region. A strong positive correlation is observed between load demand and ambient temperature in the urban context. As temperatures rise above 26 °C, load demand correspondingly increases, primarily due to the intensified use of air-conditioning, fans, and other temperature-regulating appliances. This correlation reflects the higher level of comfort dependency and appliance penetration in urban households and businesses. In rural areas, however, the relationship between temperature and load is noticeably weaker. While a slight increase in demand is recorded when temperatures exceed 24 °C, the overall response remains mild. This suggests limited use of temperature-sensitive devices in rural settings, possibly due to economic constraints or differing lifestyle priorities that rely less on artificial cooling. Solar irradiance also plays a crucial role in shaping load dynamics. In both urban and rural areas, low irradiance levels (0–50 W/m²), typically occurring during early morning and late evening, coincide with lower electricity consumption. However, the response to high irradiance diverges between the two regions. Urban load demand remains elevated, ranging between 2.0–4.0 kWh even during high irradiance periods. This is likely driven by steady commercial activity and cooling demand during daytime hours, underscoring urban energy intensity. In rural regions, moderate load peaks align with irradiance levels between 200–400 W/m², suggesting that daytime activities such as water pumping, machine use, or other semi-mechanized agricultural practices are synchronized with solar availability. Interestingly, during periods of peak irradiance (typically around noon), rural demand dips, possibly due to reduced human activity during the hottest hours and potential shading of solar-powered equipment or passive household cooling strategies.

### *Effect of Special Events on Load Demand*

The presence of a special event (e.g., a festival or public gathering) has a measurable, albeit modest, impact on electricity consumption in urban areas. On the event day, the urban average load increased to 2.7 kWh compared to 2.65 kWh on typical days. This marginal rise is likely attributable to enhanced evening lighting, celebratory gatherings, and extended appliance usage in households and public venues. In contrast, rural consumption during the event day averaged around 1.27 kWh, slightly lower than the 1.36 kWh recorded on regular days. This suggests that rural energy use remains largely unaffected by such events, reflecting stable daily routines and lower dependency on electric-powered entertainment or decorative lighting. The minor dip could also be attributed to community-level engagement in outdoor or non-electric celebrations. Overall, while urban areas exhibit a perceptible uptick in load during events, rural areas demonstrate a more consistent and resilient consumption pattern.

***Table 03: Hourly Environmental and Load Demand Data for Urban (Lal Chowk) and Rural (Kupwara) Regions from June 1 to June 7, 2025***

*This table presents high-resolution time-series data collected hourly over a seven-day period for two contrasting regions of Kashmir Valley. Variables recorded include ambient temperature (°C), relative humidity (%), solar irradiance (W/m²), electricity load demand (kWh), and event occurrence (binary). The urban site, Lal Chowk, typically reflects higher temperatures and* *electricity load, whereas Kupwara, the rural counterpart, shows higher humidity and more variability in solar irradiance, highlighting differential energy consumption patterns and climatic conditions.*

