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Financial Implications of Smart Metering for UPCL

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Introduction

Smart metering is a modern digital system designed to measure electricity consumption in a more accurate, efficient, and transparent manner. Unlike traditional electromechanical meters, which require physical visits by meter readers, smart meters automatically record electricity usage and transmit consumption data directly to the electricity distribution company. This automation significantly reduces dependence on manual meter reading and minimizes errors that often arise due to human involvement, delayed readings, or inaccessible consumer locations.

Smart meters provide real-time or near real-time information on electricity consumption and support two-way communication between consumers and the distribution company. This enables utilities to continuously monitor usage patterns, identify abnormal consumption, detect meter faults, and reduce electricity theft. Accurate data transmission ensures that electricity bills are generated strictly on the basis of actual consumption, thereby reducing billing disputes and enhancing trust between consumers and the utility. From the consumer's perspective, smart meters offer greater control by allowing users to track daily or monthly electricity usage and manage their energy expenses more effectively, helping them avoid sudden or unexpectedly high bills.

One of the most important features of smart metering is prepaid billing. Under this system, consumers are required to recharge their electricity usage in advance, similar to prepaid mobile services. This approach promotes responsible consumption, improves payment discipline, and significantly reduces outstanding dues and delayed payments for distribution companies. In addition, smart meters enable remote disconnection and reconnection of electricity supply in cases of non-payment or technical requirements, which saves time, reduces operational costs, and improves overall system efficiency.

About Uttarakhand Power Corporation Limited (UPCL)

Uttarakhand Power Corporation Limited (UPCL) is the state-owned electricity distribution company of Uttarakhand. It was established in 2001 after the formation of the state and functions as the sole electricity distribution utility responsible for supplying electricity across all districts of the state (UPCL, 2024). The corporation plays a crucial role in ensuring reliable power supply and effective revenue management throughout Uttarakhand.

UPCL serves a diverse consumer base including domestic households, commercial establishments, industrial units, agricultural consumers, and government institutions. Its operations extend across urban centers such as Dehradun, Haridwar, and Haldwani, as well as remote and hilly districts like Chamoli, Uttarkashi, and Pithoragarh (Joshi & Rawat, 2020). This wide geographical coverage makes electricity distribution both operationally complex and resource intensive. Due to Uttarakhand's difficult terrain, scattered settlements, and harsh climatic conditions, UPCL faces significant operational challenges. Manual meter reading in mountainous and remote regions is often disrupted by poor road connectivity, snowfall, landslides, and limited accessibility. These factors result in estimated billing, delayed readings, and billing inaccuracies, which contribute to revenue leakage and higher Aggregate Technical and Commercial (AT&C) losses (Sharma & Singh, 2021).

To address these challenges, UPCL has adopted digital reforms under government initiatives such as the Revamped Distribution Sector Scheme (RDSS). The implementation of smart metering under RDSS has helped improve billing accuracy, reduce technical and commercial losses, strengthen revenue collection, and enhance overall financial performance (Ministry of Power, 2023; UPCL, 2024). Smart metering is therefore considered a key step toward modernizing UPCL's distribution system and improving service delivery across the state.

Significance of Smart Metering for DISCOMs

Smart metering holds significant importance for electricity distribution companies (DISCOMs), particularly state-run utilities such as Uttarakhand Power Corporation Limited (UPCL). One of the most serious challenges faced by DISCOMs in India is the high level of Aggregate Technical and Commercial (AT&C) losses. These losses arise mainly due to electricity theft, inaccurate and estimated billing, meter tampering, and weak collection mechanisms, all of which adversely affect the financial stability of distribution utilities (Sharma & Singh, 2021).

