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Advancing smart metering and regulatory frameworks in Albania's energy sector

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Abstract

The energy sector in Albania requires modernization through the implementation of reliable metering systems and the adoption of standardized regulatory criteria. Such measures are essential to ensuring efficiency, transparency, and long-term sustainability within the sector. Without these improvements, economic stability may be significantly compromised. This study provides a comprehensive evaluation of the current metering infrastructure in Albania, with the primary objective of identifying challenges related to energy monitoring and data management and proposing feasible solutions. The analysis examines best practices in metering technologies alongside relevant regulatory frameworks to assess their applicability within the Albanian context. Financial support for this research was provided by the Government of Albania. Particular attention is given to community-specific regulations and innovative approaches to electricity and water metering. Data were collected through stakeholder consultations, technical assessments, and reviews of national regulatory policies. The study outlines a strategic plan for the implementation of smart metering applications, emphasizing the use of digital platforms, process optimization, and adaptability to evolving legal frameworks. Anticipated benefits include improved billing accuracy, reductions in technical and non-technical losses, and increased consumer trust. Conducted in collaboration with energy experts, regulators, and policymakers, this research aims to enhance transparency in the energy sector and support Albania's alignment with European Union energy standards.

Keywords: Energy sector, Metering systems, Smart metering, Billing accuracy, Water and electricity metering, Policy and regulation, EU energy requirements.

1. Introduction

The energy sector in Albania is currently at a critical juncture, driven by rapid tech-

nological advancements and an increasing demand for reliable and environmentally sustainable energy solutions. In its efforts to comply with European Union regulations and adopt international best practices, Albania has identified the modernization of its energy infrastructure as a strategic priority. Within this context, smart metering systems have emerged as a fundamental component of the ongoing transformation, increasingly regarded as essential for improving customer service, ensuring transparent billing, and enhancing overall energy management. Compared to traditional metering systems, smart metering offers several significant advantages, including more accurate measurement of energy consumption, remote monitoring capabilities, and real-time data collection. These features provide substantial benefits for utility companies, such as improved grid management, reduced technical and non-technical losses, and more efficient integration of distributed renewable energy sources. From the consumer perspective, smart meters increase awareness of energy consumption patterns and empower users to make informed decisions regarding their energy use. Additionally, smart metering supports demand-side management, peak load reduction, mitigation of energy theft, and improved revenue collection. Despite these advantages, the large-scale implementation of smart metering in Albania faces several challenges. Significant financial investment is required to deploy the necessary infrastructure, and ensuring compatibility between new technologies and the existing grid remains a major concern. Data privacy and cybersecurity issues also represent critical barriers, as the protection of sensitive consumer information must be guaranteed. Furthermore, public awareness and acceptance of smart metering technologies are limited, highlighting the need for consumer education and specialized training for utility personnel. Until these issues are adequately addressed, nationwide deployment of smart meters remains constrained. While technological innovation is essential, regulatory adaptability is equally important. Albanian regulatory authorities must address the additional complexities introduced by smart metering systems, including the establishment of clear frameworks for data ownership, data protection, and data sharing. Moreover, regulatory mechanisms should ensure that pricing structures and incentive schemes promote energy-efficient and environmentally responsible consumption. Well-designed regulatory adjustments have the potential to stimulate innovation, safeguard consumer rights, and enhance competition among energy service providers. The objective of this study is to provide a comprehensive overview of smart metering in Albania's energy sector, examining both its current implementation and future potential. The analysis considers the preparedness of key stakeholders—government institutions, utility companies, and consumers—as well as the evolving regulatory and standardization landscape. Particular emphasis is placed on the role of pilot projects and targeted investments. By assessing the opportunities and limitations associated with various development scenarios, this study aims to propose policy recommendations and practical strategies to support the development of a smarter, more resilient, and consumer-oriented energy system in Albania.