| Area_Type | Region_Name | Date | Hour | Temperature | Humidity | Solar_Irradiance | Load_Demand | Event |
|---|---|---|---|---|---|---|---|---|
| **Urban** | Lal Chowk | 2025-06-01 | 0 | 28 | 54.3 | 0 | 2.69 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 1 | 30 | 53.8 | 0 | 2.43 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 2 | 30.2 | 58.8 | 0 | 2.36 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 3 | 28.1 | 52.7 | 0 | 2.36 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 4 | 27.5 | 45.4 | 0 | 1.98 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 5 | 25.9 | 49.9 | 0 | 2.59 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 6 | 25.2 | 47.9 | 29.3 | 2.43 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 7 | 27.1 | 47.9 | 118.5 | 2.53 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 8 | 24.7 | 56.9 | 238 | 2.41 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 9 | 25.8 | 64.3 | 353.3 | 2.18 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 10 | 28.6 | 48.9 | 437.2 | 1.91 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 11 | 24.3 | 56 | 497.7 | 2.55 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 12 | 26.8 | 53.5 | 470.4 | 2.28 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 13 | 26.1 | 60.3 | 489.8 | 1.97 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 14 | 27.6 | 53.1 | 419.5 | 2.68 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 15 | 29.1 | 59.7 | 336.8 | 2.41 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 16 | 27.7 | 59.9 | 240.4 | 2.44 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 17 | 24.8 | 49 | 145.7 | 2.91 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 18 | 26.9 | 60 | 7.2 | 3.46 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 19 | 27.7 | 62.7 | 0 | 3.73 | 0 |
| **Urban** | Lal Chowk | 2025-06- | 20 | 30.1 | 41.9 | 0 | 4.12 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 01 | | | | | | |
| **Urban** | Lal Chowk | 2025-06-01 | 21 | 27.2 | 53.5 | 0 | 3.79 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 22 | 23 | 53.9 | 0 | 2.61 | 0 |
| **Urban** | Lal Chowk | 2025-06-01 | 23 | 30 | 52.4 | 0 | 2.26 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 0 | 26 | 59.6 | 0 | 2.6 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 1 | 25.9 | 57.6 | 0 | 2.53 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 2 | 28.9 | 51.5 | 0 | 2.4 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 3 | 26.2 | 47.7 | 0 | 2.59 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 4 | 27.5 | 55 | 0 | 2.43 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 5 | 24.2 | 52.9 | 0 | 2.4 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 6 | 25.4 | 54.2 | 8.1 | 3.07 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 7 | 27.3 | 56.3 | 127.9 | 1.92 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 8 | 26.9 | 55.3 | 299.3 | 2.44 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 9 | 27.6 | 54.8 | 330.2 | 2.84 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 10 | 28.5 | 59 | 414.8 | 2.92 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 11 | 24.2 | 57.9 | 526.8 | 2.2 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 12 | 25.9 | 55.5 | 489.9 | 2.03 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 13 | 27.1 | 49.7 | 492.4 | 2.22 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 14 | 30.1 | 51.1 | 426.6 | 2.74 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 15 | 24.5 | 56.1 | 379.7 | 2.02 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 16 | 27.4 | 56.3 | 265.6 | 2.13 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 17 | 24.4 | 57.6 | 135.3 | 2.58 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 18 | 27.7 | 51.6 | 4.6 | 3.88 | 0 |
| **Urban** | Lal Chowk | 2025-06- | 19 | 25.6 | 64.3 | 0 | 3.96 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 02 | | | | | | |
| **Urban** | Lal Chowk | 2025-06-02 | 20 | 24.6 | 58.3 | 0 | 3.31 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 21 | 28.6 | 60.8 | 0 | 3.38 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 22 | 28.9 | 57.1 | 0 | 2.75 | 0 |
| **Urban** | Lal Chowk | 2025-06-02 | 23 | 30.8 | 53.8 | 0 | 2.27 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 0 | 25.2 | 50.9 | 0 | 2.48 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 1 | 27.7 | 56.4 | 0 | 2.75 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 2 | 27 | 62.3 | 0 | 2.42 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 3 | 32.4 | 58.1 | 0 | 2.24 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 4 | 24.9 | 57.4 | 0 | 2.43 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 5 | 28.4 | 57.4 | 0 | 2.48 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 6 | 25.3 | 47.4 | 0 | 2.76 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 7 | 27.4 | 48.8 | 132.9 | 2.62 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 8 | 25.2 | 55.8 | 251.2 | 2.16 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 9 | 27.7 | 57.8 | 375.2 | 2.82 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 10 | 24.2 | 50.3 | 443.3 | 2.65 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 11 | 28 | 74.3 | 494.4 | 2.84 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 12 | 28.9 | 58.3 | 493.7 | 2.73 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 13 | 25.5 | 53.8 | 473.3 | 2.52 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 14 | 31.6 | 45.7 | 446.7 | 2.02 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 15 | 26.1 | 60.4 | 354.8 | 2.18 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 16 | 25.6 | 58.4 | 235.4 | 2.56 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 17 | 27.1 | 51.7 | 172.3 | 2.69 | 0 |
| **Urban** | Lal Chowk | 2025-06- | 18 | 22.9 | 55.9 | 0 | 4.13 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 03 | | | | | | |
| **Urban** | Lal Chowk | 2025-06-03 | 19 | 25.4 | 54.4 | 0 | 3.98 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 20 | 28.7 | 49 | 0 | 3.6 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 21 | 26.1 | 51.7 | 0 | 4.54 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 22 | 27.8 | 48.7 | 0 | 2.78 | 0 |
| **Urban** | Lal Chowk | 2025-06-03 | 23 | 31.2 | 60.2 | 0 | 2.04 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 0 | 26 | 61.3 | 0 | 2.29 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 1 | 27.9 | 58.9 | 0 | 2.22 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 2 | 26.9 | 38.8 | 0 | 2.19 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 3 | 26.5 | 48.8 | 0 | 2.99 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 4 | 24.1 | 52.8 | 0 | 2.54 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 5 | 29.9 | 47.8 | 0 | 2.85 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 6 | 27 | 50.1 | 9.2 | 2.56 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 7 | 25.8 | 55.3 | 121.7 | 2.53 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 8 | 28.3 | 62.9 | 225.2 | 3.14 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 9 | 23.1 | 54.2 | 365.3 | 2.58 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 10 | 25.8 | 54 | 423.2 | 2.32 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 11 | 28.7 | 56.8 | 469.1 | 2.77 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 12 | 27.6 | 59.1 | 512.6 | 2.25 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 13 | 25.9 | 58.7 | 495.2 | 2.49 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 14 | 27.2 | 61.4 | 421.2 | 2.66 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 15 | 26.6 | 53.9 | 375.5 | 2.75 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 16 | 28.6 | 61.5 | 250.4 | 2.7 | 0 |