Smart meters play a crucial role in reducing AT&C losses by enabling accurate and automated meter readings. Since electricity consumption data is transmitted digitally to the utility, the scope for human error, manual manipulation, and estimated billing is significantly reduced. In addition, smart meters are equipped with tamperdetection features that help identify unauthorized consumption and meter interference at an early stage, allowing DISCOMs to take timely corrective action (Kumar, 2020). Another major benefit of smart metering is faster billing and improved revenue collection. Automated meter readings eliminate delays associated with manual meter reading, ensuring timely bill generation based on actual consumption. Prepaid smart meters further strengthen financial discipline by requiring consumers to pay in advance for electricity usage. This system improves cash flow, reduces outstanding dues, and minimizes the accumulation of arrears (EESL, 2023). Smart metering also enhances operational efficiency by reducing manpower requirements, lowering meter reading and operational costs, and enabling remote monitoring of the distribution network. For DISCOMs operating in hilly or rural regions, where physical access to consumer premises is often difficult and time-consuming, smart meters reduce dependency on field visits and improve overall service reliability and operational control (Mehra, 2023).

Literature Review

Previous studies consistently highlight smart metering as one of the most effective technological and financial reforms for improving the performance and financial health of electricity distribution companies (DISCOMs). Researchers have pointed out that traditional electromechanical metering systems contribute significantly to revenue leakage due to inaccurate readings, estimated billing, delayed data recording, and heavy dependence on manual meter reading processes. Sharma and Singh (2021) explain that such inefficiencies weaken billing systems and result in poor revenue realization, ultimately increasing Aggregate Technical and Commercial (AT&C) losses for DISCOMs.

Smart metering addresses these limitations by introducing automated meter reading and real-time data transmission. According to Sharma and Singh (2021), automated data collection ensures that electricity consumption is recorded accurately and bills are generated on the basis of actual usage, thereby reducing disputes and improving transparency. The availability of real-time consumption data also allows utilities to monitor usage patterns and identify irregularities more efficiently. Kumar (2020) highlights that smart metering plays a crucial role in reducing AT&C losses by minimizing human intervention and strengthening theft detection mechanisms. Smart meters are capable of detecting meter tampering and unauthorized consumption at an early stage, enabling DISCOMs to take timely corrective actions. This not only reduces commercial losses but also improves billing efficiency and consumer accountability. Mehra (2023) emphasizes that the benefits of smart metering are especially significant

in hilly and geographically challenging states. In such regions, manual meter reading is often unreliable due to poor accessibility, scattered settlements, and adverse weather conditions. Smart meters overcome these challenges by enabling remote monitoring and automated readings, thereby improving operational reliability and reducing dependence on field visits.

Major Role of Smart Metering in Reducing AT&C Losses and Speeding Up Operations

Smart metering plays a significant and multi-dimensional role in reducing Aggregate Technical and Commercial (AT&C) losses in electricity distribution systems. One of the primary causes of high AT&C losses in traditional systems is the heavy dependence on manual meter reading and estimated billing. In many areas, especially remote and hilly regions, meter readers are unable to access consumer premises regularly due to poor connectivity, difficult terrain, or adverse weather conditions. This results in estimated billing, inaccurate consumption records, and revenue leakage. Smart metering addresses these issues by enabling automated meter reading, ensuring that electricity consumption is measured accurately and billed strictly on the basis of actual usage. This improves billing reliability and strengthens consumer trust in the billing system.

Another major contributor to AT&C losses is electricity theft and meter tampering. Traditional meters offer limited protection against unauthorized usage and are often difficult to monitor in real time. Smart meters are equipped with advanced tamper-detection mechanisms that generate instant alerts in cases of meter bypassing, reverse current flow, or abnormal consumption patterns. These alerts allow distribution companies to identify theft-prone areas quickly and take timely corrective action. Early detection not only reduces commercial losses but also acts as a deterrent against future unauthorized consumption, thereby improving overall revenue realization.

In addition to loss reduction, smart metering significantly speeds up operational processes within distribution companies. Automated data transmission ensures that meter readings are available immediately, enabling faster billing cycles and timely bill generation. This eliminates delays associated with manual data collection and entry, reduces administrative workload, and ensures consistency in billing schedules. Faster billing improves cash flow and enhances financial planning for DISCOMs.