2. Current State of Albania's Energy Sector

Hydropower plays a dominant role in the electricity supply of Albania. According to the World Bank, by 2022 the country was able to generate more than 95% of its electricity domestically, largely from renewable sources. This heavy reliance on hydropower positions Albania as a regional leader in green energy. However, such dependence also exposes structural vulnerabilities. The Energy Community Secretariat (2023) reports that climate change is increasingly constraining electricity generation, primarily due to more frequent and severe droughts as well as growing variability in annual precipitation levels. As a consequence, Albania often relies on electricity imports during periods of reduced hydropower output. The International Energy Agency (2021) warns that rising consumer electricity prices may further exacerbate trade imbalances under these conditions. A major challenge facing Albania's energy sector is the obsolescence of its infrastructure. Much of the transmission and distribution equipment was installed decades ago, resulting in significant financial and operational inefficiencies. Technical losses are largely attributed to aging equipment, deteriorated distribution lines, and insufficient maintenance practices. In addition, non-technical losses—such as electricity theft, illegal connections, and meter tampering or malfunction—remain widespread (IEA, 2021; Energy Regulatory Entity [ERE], 2021). Sector reports indicate that distribution losses remain substantially higher than the European Union average, ranging between 20% and 25% (ERE, 2021). These losses negatively affect utility revenues, supply reliability, and consumer trust in the electricity system. The rigidity of the existing metering infrastructure further limits the sector's ability to adapt. Traditional electromechanical meters, which are still widely used in both urban and rural areas, can often be recalibrated but are generally less accurate and reliable than modern digital alternatives (ERE, 2021). The absence of advanced metering technologies constrains utilities' capacity to detect faults, identify theft, and manage losses efficiently. Manual meter reading also increases the risk of human error and fraud. Consequently, shortcomings in current energy management software and tariff systems can be attributed in part to the lack of transparency and reliability associated with outdated metering practices (European Commission, 2020). In response to these challenges, pilot smart metering initiatives have been introduced in several major urban centers and industrial zones across Albania. Supported by government funding and international donors, these projects aim to deploy smart meters capable of remote reading, real-time data collection, and improved billing accuracy (IEA, 2021). Despite their technical potential, large-scale consumer acceptance has been limited. High upfront investment costs, restricted access to concessional financing, and unresolved technical and regulatory barriers within utilities continue to slow adoption (IEA, 2021). Regulatory reform has also been influenced by Albania's alignment with the European Union's Third Energy Package. According to the European Commission (2020), the primary objectives of this framework include facilitating cross-border electricity trade, strengthening consumer protection, and promoting competition within the energy market. Key reforms include market

liberalization, enhanced regulatory oversight, and the unbundling of electricity generation, transmission, and distribution activities. The Energy Community Secretariat (2023) emphasizes that the Energy Regulatory Entity (ERE) plays a central role in ensuring that new metering infrastructure complies with EU standards and actively supports the deployment of smart metering technologies.

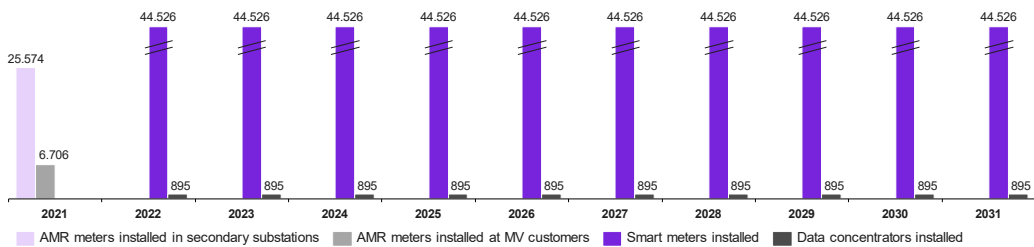


Figure 1. Summary of meters installed 2021-2031

3. The Role of Smart Metering

3.1 Benefits

Smart metering technologies are transforming electricity systems by enhancing operational simplicity, speed, and efficiency. Through continuous monitoring of electricity consumption, smart meters enable utility companies to obtain accurate, real-time data on energy use. For consumers, this eliminates the need for estimated billing and manual meter readings, ensuring that charges are based on actual consumption (International Energy Agency, 2021). From a utility perspective, smart metering supports improved billing accuracy and accelerates the identification of non-technical losses, including electricity theft and meter manipulation (Energy Regulatory Entity [ERE], 2021). Remote meter reading represents a core component of smart energy systems. Manual meter inspections are time-consuming, costly, and susceptible to human error, whereas automated data transmission significantly reduces operational expenses. According to the European Commission (2020), effective grid management requires transparent regulatory frameworks and efficient access to high-quality consumption data. Smart metering technologies facilitate these requirements by enabling utilities to monitor system performance more accurately and respond promptly to irregularities. For households and businesses, smart meters provide real-time visibility of electricity consumption, which can encourage more efficient energy use. Increased awareness of consumption patterns may motivate users to adopt demand-response technologies, modify usage behavior, and reduce overall energy demand. Furthermore, smart meters that support time-based pricing structures allow consumers to shift electricity use away from peak periods, thereby lowering costs while improving grid efficiency. Smart metering also plays a critical role in supporting the integration of renewable energy sources, particularly solar and wind power. By enabling two-way communication between utilities and consumers, smart meters facilitate better coordination of distributed energy generation. The World Bank (2022) highlights that

such systems enhance grid reliability and maximize the utilization of renewable energy resources. For Albania, the rapid adoption of smart metering is essential to supporting a transition toward a more sustainable energy mix. Ultimately, smart meters contribute to the development of more efficient power systems that align with European Union standards for energy efficiency and environmental performance.