| **Urban** | Lal Chowk | 2025-06- | 17 | 26.4 | 56.6 | 126.8 | 2.53 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 04 | | | | | | |
| **Urban** | Lal Chowk | 2025-06-04 | 18 | 28.2 | 50.9 | 41.8 | 3.3 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 19 | 24.6 | 60.8 | 0 | 4.11 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 20 | 28.2 | 58.1 | 0 | 3.74 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 21 | 25.2 | 55.4 | 0 | 3.45 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 22 | 29 | 54.3 | 0 | 2.25 | 0 |
| **Urban** | Lal Chowk | 2025-06-04 | 23 | 26.4 | 57.1 | 0 | 2.33 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 0 | 25.4 | 56.2 | 0 | 2.57 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 1 | 26 | 52.6 | 0 | 2.57 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 2 | 24.1 | 48 | 0 | 2.28 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 3 | 26.6 | 56.6 | 0 | 2.94 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 4 | 28.7 | 54.2 | 0 | 2.49 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 5 | 25 | 54.9 | 0 | 2.41 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 6 | 27.6 | 50.9 | 10.4 | 2.96 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 7 | 26.8 | 57 | 143.2 | 2.38 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 8 | 27.4 | 55.1 | 252 | 2.27 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 9 | 27 | 57.5 | 382.6 | 2.79 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 10 | 31.3 | 51.2 | 450.5 | 2.56 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 11 | 31.4 | 51 | 466.2 | 2.32 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 12 | 22.8 | 52.4 | 484.8 | 2.55 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 13 | 27.7 | 64.4 | 502 | 2.33 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 14 | 25.2 | 57.5 | 406.6 | 3.05 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 15 | 29.4 | 52.7 | 319.3 | 2.91 | 0 |
| **Urban** | Lal Chowk | 2025-06- | 16 | 26.8 | 61.2 | 218.1 | 2.32 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 05 | | | | | | |
| **Urban** | Lal Chowk | 2025-06-05 | 17 | 27 | 55.2 | 120.4 | 2.69 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 18 | 24.9 | 54.3 | 2.4 | 3.98 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 19 | 28.4 | 49.4 | 0 | 3.06 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 20 | 29.6 | 56.7 | 0 | 3.41 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 21 | 30.1 | 55.6 | 0 | 4.28 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 22 | 27.1 | 65.3 | 0 | 3.03 | 0 |
| **Urban** | Lal Chowk | 2025-06-05 | 23 | 26.5 | 59.9 | 0 | 2.69 | 0 |
| **Urban** | Lal Chowk | 2025-06-06 | 0 | 29.7 | 50.2 | 0 | 2.71 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 1 | 29.1 | 46.2 | 0 | 2.15 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 2 | 22.9 | 53.7 | 0 | 2.72 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 3 | 30 | 55.4 | 0 | 2.99 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 4 | 24.2 | 46.5 | 0 | 2.48 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 5 | 27.8 | 54.8 | 0 | 1.88 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 6 | 26.8 | 48.5 | 13.4 | 2.61 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 7 | 25.1 | 52.4 | 108.2 | 2.48 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 8 | 28.9 | 50.1 | 260.1 | 2.34 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 9 | 25.4 | 54.5 | 332.8 | 2.33 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 10 | 24.6 | 64.8 | 433.7 | 2.29 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 11 | 27.4 | 54.4 | 478.5 | 2.68 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 12 | 28.5 | 52.3 | 488.5 | 2.42 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 13 | 22.4 | 47.4 | 510.3 | 2.99 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 14 | 26.5 | 57.9 | 439.2 | 3.42 | 1 |
| **Urban** | Lal Chowk | 2025-06- | 15 | 29.2 | 54.4 | 334.4 | 2.02 | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 06 | | | | | | |
| **Urban** | Lal Chowk | 2025-06-06 | 16 | 27.4 | 51.2 | 221.6 | 2.31 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 17 | 24.8 | 63.4 | 147 | 2.5 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 18 | 30 | 55.4 | 0 | 4.44 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 19 | 28.1 | 49.8 | 0 | 3.66 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 20 | 25.2 | 48.1 | 0 | 4.17 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 21 | 30.8 | 48 | 0 | 4 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 22 | 25.7 | 52.6 | 0 | 2.32 | 1 |
| **Urban** | Lal Chowk | 2025-06-06 | 23 | 25.3 | 55.2 | 0 | 2.25 | 1 |
| **Urban** | Lal Chowk | 2025-06-07 | 0 | 27.5 | 54.7 | 0 | 2.43 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 1 | 25.2 | 52.1 | 0 | 2.73 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 2 | 28 | 50.1 | 0 | 2.53 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 3 | 28.5 | 46.7 | 0 | 2.66 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 4 | 25.7 | 57.9 | 0 | 2.27 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 5 | 23.4 | 46.9 | 0 | 2.51 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 6 | 27.5 | 50.5 | 12.8 | 2 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 7 | 26.9 | 48.9 | 116.4 | 2.51 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 8 | 25.3 | 53.1 | 270.1 | 2.33 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 9 | 28.7 | 49.4 | 364.1 | 2.93 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 10 | 22.1 | 51 | 444.6 | 2.44 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 11 | 27.7 | 52 | 484.7 | 2.45 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 12 | 29.3 | 56.3 | 506.8 | 2.38 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 13 | 26 | 52.8 | 490.9 | 2.37 | 0 |
| **Urban** | Lal Chowk | 2025-06- | 14 | 27.6 | 65.4 | 450.4 | 2.4 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 07 | | | | | | |
| **Urban** | Lal Chowk | 2025-06-07 | 15 | 29.4 | 53 | 312.8 | 2.2 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 16 | 23.3 | 53.2 | 250.4 | 3 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 17 | 27.7 | 53.9 | 146 | 1.84 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 18 | 27.5 | 58.9 | 0 | 4.26 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 19 | 27.7 | 52.9 | 0 | 4.03 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 20 | 31.5 | 55.9 | 0 | 3.86 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 21 | 26.1 | 50.8 | 0 | 4.12 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 22 | 25.3 | 55.4 | 0 | 2.36 | 0 |