Need of the Study

The need for this study arises from the persistent financial and operational challenges faced by electricity distribution companies in India, particularly state-owned utilities such as Uttarakhand Power Corporation Limited (UPCL). Despite improvements in power generation and transmission infrastructure, the distribution segment continues to suffer from high Aggregate Technical and Commercial (AT&C) losses, inaccurate and estimated billing, delayed revenue collection, and increasing levels of outstanding arrears. These issues have placed significant financial pressure on DISCOMs and have limited their ability to invest in infrastructure upgrades and service improvements.

In a hilly state like Uttarakhand, the challenges of electricity distribution are more complex compared to plain regions. Remote and scattered settlements, difficult terrain, poor road connectivity, and frequent weather-related disruptions such as heavy rainfall, snowfall, and landslides make manual meter reading difficult and unreliable. As a result, meter readings are often delayed or skipped, leading to estimated billing instead of actual consumption-based billing. This not only reduces billing accuracy but also contributes to revenue leakage, consumer dissatisfaction, and higher AT&C losses for UPCL.

To address these long-standing issues, smart metering has been introduced as a key technological reform under government initiatives such as the Revamped Distribution Sector Scheme (RDSS). Smart meters promise several benefits, including automated meter reading, real-time consumption data, tamper detection, prepaid billing, and improved billing transparency. However, since smart metering is a relatively recent reform, especially in hilly and remote

districts of Uttarakhand, it is necessary to systematically evaluate its actual impact on UPCL's financial and operational performance.
This study is therefore needed to examine whether smart metering is effectively improving billing accuracy, reducing AT&C losses, strengthening revenue collection, and enhancing the overall financial position of UPCL.

Objectives of the Study

1. To analyze the performance of UPCL in terms of revenue and AT&C losses.
2. Impact of Smart Metering on the Future Performance of UPCL.

Scope of the Study

The scope of this study is to examine in detail the impact of smart metering on the operational and financial performance of Uttarakhand Power Corporation Limited (UPCL). The study focuses on understanding how the introduction of smart meters has influenced key aspects of electricity distribution such as billing accuracy, revenue collection efficiency, reduction in Aggregate Technical and Commercial (AT&C) losses, and overall improvement in operational processes. By concentrating on these parameters, the study aims to evaluate the effectiveness of smart metering as a financial and technological reform for UPCL.
The geographical scope of the study is limited to the state of Uttarakhand, which presents a unique mix of urban centers, semi-urban regions, rural areas, and remote hilly districts. The inclusion of both plain districts like Dehradun, Haridwar, and Udham Singh Nagar, and mountainous districts such as Chamoli, Uttarkashi, Pithoragarh, and Rudraprayag allows for a comparative understanding of smart meter performance under different geographical and infrastructural conditions. This district-wise focus helps in identifying variations in implementation progress, operational efficiency, and financial outcomes across the state.
The study relies exclusively on secondary data sourced from UPCL annual reports, internal performance records, government publications, and official dashboards under schemes such as the Revamped Distribution Sector Scheme (RDSS). The data used includes information related to billing efficiency, collection efficiency, NA/NR cases, defective meters, and arrear levels. As primary data collection is not included, the scope of the study does not cover consumer opinions, field-level operational challenges, or staff perspectives in detail.
the study is limited to the evaluation of smart metering outcomes during the available data period and does not attempt to forecast long-term future impacts beyond the current implementation phase. It also does not include inter-state comparisons with other distribution utilities. Despite these limitations, the scope remains sufficient to provide meaningful insights into how smart metering has affected UPCL's performance and to highlight areas where further improvements and targeted interventions may be required.