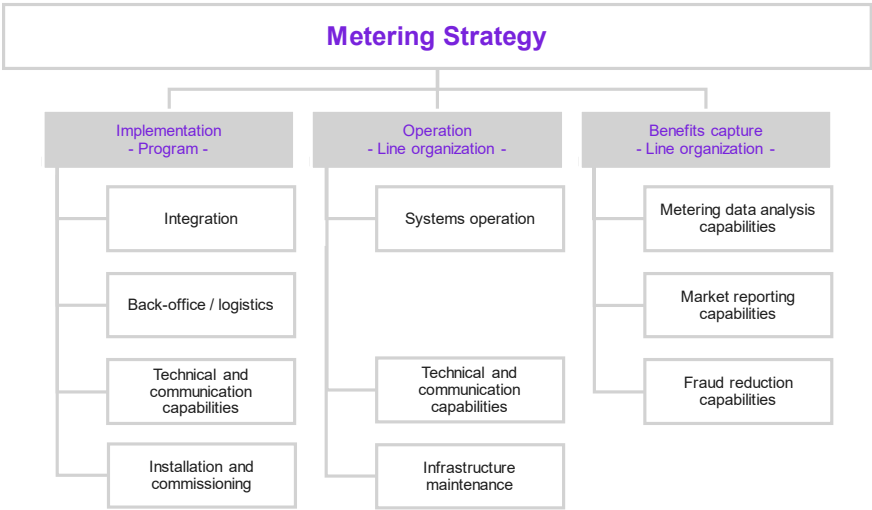


Figure 2. Summary of necessary capabilities in the implementation, operation and benefits capture

3.2 Challenges

Despite the potential of smart metering systems to significantly enhance energy efficiency, several barriers continue to hinder their widespread adoption, particularly at the household level. The deployment of advanced information technology systems, the installation of smart meters, and the modernization of electricity distribution infrastructure require substantial financial investment. In addition, extensive workforce training is necessary to ensure the proper installation, operation, and maintenance of new metering technologies (Energy Community Secretariat, 2023). These requirements contribute to increased operational costs for utility companies and may slow large-scale implementation efforts. Technological interoperability and standardization represent further challenges. Smart meters produced by different manufacturers must be compatible with existing grid architectures and communication protocols. Without clearly defined and universally adopted technical standards, metering systems may be unable to communicate effectively, resulting in fragmented and inefficient networks. Such interoperability issues are commonly observed during large-scale deployment programs and can undermine the overall performance of smart metering initiatives (International Energy Agency, 2021). Data privacy and cybersecurity concerns have also become increasingly prominent as smart meters collect and transmit detailed information on electricity consumption. Inadequate tech-

nological, legal, or organizational safeguards may expose consumers to risks such as unauthorized access, data theft, or misuse of personal information. The European Commission (2020) emphasizes the need for stronger cybersecurity regulations and increased investment in data protection measures to address these vulnerabilities. Finally, social acceptance remains a critical barrier to smart metering adoption. Public skepticism and resistance often stem from limited awareness of smart meter functionalities and perceived risks related to privacy and costs. Building consumer trust requires clear, accessible information and targeted education initiatives. Moreover, continuous professional training for utility company staff is essential to ensure familiarity with evolving technologies and best practices in smart metering deployment (Energy Regulatory Entity [ERE], 2021).