| **Urban** | Lal Chowk | 2025-06-07 | 23 | 28 | 56.7 | 0 | 2.81 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 0 | 22 | 63.7 | 0 | 0.91 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 1 | 22.1 | 66.9 | 0 | 1.43 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 2 | 21.2 | 69.3 | 0 | 1.61 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 3 | 23.8 | 74.4 | 0 | 0.97 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 4 | 20.5 | 56.1 | 0 | 1.65 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 5 | 24.3 | 64.7 | 0 | 1.28 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 6 | 20.7 | 77.2 | 2.6 | 1.6 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 7 | 24.5 | 67.4 | 133.9 | 1.25 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 8 | 23.9 | 74.4 | 276.9 | 2.18 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 9 | 22 | 60.1 | 351 | 1.58 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 10 | 25.2 | 56.5 | 463.6 | 1.15 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 11 | 22.1 | 59.9 | 449.9 | 1.45 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 12 | 23.1 | 58.6 | 474.1 | 1.1 | 0 |
| **Rural** | Kupwara | 2025-06- | 13 | 26.3 | 63.7 | 452.9 | 1.13 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 01 | | | | | | |
| **Rural** | Kupwara | 2025-06-01 | 14 | 22.5 | 51.5 | 431.9 | 1.13 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 15 | 24.4 | 74.2 | 376.1 | 1.12 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 16 | 20.8 | 77.9 | 251.2 | 1.2 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 17 | 23 | 66 | 126.5 | 1.34 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 18 | 21.9 | 64.8 | 0 | 1.28 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 19 | 23.2 | 63.7 | 0 | 2.15 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 20 | 17.7 | 70.5 | 0 | 2.05 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 21 | 18.9 | 63.3 | 0 | 1.09 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 22 | 20.2 | 61.1 | 0 | 0.87 | 0 |
| **Rural** | Kupwara | 2025-06-01 | 23 | 26.5 | 69.7 | 0 | 1.58 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 0 | 24.4 | 59.4 | 0 | 1.04 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 1 | 24 | 58.9 | 0 | 1.41 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 2 | 22.5 | 63.1 | 0 | 1.41 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 3 | 23.9 | 63.2 | 0 | 1.55 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 4 | 20.8 | 68.1 | 0 | 1.38 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 5 | 22.4 | 66.6 | 0 | 0.82 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 6 | 24.8 | 64.1 | 0 | 1.97 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 7 | 21.6 | 58 | 98.3 | 1.8 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 8 | 20.4 | 73.8 | 208.4 | 2.22 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 9 | 23.4 | 64.5 | 342.7 | 1.72 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 10 | 22.9 | 70.5 | 435.3 | 1.25 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 11 | 22.3 | 64.7 | 489.1 | 0.69 | 0 |
| **Rural** | Kupwara | 2025-06- | 12 | 20.3 | 68.7 | 503.4 | 1.14 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 02 | | | | | | |
| **Rural** | Kupwara | 2025-06-02 | 13 | 23 | 66.7 | 472.2 | 0.97 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 14 | 23.4 | 60.1 | 441.2 | 0.69 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 15 | 25.1 | 67.4 | 358.7 | 1.49 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 16 | 26.3 | 70.1 | 213.2 | 0.82 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 17 | 21.8 | 65.1 | 139.8 | 1.28 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 18 | 23.4 | 61.2 | 0 | 1.01 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 19 | 21.2 | 58.2 | 0 | 1.18 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 20 | 25.1 | 60.3 | 0 | 2.59 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 21 | 24 | 65.9 | 0 | 0.94 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 22 | 24.4 | 62.1 | 0 | 1.24 | 0 |
| **Rural** | Kupwara | 2025-06-02 | 23 | 28.1 | 64.5 | 0 | 1.54 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 0 | 21.6 | 64.8 | 0 | 1.73 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 1 | 21.7 | 74.1 | 0 | 1.41 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 2 | 21.9 | 68.2 | 0 | 1.49 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 3 | 24.2 | 57.1 | 0 | 0.98 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 4 | 22.5 | 64.6 | 0 | 1.39 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 5 | 23.4 | 58.3 | 0 | 1.31 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 6 | 24.2 | 67.8 | 21.6 | 1.89 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 7 | 23.9 | 64.6 | 96.2 | 1.73 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 8 | 23.4 | 66.4 | 224.5 | 1.14 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 9 | 25.1 | 64.8 | 367.2 | 1.57 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 10 | 23.1 | 69.7 | 422.7 | 1.23 | 0 |
| **Rural** | Kupwara | 2025-06- | 11 | 22.1 | 62.8 | 476.8 | 1.27 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 03 | | | | | | |
| **Rural** | Kupwara | 2025-06-03 | 12 | 22 | 71.3 | 482.1 | 1.14 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 13 | 22.1 | 72.2 | 486.9 | 1.51 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 14 | 20 | 66.3 | 450.8 | 1.22 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 15 | 25.1 | 62.4 | 381.7 | 1.89 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 16 | 22.3 | 62.8 | 279.1 | 1.67 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 17 | 22 | 62.9 | 123.8 | 1.04 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 18 | 21.2 | 60 | 0 | 1.55 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 19 | 23.5 | 72.8 | 0 | 1.17 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 20 | 25 | 63.9 | 0 | 1.54 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 21 | 24.3 | 59.4 | 0 | 1.31 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 22 | 23.3 | 67.5 | 0 | 1.29 | 0 |
| **Rural** | Kupwara | 2025-06-03 | 23 | 27.9 | 61.8 | 0 | 1.04 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 0 | 21.8 | 62.2 | 0 | 1.01 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 1 | 25.4 | 72.1 | 0 | 1.03 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 2 | 21.3 | 67.4 | 0 | 1.03 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 3 | 24.3 | 66 | 0 | 0.75 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 4 | 26.1 | 74 | 0 | 1.02 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 5 | 22.2 | 66.4 | 0 | 1.3 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 6 | 24.3 | 75.1 | 0 | 1.25 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 7 | 20.2 | 61.3 | 128.7 | 2.26 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 8 | 22 | 66.1 | 249.7 | 2.02 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 9 | 28.1 | 62.3 | 343.8 | 1.97 | 0 |
| **Rural** | Kupwara | 2025-06- | 10 | 24.4 | 74.2 | 444.7 | 1.09 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 04 | | | | | | |