Research Methodology

The research methodology adopted for this study provides a systematic framework to examine the impact of smart metering on the operational and financial performance of Uttarakhand Power Corporation Limited (UPCL). Since smart metering is a large-scale technological reform implemented under government schemes, the study relies on a structured and data-based approach to ensure accuracy and reliability of findings. The study is based entirely on secondary data collected from various credible and official sources. These include UPCL annual reports and internal performance records, government publications, reports issued by the Ministry of Power, Revamped Distribution Sector Scheme (RDSS) dashboards, and data from the Smart Meter National Programme. In addition, research journals, academic articles, and policy papers related to smart metering, AT&C losses, and electricity distribution reforms have been referred to in order to build a strong theoretical foundation.
A descriptive research design has been adopted for the study, as it is most suitable for analyzing existing data and identifying patterns, trends, and relationships. This research design helps in

presenting a clear picture of UPCL's performance before and after the implementation of smart metering, particularly with respect to billing efficiency, collection efficiency, loss reduction, and operational improvements. The descriptive approach allows for district-wise comparison within Uttarakhand, highlighting variations in performance across urban, rural, and hilly regions. The collected data has been organized, tabulated, and analyzed using simple statistical tools such as percentages, comparisons, and trend analysis. This method enables easy interpretation of results and supports meaningful conclusions regarding the effectiveness of smart metering. Since the study is based on secondary data, no primary surveys or interviews have been conducted. However, cross-verification of data from multiple sources has been carried out to enhance reliability and reduce the possibility of errors.

District wise status of AT&C and Revenues of UPCL

Table-1: District-wise Fastest Consumer Base Growth in Uttarakhand (FY 2023–24 to 2024–25)

District	Size of Consumer Base (as on 2024-25)	YoY Growth %
Pithoragarh	1,12,642	1.40%
Chamoli	91,985	1.55%
Almora	2,82,851	1.58%
Pauri Garhwal	2,10,819	1.98%
Tehri Garhwal	1,50,172	2.24%
Champawat	58,344	2.57%
Rudraprayag	62,694	2.59%
Haridwar	4,73,487	2.93%
Udham Singh Nagar	4,56,118	3.06%
Nainital	2,86,066	3.31%
Dehradun	6,36,113	3.99%
Uttarkashi	1,30,000	7.00%
Bageshwar	1,16,500	7.37%

Interpretation

The consumer base in Uttarakhand grew unevenly during FY 2023–24 to FY 2024–25, with Bageshwar (7.37%) and Uttarkashi (7.00%) showing the highest growth due to rapid electrification, housing, and infrastructure development in hill areas, while urban and industrial districts such as Dehradun (3.99%), Nainital (3.31%), Udham Singh Nagar (3.06%) and Haridwar (2.93%) also recorded strong expansion driven by urbanization, tourism, and industry. Udham Singh Nagar has the largest consumer base among all districts, reflecting its strong industrial, commercial, and urban character, which results in a higher concentration of electricity demand. In contrast, Pithoragarh, Chamoli, Almora, and Pauri Garhwal experienced relatively low growth, reflecting slower economic and population expansion, indicating that electricity demand is shifting toward both hill regions and key urban centers with significant implications for future power planning and investment.

