

A Review Paper on Power Theft in Electrical Distribution System

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Abstract

Power theft remains a significant challenge in energy distribution systems globally, impacting operational efficiency, revenue streams, and socio-economic development. This research paper presents a comprehensive review of power theft, drawing on case studies from diverse regions to examine its causes, socio-economic impacts, and mitigation strategies. Through an analysis of real-world examples and empirical evidence, this paper aims to provide insights into the complexities of power theft and inform targeted interventions for sustainable energy management and socio-economic progress.

Keywords: *Power theft, energy distribution, case studies, socio-economic impacts, mitigation strategies.*

Introduction: -

In the landscape of modern energy distribution, the clandestine diversion of electricity, commonly known as power theft, stands as a persistent challenge with far-reaching implications. Power theft encompasses a spectrum of illicit activities, ranging from tampering with meters to illegal connections and bypassing billing mechanisms. While prevalent across various regions, it disproportionately affects developing and emerging economies, where factors such as poverty, inadequate infrastructure, and lax regulatory enforcement converge to create fertile ground for illicit energy diversion.

The significance of addressing power theft cannot be overstated. Beyond the immediate financial losses incurred by utility companies, power theft undermines the integrity of electrical infrastructure, contributes to energy inefficiency, and perpetuates socio-economic disparities. Moreover, it poses a barrier to achieving universal access to electricity and hinders efforts toward sustainable development.

Understanding the complex dynamics of power theft requires a multidisciplinary approach that delves into its root causes, socio-economic impacts, and potential mitigation strategies. This research paper aims to contribute to this discourse by examining the intricacies of power theft and exploring avenues for effective intervention.

The first section of this paper will delve into the causes of power theft, shedding light on the socio-economic, institutional, and cultural factors that contribute to its prevalence. From there, the subsequent sections will explore the wide-ranging impacts of power theft, encompassing its effects on utility companies, consumers, and society at large. Finally, the paper will delineate potential mitigation strategies, encompassing regulatory reforms, technological innovations, community engagement, and public awareness campaigns.

Objective: -

This proposed system is designed using smart meters installed on each distribution pole grid/node and each consumer house.

The power distribution sector has been played with distribution losses (overall 30%) coupled with theft of electricity. To minimize the theft of power by bypassing or by hooking we are proposing a digital IC which will notify about the theft of electricity that is happening in a particular area.

Our main objective to make a circuit which can reduces electricity thief. When a power theft incident is reported, the light in the that area or house the light get ON OFF.

What is power theft?

Power theft is the criminal practice of stealing electrical power. It is accomplished via a variety of means, from methods as rudimentary as directly hooking to a power line, to manipulation of computerized electrical meters¹. According to Section 135 of the Electricity Act 2003, electricity theft occurs when a person taps electricity lines, tampers with electricity meters or transformers or uses a device that interferes with reading or damages equipment such as electric meters or uses electricity for purposes other than authorized.

Power theft occurs when individuals tamper with electric service by trying to bypass the electric meter at a service panel. Tampering can create unsafe conditions that could possibly result in electrical shock, fire, explosion or death.

This is accomplished by installing an electronic energy meter on the load side, with meter readings wirelessly transmitted to the distribution unit. The wireless receiver receives this reading and compares it to the actual power applied to the load.

Power theft refers to the illegal diversion or unauthorized consumption of electricity from utility grids without proper payment or authorization. This can take various forms, such as tampering with meters, bypassing metering mechanisms, or tapping into electrical lines illegally. Power theft poses significant challenges to utility companies, regulators, and society, leading to revenue losses, compromised infrastructure, energy inefficiency, and socio-economic disparities. Understanding power theft involves examining its root causes, socio-economic impacts, and potential mitigation strategies to address this complex issue effectively.

Types of power theft

There are few types of power thefts are existing in our society and the types are the following:

1. Hooking

This is the most using method found in our society, the direct hooking from the power line means the power is tapping from the utility's distribution line. This kind of theft of power is unmeasured and most dangerous act of power theft.

2. Bypassing

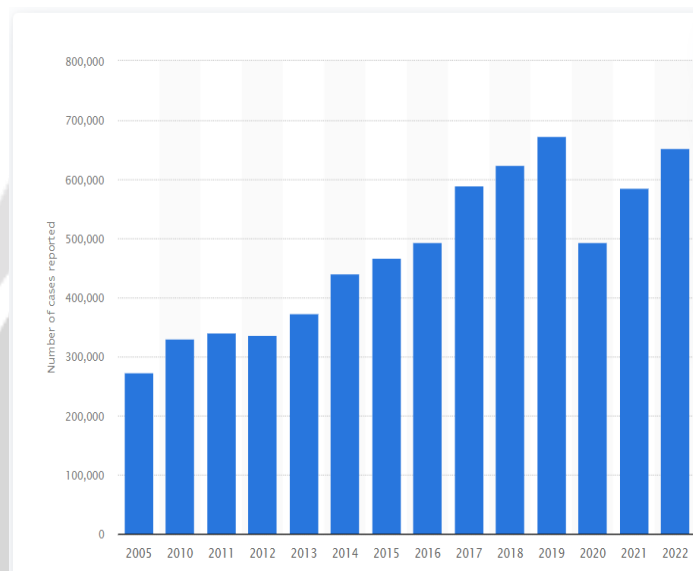
The bypassing of the energy meter means the input and output terminals of the energy meter is short-circuited and the power is bypassing the consumption recording function of the energy meter.