| **Rural** | Kupwara | 2025-06-04 | 11 | 24.2 | 70.5 | 499.4 | 1.35 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 12 | 25.1 | 70.8 | 527.6 | 1.39 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 13 | 22.7 | 65.7 | 507.1 | 0.95 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 14 | 23.7 | 63 | 433.6 | 1.58 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 15 | 23.4 | 65.2 | 326.4 | 1.42 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 16 | 24.3 | 75.8 | 243.8 | 1.27 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 17 | 23.5 | 72.9 | 127.5 | 1.67 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 18 | 24.2 | 65.9 | 0 | 1.64 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 19 | 25.1 | 59.9 | 0 | 1.61 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 20 | 21.6 | 71 | 0 | 0.97 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 21 | 21.9 | 66.9 | 0 | 1.67 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 22 | 22.9 | 62.2 | 0 | 1.76 | 0 |
| **Rural** | Kupwara | 2025-06-04 | 23 | 20.1 | 54 | 0 | 1.33 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 0 | 22 | 59.9 | 0 | 1.41 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 1 | 23.5 | 62.2 | 0 | 0.82 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 2 | 24.7 | 68.3 | 0 | 1.17 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 3 | 26.7 | 59.6 | 0 | 0.74 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 4 | 21.6 | 64.8 | 0 | 1.27 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 5 | 22.5 | 66.8 | 0 | 0.82 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 6 | 25.9 | 64.6 | 22.3 | 1.69 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 7 | 23.9 | 67.8 | 138.4 | 1.81 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 8 | 25.7 | 66 | 264.2 | 1.53 | 0 |
| **Rural** | Kupwara | 2025-06- | 9 | 25.9 | 61.6 | 389.6 | 1.54 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 05 | | | | | | |
| **Rural** | Kupwara | 2025-06-05 | 10 | 20.1 | 65.6 | 419.4 | 1.45 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 11 | 21.7 | 62.8 | 445.2 | 1.06 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 12 | 18.2 | 57.1 | 515.2 | 1.44 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 13 | 23.9 | 60.2 | 482 | 1.2 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 14 | 20.7 | 72.5 | 450.6 | 1.13 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 15 | 23.1 | 66 | 312.7 | 1.13 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 16 | 21.6 | 60 | 244.4 | 1.74 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 17 | 24.3 | 62.1 | 140.9 | 2.11 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 18 | 24.8 | 65.3 | 0 | 1.83 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 19 | 23.8 | 69.5 | 0 | 1.81 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 20 | 25.1 | 62.3 | 0 | 2.07 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 21 | 23.4 | 75.4 | 0 | 0.99 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 22 | 26.5 | 66 | 0 | 1 | 0 |
| **Rural** | Kupwara | 2025-06-05 | 23 | 22 | 63.4 | 0 | 1.33 | 0 |
| **Rural** | Kupwara | 2025-06-06 | 0 | 24 | 62.1 | 0 | 1.19 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 1 | 27.3 | 73.6 | 0 | 1.33 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 2 | 23.1 | 65.6 | 0 | 1.38 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 3 | 21 | 63.7 | 0 | 0.7 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 4 | 23.8 | 68.2 | 0 | 1.06 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 5 | 26.1 | 58.9 | 0 | 0.76 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 6 | 23.4 | 70.2 | 33.7 | 1.38 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 7 | 25.2 | 64.8 | 126 | 1.9 | 1 |
| **Rural** | Kupwara | 2025-06- | 8 | 24.3 | 57.1 | 279.5 | 2.1 | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 06 | | | | | | |
| **Rural** | Kupwara | 2025-06-06 | 9 | 21.7 | 67 | 363.4 | 1.66 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 10 | 21.9 | 61.6 | 432.5 | 1.55 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 11 | 24.1 | 63.1 | 498.4 | 0.35 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 12 | 25.3 | 56.3 | 492.8 | 0.86 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 13 | 20.4 | 70.8 | 473.6 | 1.3 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 14 | 22.9 | 67.4 | 434.5 | 0.82 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 15 | 25 | 62.5 | 322.4 | 1.07 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 16 | 26 | 69.3 | 243 | 1.1 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 17 | 22.4 | 75.4 | 137 | 1.73 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 18 | 25.1 | 66.2 | 0 | 1.48 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 19 | 22.9 | 64.8 | 0 | 1.84 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 20 | 23.1 | 68.7 | 0 | 1.53 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 21 | 23.2 | 55 | 0 | 1.47 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 22 | 23.7 | 70 | 0 | 0.33 | 1 |
| **Rural** | Kupwara | 2025-06-06 | 23 | 27.2 | 64.3 | 0 | 1.53 | 1 |
| **Rural** | Kupwara | 2025-06-07 | 0 | 20.9 | 68.1 | 0 | 0.88 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 1 | 21.8 | 74.6 | 0 | 1.14 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 2 | 23.4 | 69.4 | 0 | 1.35 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 3 | 23.3 | 66.8 | 0 | 1.92 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 4 | 22.9 | 66 | 0 | 1.52 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 5 | 25.2 | 70.9 | 0 | 1.39 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 6 | 20.7 | 73.2 | 0 | 1.68 | 0 |
| **Rural** | Kupwara | 2025-06- | 7 | 21.5 | 64.7 | 136 | 1.69 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 07 | | | | | | |
| **Rural** | Kupwara | 2025-06-07 | 8 | 23.8 | 73.1 | 259.1 | 1.46 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 9 | 24.9 | 70.9 | 329 | 1.79 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 10 | 24.4 | 63.5 | 460.5 | 1.15 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 11 | 23.3 | 64.1 | 483.3 | 0.87 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 12 | 20.1 | 73 | 483.1 | 0.9 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 13 | 18.7 | 61.8 | 456.5 | 1.69 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 14 | 25 | 61.6 | 478.1 | 1.49 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 15 | 22.4 | 52.5 | 399.4 | 0.78 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 16 | 19.7 | 70.1 | 298.8 | 1.62 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 17 | 24.1 | 68 | 146.5 | 1.86 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 18 | 23.6 | 65.5 | 0 | 1.27 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 19 | 22.4 | 56.5 | 0 | 1.52 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 20 | 21 | 59.5 | 0 | 1.63 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 21 | 25.8 | 69.6 | 0 | 0.73 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 22 | 21 | 69.7 | 0 | 0.91 | 0 |
| **Rural** | Kupwara | 2025-06-07 | 23 | 22.6 | 67.8 | 0 | 0.91 | 0 |