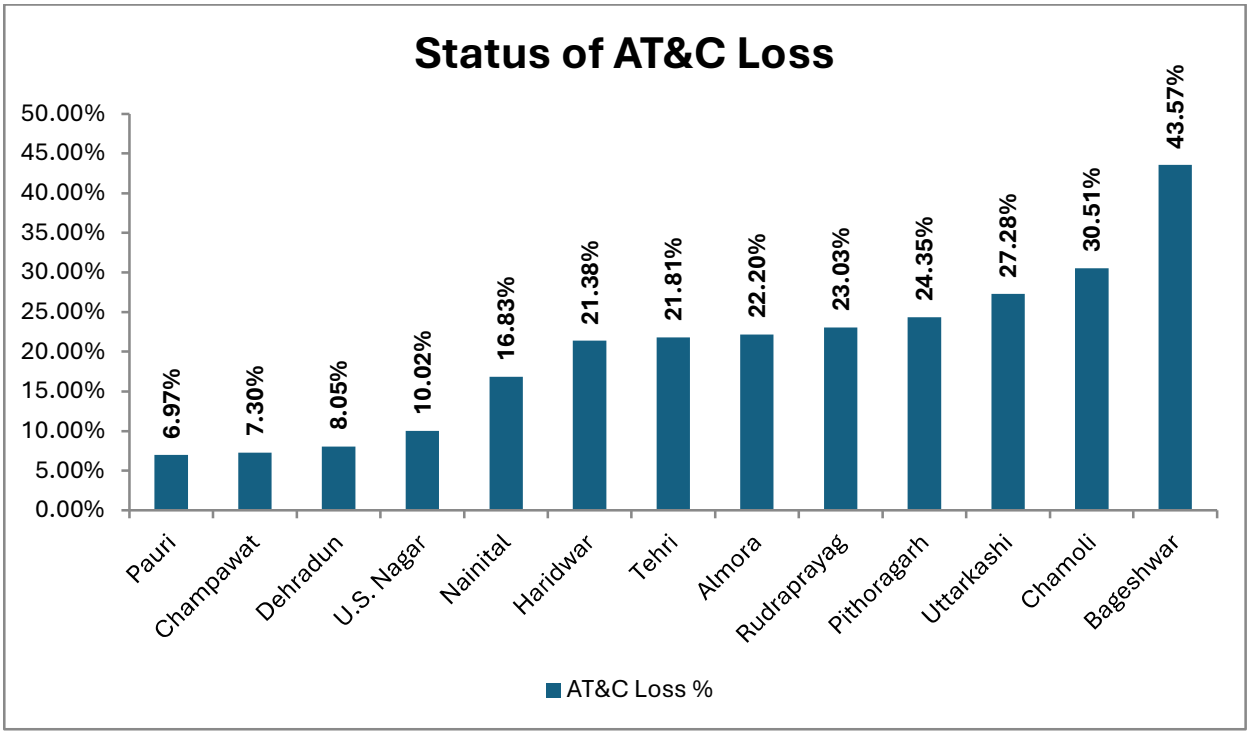

Figure-1: District-wise AT&C Loss Performance Uttarakhand (2023–24)

(Why we don't have data of 2024-25)
District-wise AT&C loss data for FY 2024–25 is not yet available because UPCL publishes detailed and audited district-level AT&C figures only after the completion of annual financial audits and data validation. For FY 2024–25, only provisional and state-level performance data has been released so far, while district-wise figures will be published later in official reports.

Interpretation
The district-wise AT&C loss data for Uttarakhand (2023–24) shows wide variation in power distribution efficiency, with Pauri (6.97%), Champawat (7.30%), Dehradun (8.05%) and U.S. Nagar (10.02%) recording low losses due to strong billing, collection, and network management, while hill districts such as Bageshwar (43.57%), Chamoli (30.51%), Uttarkashi (27.28%), Pithoragarh (24.35%) and Rudraprayag (23.03%) suffer from very high losses caused by difficult terrain, weak infrastructure, and operational inefficiencies, highlighting a clear urban–hill divide in distribution performance.