3. Installing external elements

In this method the energy meters are manipulated by installing external elements like circuits or alike things. Due to the external element is controlled remotely to slowdown the consumption registers of energy meter. It requires time consuming expert analysis to find the theft.

4. Electro Static Discharge

The Electro Static Discharge (ESD) method is modern technique used in the modern meters like digital electronic meters. This kind of theft can be identify now a days by accurate inspection and analysis of energy meters on premises and high-end meters have built in functionality to detect easily.



Power theft scenario of India from 2005 to 2022

power theft cases in Maharashtra for the year 2022. While I couldn't locate a specific graph, the statistics indicate that there was a significant number of power thefts detected. For instance, in a three-month period, 2,625 power thefts were detected across Maharashtra. Additionally, in the distribution areas of Adani Electricity, which supplies electricity to a large number of consumers in Mumbai, there was a 38% increase in power theft cases detected in 2022 compared to the previous year.

India's power companies lose revenue on about a fifth of the electricity they supply, or about USD 10.2 billion annually, due to problems including theft, meter tampering, billing issues and leakage due to faulty equipment. The World Bank estimated that in 2011 power sector debt reached INR 3.5 trillion (USD 77 billion), that is 5 pc of India's GDP. Of all the power generated in the country, around one fourth is either stolen or lost in transmission.

Transmission and distribution losses at the national level in India were about 22.77 pc in 2014-15 and 21.81 pc in 2015-16. Some states incurred higher losses than the national average in FY15-16 and these include Madhya Pradesh (28.61 pc), Rajasthan (29.13 pc), Chhattisgarh (30.78 pc), Haryana (31.61 pc), Odisha (39.15 pc), Bihar (49.29 pc) and Jammu and Kashmir (50.06 pc). So theft power indicates loss of revenue.

Prevention of Power theft

Smart and connected meters-

Distributor company increasingly use new technologies to avoid power theft, fraud. For that reasons DISCOM introduce smart meter in every residential and commercial connections and change old conventional meters with smart

meter free of cost. To reduction of power loss utilities having great responsibility that they should change their loads with led or energy saving instruments.

Preventing power theft in distribution systems requires a multi-faceted approach that addresses various aspects of the problem. Here are some key prevention strategies:

Strengthening Legal Frameworks: Implement and enforce stringent laws and regulations that deter power theft. This includes imposing severe penalties on offenders, prosecuting individuals and entities involved in power theft, and enhancing regulatory oversight.

Advanced Metering Infrastructure (AMI): Deploy smart meters and advanced metering infrastructure to accurately measure and monitor electricity consumption in real-time. Smart meters can detect abnormal usage patterns indicative of power theft, enabling utilities to take timely action.

Technological Solutions: Utilize technology such as tamper-evident meters, anti-tampering devices, and remote monitoring systems to detect and prevent unauthorized access to electricity. Employing digital encryption and authentication mechanisms can enhance the security of metering systems and prevent tampering.

Grid Monitoring and Analytics: Implement grid monitoring systems equipped with advanced analytics capabilities to detect anomalies, identify areas with high incidences of power theft, and pinpoint unauthorized connections. Real-time monitoring allows utilities to respond swiftly to incidents of theft and take appropriate enforcement actions.

Public Awareness Campaigns: Raise awareness among consumers about the consequences of power theft, emphasizing its impact on electricity prices, service reliability, and safety. Educate customers on the legal and ethical implications of stealing electricity and encourage them to report suspicious activities to utility authorities.

Community Engagement: Foster collaboration with local communities, neighborhood associations, and law enforcement agencies to combat power theft effectively. Encourage community members to become vigilant watchdogs and report instances of power theft or suspicious behavior in their neighborhoods.

Regulatory Collaboration: Collaborate with regulatory agencies, government authorities, and industry stakeholders to develop comprehensive strategies for combating power theft. Coordinate efforts to streamline legal processes, share information, and implement best practices for prevention and enforcement.

Economic Incentives and Assistance: Provide economic incentives, subsidies, or assistance programs to low-income households or businesses struggling to afford electricity. Addressing the root causes of power theft, such as poverty and affordability issues, can help reduce the motivation for individuals to engage in illicit activities.

Conclusion & Future Scope

The traditional detection methods of power theft mainly rely on the scheduled operations of technicians who work in power supply enterprises. The operation goes with reading the electricity meter and then recording, counting, and performing manual analysis and calculation but this method does not give satisfactory result. So, we think about new methods and process how to identifying power theft and prevent it to save the Power Industry. This is a review paper discuss some ideas, aspects only for research analysis. the heavy power and revenue losses that occur due to power theft by customers. By this design it can be concluded that power theft can be effectively curbed by detecting where the power theft occurs and informing the authorities. we can identify electricity power theft by looking towards this energy metering system tracking theft detection technology is used.

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