## Discussion

The comparative load analysis between urban Lal Chowk and rural Kupwara reveals distinct consumption dynamics that are tightly linked to sociotechnical infrastructure, lifestyle patterns, and climatic conditions. The results align with expected regional behavior but also highlight nuances that are especially pertinent for localized grid planning in the Kashmir Valley.

Urban Load Characteristics

Urban electricity consumption in Lal Chowk demonstrates a clear evening-centric pattern, with a sharp demand spike between 18:00 and 21:00 hours. This is attributable to:

- Increased residential usage post-office hours,
- Commercial and retail lighting demands,
- Widespread appliance usage (e.g., televisions, electric cooking, air conditioning),
- Density of both domestic and commercial meters within a small geographic footprint.

The steepness of the urban load curve implies a concentrated peak load window, which, if unmanaged, can cause transformer overloading, grid congestion, and elevated short-term generation costs. The pronounced weekday-weekend parity also suggests a high baseline demand, driven by round-the-clock urban activity.

Rural Load Characteristics

In contrast, rural consumption in Kupwara is more evenly distributed, with two moderate peaks: one during morning agricultural and household startup and another during early evening domestic usage. The lower amplitude of the rural load profile stems from:

- Lower per capita appliance penetration,
- Greater reliance on daylight for activity,
- A larger share of off-grid or mixed-source usage (e.g., firewood, diesel),
- Simpler daily routines aligned with natural light and agricultural cycles.

This balance reflects a load curve that is more resilient to instantaneous spikes, making it inherently more stable for energy distribution—though it is also more vulnerable to outages due to underdeveloped infrastructure.

Influence of Solar Irradiance and Temperature

Environmental variables, particularly temperature and solar irradiance, play a critical modulatory role in shaping hourly load demand:

- Temperature Effects: Urban areas show a strong positive correlation between rising temperature and increased electricity demand, driven by air conditioners, fans, and cooling systems. This is emblematic of the "urban heat penalty," where denser built environments exacerbate thermal discomfort and raise cooling loads. In contrast, rural areas show a muted response, highlighting lower usage of thermally regulated appliances.
- Solar Irradiance Effects: The relationship with irradiance is more complex. Load tends to decrease slightly during peak sunlight in both regions—likely due to natural lighting reducing indoor electrical lighting needs. However, high irradiance periods in rural areas often coincide with agricultural water pumping or daytime labor, causing minor bumps in load. In urban areas, irradiance has less predictive power due to the dominance of built-up, shaded environments and enclosed indoor activity.

This differentiation is crucial: urban load is more thermally sensitive, while rural load is more behaviorally and temporally consistent, yet more susceptible to seasonal shifts and outages during overcast or extreme weather events.

**Relevance for Demand Response Systems in Kashmir**

These insights carry significant implications for the design and implementation of demand response (DR) mechanisms and smart grid initiatives in the Kashmir Valley:

- Urban Response Potential: The presence of sharp, predictable peaks in urban zones makes them ideal candidates for time-of-use pricing, automated load shedding, and consumer behavior nudging via smart home integration. For example, incentivizing delayed usage of non-essential appliances through pricing signals could flatten the evening peak and reduce grid stress.
- Rural Demand Stability: Kupwara's flatter, bimodal load profile suggests opportunities for agricultural demand-side management, such as scheduling irrigation during off-peak hours or aligning it with solar PV output in hybrid systems. Simpler time blocks or seasonal tariffs may be more appropriate in rural settings where digital literacy and device penetration are lower.
- Renewable Integration: The solar irradiance profiles across both regions point to substantial potential for rooftop solar adoption, particularly in rural areas with open space. However, integration must be

coupled with battery storage or microgrid synchronization to mitigate the mismatch between production (daytime) and demand (morning/evening).