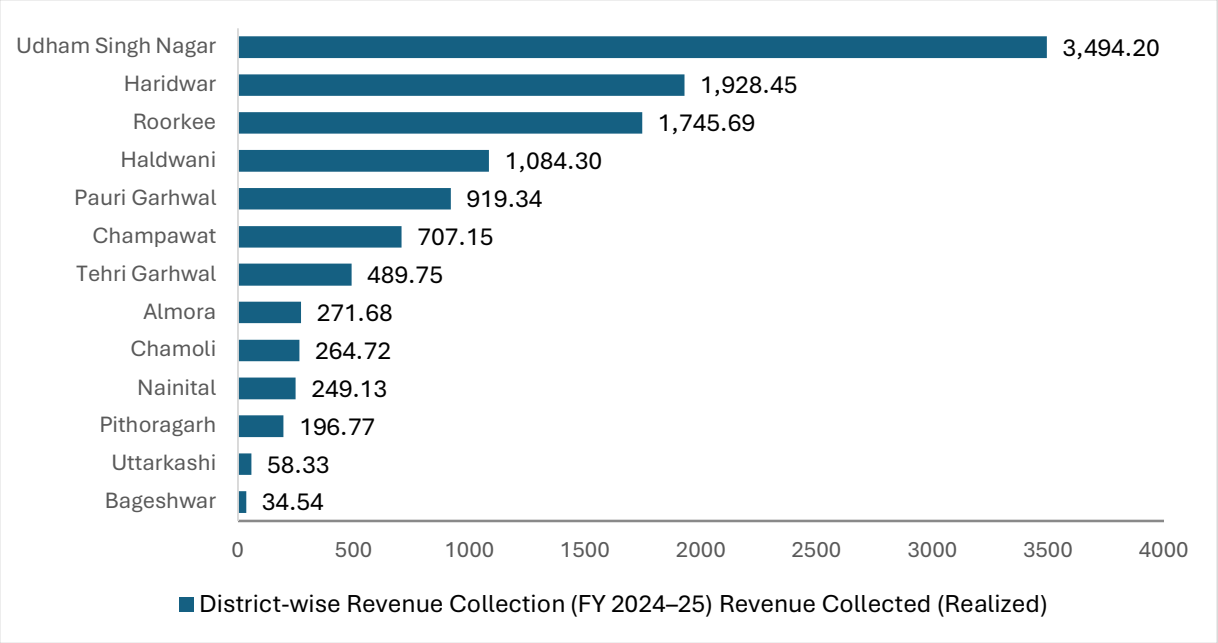

Figure-2: District-wise Revenue Collection (FY 2024–25)

(State- if figures are in lakhs or crore)

Lakhs

Interpretation

The revenue collection pattern in FY 2024–25 shows that Uttarakhand's power revenue is heavily concentrated in a few districts, with Udham Singh Nagar as the largest contributor followed by Roorkee and Haridwar, together forming the financial backbone of the utility, while Pauri Garhwal and Tehri Garhwal contribute moderately and hill districts like Chamoli, Pithoragarh, Uttarkashi, and Bageshwar contribute very little despite high collection efficiency, indicating that the main revenue challenge lies not in collection but in low demand and a weak consumer base in hilly regions, whereas plains and industrial districts drive most of the utility's financial strength.

Table-2: Slab-wise Analysis of Outstanding Electricity Arrears in Uttarakhand (FY 2023–24 to FY 2024–25)

Analysis of Outstanding Arrear Levels				
FY (2023–24 to FY 2024–25)				
Slab	**23–24 (No. & %)**	**23–24 Amount (₹ lakh & %)**	**24–25 (No. & %)**	**24–25 Amount (₹ lakh & %)**
₹5 lakh & Above	3,020 (0.99%)	10,605.9 (19.34%)	2,806 (0.99%)	9,765.2 (19.36%)
₹1 – 5 lakh	11,051 (3.63%)	1,946.7 (3.55%)	10,686 (3.78%)	1,917.3 (3.80%)
₹50,000 – 1 lakh	21,470 (7.06%)	1,483.0 (2.70%)	19,128 (6.76%)	1,319.0 (2.61%)
₹10,000 – 50,000	152,484 (50.14%)	32,505.8 (59.27%)	138,072 (48.79%)	29,471.3 (58.42%)
Below ₹10,000	116,093 (38.17%)	8,297.7 (15.13%)	112,327 (39.69%)	7,974.8 (15.81%)
Total	304,118 (100%)	54,839 (100%)	283,019 (100%)	50,448 (100%)

• Figures in brackets indicate the proportionate weightage of arrears in various slabs of pending arrears.

Interpretation

The slab-wise analysis of outstanding electricity arrears from FY 2023–24 to FY 2024–25 indicates a gradual improvement in UPCL's revenue recovery performance, as both the number of defaulters and total arrears declined across most slabs. High-value defaulters in the ₹5 lakh & above category reduced in both number and amount, though they still account for about 19% of total arrears, making them a major risk group. The ₹10,000–₹50,000 slab remains the most critical, contributing nearly 58–59% of total arrears despite a fall in consumer count, showing that mid-range consumers are the main source of revenue backlog. Small consumers below ₹10,000, while large in number, contribute only about 15–16% of arrears, indicating lower financial risk. Overall, the trend reflects improving billing and recovery efficiency, but UPCL's future revenue stability will largely depend on better control over mid- and high-value defaulters through targeted recovery measures and the continued expansion of smart metering.

Table-3: Proportionate Achievement of Sanctioned Smart Consumer Meters in Northern States (as on 31 December 2025)

Proportionate Achievement of Sanctioned Smart Consumer Meters in Northern States		
(as on 31-Dec-2025)		
State	**Cumulative Smart Meters Installed**	**Proportionate Achievement (%)**
Delhi	2,60,000	100.00%
Ladakh	55,580	94.30%
Haryana	8,47,467	84.70%
Chandigarh	24,214	82.30%
Jammu & Kashmir	11,79,117	50.50%
Himachal Pradesh	8,53,786	28.90%
Uttarakhand	4,11,358	25.90%
Uttar Pradesh	68,12,965	21.80%
Punjab	18,17,929	16.20%
Rajasthan	20,13,774	13.70%

Interpretation

The proportionate achievement of sanctioned smart consumer meters across northern states as on 31 December 2025 reveals wide variation in implementation progress, with Delhi (100.00%), Ladakh (94.30%), Haryana (84.70%), and Chandigarh (82.30%) showing very high achievement due to faster execution, compact geography, and stronger infrastructure, while Jammu & Kashmir records a moderate 50.50% progress under challenging conditions; in contrast, Himachal Pradesh (28.90%), Uttar Pradesh (21.80%), Punjab (16.20%), and Rajasthan (13.70%) reflect slower rollout. Uttarakhand has achieved 25.90% of its sanctioned smart metering target with a cumulative installation of 4,11,358 smart meters, placing it outside the top-performing northern states but comparable to other hilly and large states facing geographical, connectivity, and operational constraints. The moderate achievement level in Uttarakhand can largely be attributed to difficult terrain, scattered consumer settlements, and communication infrastructure limitations; however, when viewed among all states with sanctioned smart metering projects, Uttarakhand's performance indicates steady rather than weak implementation, suggesting that focused acceleration in high-loss districts, improved communication networks, and wider adoption of prepaid smart meters can significantly enhance its future proportionate achievement.

UPCL Performance

Uttarakhand Power Corporation Limited (UPCL) plays a critical role in the electricity distribution system of the state and operates under challenging geographical and operational conditions. An assessment of UPCL's performance shows mixed but improving trends in recent years, particularly after the introduction of digital reforms such as smart metering. The utility has made noticeable progress in strengthening billing systems, improving revenue collection, and reducing certain operational inefficiencies, though challenges remain in remote and hilly regions.

Billing efficiency has shown improvement across many divisions, especially in urban and semi-urban districts such as Dehradun, Haridwar, Haldwani, and Udham Singh Nagar. These areas benefit from better infrastructure, higher consumer density, and improved meter accessibility. The gradual replacement of traditional meters with smart meters has reduced dependence on estimated billing and manual readings, resulting in more accurate billing and fewer consumer complaints.

Collection efficiency has also improved in several divisions, supported by timely billing, digital payment options, and focused arrear recovery drives. In some areas, collection efficiency has exceeded 100 percent, indicating recovery of past dues along with current billing. This reflects improved financial discipline among consumers and stronger enforcement measures adopted by UPCL.