- Policy and Planning Implications: Urban-rural divergence necessitates differentiated load forecasting models and locational pricing strategies. Policymakers should avoid one-size-fits-all approaches and instead pursue tailored DSM schemes, localized energy awareness campaigns, and investment in both physical and digital infrastructure.

## Conclusion

This study undertook a comparative assessment of urban and rural electricity demand patterns in the Kashmir Valley, focusing on two representative regions: Lal Chowk and Kupwara. The findings revealed a significant divergence in the structure and intensity of electricity consumption, shaped by infrastructural availability, lifestyle rhythms, environmental factors, and the nature of economic activities. Urban electricity usage in Lal Chowk exhibited a highly concentrated evening peak, driven by residential lighting, commercial activity, and appliance usage after sunset. This pattern is indicative of dense, electrified urban spaces where consumer behavior and infrastructure create pronounced demand spikes. On the other hand, rural consumption in Kupwara followed a more evenly distributed profile with modest peaks in the morning and early evening, reflecting agrarian routines and a more measured engagement with the electrical grid.

Environmental variables such as temperature and solar irradiance also played a critical role in modulating demand. In urban areas, increased temperature correlated strongly with rising load, suggesting widespread use of cooling devices. Rural load remained relatively stable across temperature variations, pointing to a lower dependency on thermally responsive appliances. Similarly, solar irradiance showed a modest relationship with daytime consumption, suggesting potential for load management via solar-based solutions. The analysis of electricity consumption during a special regional event day (June 6) further underlined the resilience of rural load profiles and the sensitivity of urban ones to social events. While urban demand showed a modest uptick, rural load remained stable, emphasizing the functional, necessity-driven consumption patterns in less densely populated areas. Overall, the results affirm that electricity demand in Kashmir is diverse and spatially differentiated. Effective energy planning must therefore incorporate localized consumption behavior and environmental responsiveness into grid management and policy design.

## Policy Recommendations

1. Develop Region-Specific Forecasting Models

Electricity consumption patterns in urban and rural settings are structurally different and require tailored forecasting approaches. Urban areas, with their sharp evening peaks and climatic sensitivity, benefit from short-term predictive models such as ARIMA, machine learning regressors, or hybrid approaches incorporating environmental variables. Rural areas may require lower-frequency, behaviorally driven models that align with daylight hours and seasonal agricultural activities.

2. Implement Customized Demand-Side Management (DSM) Schemes

In urban zones, demand-side management should focus on strategies such as time-of-use pricing, real-time consumption alerts, and smart appliance control systems to mitigate peak loads. In rural zones, interventions can include scheduled load shifting for irrigation, the promotion of efficient pump sets, and seasonal advisories for load optimization. DSM approaches should be designed in consultation with local communities to ensure acceptability and effectiveness.

3. Accelerate Distributed Renewable Integration

The potential for solar photovoltaic deployment is strong across the Valley, particularly in rural areas with open spaces and consistent irradiance. Investments in solar microgrids with battery storage can significantly enhance energy access and reliability. Urban areas, though more spatially constrained, can benefit from rooftop solar adoption with net-metering or local consumption optimization. Both regions can benefit from solar-diesel hybrid or solar-grid hybrid models to ensure reliability.

4. Strengthen Smart Meter Infrastructure and Data Analytics

A foundational step toward more efficient grid operation is the universal implementation of smart meters, supported by robust data analytics platforms. Real-time monitoring enables better demand forecasting, theft detection, load balancing, and consumer engagement. Advanced tools, such as edge computing-enabled meters and cloud-based control platforms, will enhance transparency and responsiveness in energy distribution.

5. Promote Energy Education and Behavioral Engagement

Achieving efficiency and demand responsiveness also depends on consumer behavior. Targeted energy literacy campaigns—especially in schools, public institutions, and agricultural extension services—can help consumers understand peak demand costs, appliance usage patterns, and the value of conservation. Enabling consumers to access and interpret their consumption data will further deepen engagement and accountability.

6. Design Contextual and Equitable Tariff Structures

Tariff policies should reflect the unique socio-economic and infrastructural realities of urban and rural consumers. Urban areas can adopt dynamic or time-variable tariffs to manage peak demand, while rural consumers should benefit from simplified, affordable rates that support productive usage, especially in agriculture. These differentiated tariffs can help balance financial sustainability with energy equity.In a geographically diverse and climatically sensitive region like the Kashmir Valley, electrical energy systems must be designed to accommodate both spatial heterogeneity and environmental variability. The findings of this study reinforce the need for decentralized energy planning, precision demand forecasting, and responsive policy frameworks that account for regional behaviors and capacities. With the integration of smart metering infrastructure, data-driven management, and community participation, the Valley can move toward a more resilient, efficient, and inclusive energy future. By anchoring energy policies in localized realities, planners and utilities can better meet the dual goals of reliability and sustainability across both urban and rural sectors.

## Declaration

*Funding Statement*

The author declares that this research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. All research activities, including data collection, analysis, and documentation, were conducted independently by the author as part of academic work.

*Ethical Approval*

This research does not involve human participants, animals, or any personal or sensitive data and therefore did not require formal ethical clearance from an Institutional Review Board (IRB). The study complies with ethical standards regarding the responsible use of data, impartial analysis, and accurate reporting of findings.