Operational indicators such as NA (Not Accessible) and NR (Not Read) cases have declined in many divisions, suggesting better meter accessibility and improved monitoring systems. However, hilly and remote districts such as Chamoli, Uttarkashi, Pithoragarh, and Rudraprayag continue to record higher NA and NR levels due to difficult terrain, scattered settlements, and weather-related disruptions. These factors increase operational costs and slow the pace of improvement.

UPCL has also made efforts to manage defective meters and reduce outstanding arrears, though the burden remains significant in certain divisions. High-value consumer arrears, particularly in industrial and commercial categories, continue to pose financial risks. Overall, UPCL's performance reflects gradual improvement supported by smart metering and digital initiatives, but sustained efforts, targeted interventions, and infrastructure strengthening are required to achieve uniform performance across the state.

Future of Smart Metering in UPCL

Smart metering is expected to play a crucial role in shaping the future of electricity distribution and financial sustainability of Uttarakhand Power Corporation Limited (UPCL). As the utility continues to expand smart meter deployment under national reform programs, smart metering will become a core component of UPCL's operational and revenue management strategy. The gradual replacement of traditional meters with advanced smart meters will further improve billing accuracy, reduce manual intervention, and strengthen transparency in electricity consumption and billing processes.

One of the key future developments will be the wider adoption of prepaid smart meters across both urban and rural areas. Prepaid metering will help UPCL maintain steady cash flow by ensuring that electricity is consumed only after payment. This will significantly reduce outstanding arrears and improve financial discipline among consumers. High-risk and high-arrear consumer categories can be specifically targeted for prepaid metering to minimize revenue loss and improve recovery efficiency.

Strengthening communication infrastructure will also be critical for the successful expansion of smart metering in Uttarakhand. In many hilly and remote regions, network connectivity remains a major challenge. Investment in reliable communication technologies such as hybrid networks, signal boosters, and improved data management systems will ensure uninterrupted data transmission from smart meters to central servers. Improved connectivity will enhance real-time monitoring, fault detection, and system reliability across all districts.

Consumer awareness and acceptance will play an equally important role in the future of smart metering. UPCL will need to conduct awareness campaigns to educate consumers about the benefits of smart meters, including accurate billing, real-

time consumption monitoring, and better control over electricity expenses. Increased consumer trust and participation will support smoother implementation and reduce resistance to meter replacement.

Conclusion

This study examined the financial implications of smart metering for Uttarakhand Power Corporation Limited (UPCL) using district-wise data on consumer base growth, AT&C losses, revenue collection, outstanding arrears, and the status of smart meter implementation. The analysis shows that electricity demand in Uttarakhand is growing unevenly, with higher growth and a larger consumer base concentrated in urban and industrial districts such as Dehradun, Udham Singh Nagar, Nainital, and Haridwar, while many hilly districts continue to experience slower growth and operational constraints.

District-wise AT&C loss performance reveals a clear contrast between plains and hill regions. Plains districts demonstrate relatively lower losses due to better billing systems, higher collection efficiency, and stronger infrastructure, whereas hilly districts record significantly higher losses because of difficult terrain, dispersed consumers, and technical and operational challenges. Revenue collection remains heavily concentrated in a few high-demand districts, indicating that UPCL's financial stability largely depends on urban and industrial centers rather than hilly regions.

The slab-wise arrear analysis indicates an overall improvement in collection performance during FY 2024–25, with a reduction in both the number of defaulters and total outstanding arrears across all slabs. However, mid- and high-value defaulters continue to account for a major share of arrears, highlighting the need for targeted recovery measures. Smart metering has contributed to improved billing accuracy, transparency, and revenue control, but the implementation progress remains uneven and relatively slow, particularly in hilly districts.

Overall, the study concludes that smart metering has had a positive impact on UPCL's financial and operational performance. However, faster and more focused deployment, especially in high-loss and hilly districts, along with continued improvements in infrastructure and prepaid metering adoption, is essential to achieve uniform efficiency and long-term financial sustainability for UPCL.

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