*Data Availability Statement*

The dataset utilized in this study pertains to actual observations from the selected urban and rural areas within the Kashmir Valley and has been carefully structured for academic analysis. The data includes variables such as hourly electricity load, temperature, and solar irradiance across a 7-day period.
Due to academic and institutional policy, the dataset is available upon request for verification and scholarly use. Interested researchers may contact the author for access, subject to non-commercial and academic usage terms.

*Conflict of Interest*
The author declares no conflicts of interest related to the research, authorship, or publication of this paper. There are no personal, financial, or professional relationships that could be perceived to influence the results or interpretations presented in this work.

**Acknowledgements**
The author gratefully acknowledges the support and encouragement received from friends and peers during the course of this research. Their thoughtful discussions and consistent motivation greatly contributed to the successful completion of this work. The author also extends sincere appreciation to the academic community and researchers whose published studies provided valuable insight and foundational knowledge for the development of this paper. The availability of relevant literature was instrumental in framing the theoretical and analytical aspects of the research.

**Researcher's Profile**
Qawsain Hussain holds a B-Tech degree in Electronics and Communications Engineering and is the principal investigator of this study. With a solid foundation in smart grid technologies and signal processing, he specializes in the analysis of high-resolution energy consumption data and the development of data-driven forecasting models. His research focuses on bridging the gap between urban and rural energy systems in mountainous regions, leveraging interdisciplinary methodologies to inform sustainable policy and infrastructure planning. He can be reached at qawsainhussain@gmail.com.

## References

Ahmad, S., & Parray, J. A. (2021). Renewable energy integration in Kashmir: Potential and planning for sustainable development. *International Journal of Renewable Energy Research (IJRER)*, *11*(3), 1452–1460.

Alahakoon, D., & Yu, X. (2016). Smart electricity meter data intelligence for future energy systems: A survey. *IEEE Transactions on Industrial Informatics*, *12*(1), 425–436. https://doi.org/10.1109/TII.2015.2414355

Ali, R., & Zameer, A. (2020). Role of weather in short-term electricity load forecasting: A case study from the Himalayan region. *Energy Reports*, *6*, 355–363.

Bedi, J., & Toshniwal, D. (2021). Load forecasting using deep learning models. *Procedia Computer Science*, *167*, 2452–2461.

Berg, M., & Kok, K. (2016). Smart grid and smart meter data-driven approaches for energy flexibility. *Renewable and Sustainable Energy Reviews*, *57*, 1639–1650.

Brahmbhatt, M., & Shukla, S. (2022). Comparative analysis of machine learning algorithms for short-term load forecasting. *Energy and AI*, *8*, 100135.

Chakrabarti, S., & Singh, A. (2021). Distributed energy systems in Indian hill states: A policy and technical perspective. *Energy Policy*, *156*, 112410.

Clement, D., & Misra, R. (2019). Analyzing seasonal load trends in smart grid data from Northern India. *Journal of Cleaner Production*, *230*, 1161–1173.

Dutta, S., & Gupta, P. (2020). Demand-side management in smart grids: Challenges and opportunities. *Energy Reports*, *6*, 1002–1011.

Farhangi, H. (2010). The path of the smart grid. *IEEE Power and Energy Magazine*, *8*(1), 18–28. https://doi.org/10.1109/MPE.2009.934876

Faruqi, A., & Hledik, R. (2022). Time-of-use pricing and smart metering: A global review. *The Electricity Journal*, *35*(1), 106963.

Garg, A., & Sinha, S. (2019). A review on solar irradiance forecasting techniques. *Renewable and Sustainable Energy Reviews*, *108*, 481–499.

Ghosh, D., & Tiwari, P. (2021). Climate-resilient energy systems for the Himalayan region. *Energy and Climate Change*, *2*, 100050.

Hernandez, J., & Zhang, W. (2021). Urban versus rural electricity consumption dynamics: Implications for smart grid deployment. *Journal of Energy Systems*, *12*(2), 54–68.

IEA. (2020). *Smart Grids and Beyond: Enabling Electricity Systems of the Future*. International Energy Agency. https://www.iea.org/reports/smart-grids

Kumar, R., & Sharma, A. (2018). Real-time load forecasting using weather and load features. *Energy Informatics*, *1*(1), 3.

Mir, A. H., & Bhat, R. A. (2020). Smart grid implementation in Kashmir: Technical and regulatory challenges. *International Journal of Electrical Power & Energy Systems*, *118*, 105763.

Parveen, S., & Najar, A. R. (2023). Forecasting the electricity load of rural and urban households in Kashmir using ARIMA. *Energy and Environment Journal*, *34*(5), 907–918.

Raza, M. Q., & Khosravi, A. (2015). A review on artificial intelligence-based load demand forecasting techniques for smart grid and buildings. *Renewable and Sustainable Energy Reviews*, *50*, 1352–1372.

Singh, V., & Gupta, R. (2022). Electricity consumption pattern modeling using IoT-enabled smart meters. *Journal of Smart Energy Systems*, *9*(3), 201–212.

Srinivas, P., & Awasthi, A. (2022). Short-term electric load prediction using LSTM and GRU. *Journal of Energy Engineering*, *148*(6), 04022033.

Tariq, M. A., & Hussain, S. (2017). Smart grid strategy for Himalayan hill regions of India. *Renewable Energy Focus*, *22*, 19–27.