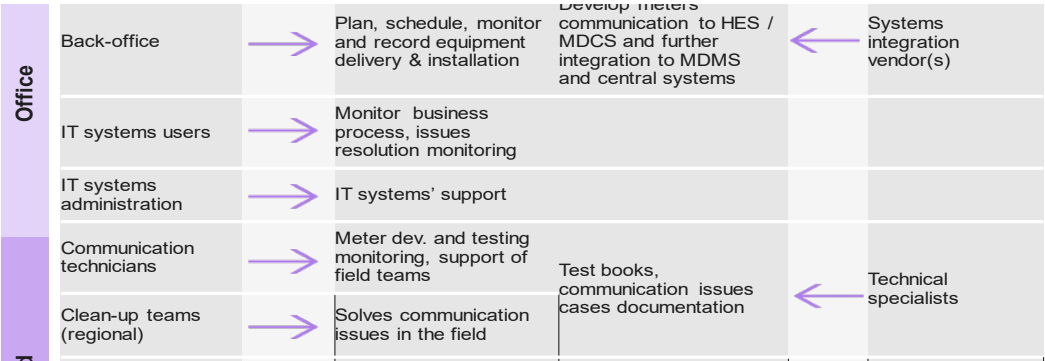


Figure 3. Summary of necessary capabilities for the Metering Strategy implementation and operation

3.3. Regulatory Frameworks: Current Status and Gaps

The alignment of Albania’s energy sector regulations with those of the European Union has been largely driven by the Law on the Power Sector No. 43/2015. This legislation provides the foundational framework governing metering practices, market operations, and consumer protection within the electricity sector. According to the Energy Community Secretariat (2023), the adoption of advanced technologies is also essential to enhancing market competitiveness and operational efficiency. In this context, the Energy Regulatory Entity (ERE) has taken proactive steps by issuing regulatory guidance to facilitate the deployment of smart metering systems and improve electricity service provision. Nevertheless, several legal constraints continue to limit the widespread adoption of smart meters. One of the most significant regulatory gaps is the absence of detailed secondary legislation establishing minimum technical standards for smart metering systems. As noted by the European Commission (2020), such standards are necessary to define interoperability requirements, data accuracy thresholds, and system reliability benchmarks. Without clearly articulated technical criteria, smart metering devices and associated information systems may fail to operate cohesively, potentially undermining both utility efficiency and con-

sumer confidence. Data governance represents another area where regulatory provisions remain insufficient. Clear and enforceable rules concerning data ownership, storage, transfer, and usage are critical to ensuring the security and appropriate use of consumer information. The lack of comprehensive data governance regulations may erode public trust and discourage both consumers and investors from supporting the deployment of advanced metering technologies. Financial and cost-recovery mechanisms also present substantial regulatory challenges. Network operators currently face uncertainty regarding how investments in smart metering infrastructure can be recovered through tariffs or other financial instruments. The World Bank highlights that the existing legislative framework does not clearly specify whether distribution companies are mandated to install smart meters or how associated capital costs should be compensated. This regulatory ambiguity complicates investment planning and weakens the business case for large-scale smart meter rollouts. Furthermore, consumer protection regulations require revision to address emerging risks associated with smart metering, including data breaches, billing transparency, and service quality. As smart meters increasingly influence the entire energy value chain, robust mechanisms for dispute resolution and consumer safeguards become essential. The ERE (2017) emphasizes the importance of establishing procedures to manage conflicts and protect consumers from potential harm arising from advanced metering technologies. To fully realize the benefits of smart metering, Albania must maintain a regulatory framework that is coherent, transparent, and enforceable. Clear data governance rules, well-defined financial incentives, and strong consumer protection measures are necessary preconditions for success. Achieving widespread adoption will also require closer cooperation among regulators, utilities, and consumers, supported by continuous regulatory refinement and institutional capacity building.

4. Conclusions and Policy Recommendations

The nationwide implementation of a smart metering program represents a strategic pathway for Albania to address persistent inefficiencies and structural weaknesses within its energy sector. According to the International Energy Agency (2021), priority should initially be given to high-consumption users and large-scale consumers, allowing for a phased deployment strategy with clearly defined implementation targets. A multi-stage rollout framework would enable policymakers to evaluate performance outcomes, refine technical standards, and manage financial risks effectively. In parallel, regulatory reform must accompany technological deployment. The European Commission (2020) emphasizes the necessity of adopting secondary legislation addressing data protection, cybersecurity, and cost-recovery mechanisms. Clear enforcement procedures and monitoring standards are essential to ensure compliance and maintain public trust in smart metering systems.

Financing large-scale implementation remains a central challenge. The World Bank (2022) suggests that utilities may consider tariff adjustments, public-private partnerships, or blended financing mechanisms as viable funding strategies. These ap-

proaches can help distribute investment costs while preserving financial sustainability within the sector. Public engagement is equally important. According to the Energy Regulatory Entity (ERE, 2021), increasing national awareness and ensuring transparent stakeholder participation are critical to building consumer confidence and securing broad societal acceptance. Ultimately, progress toward a resilient, intelligent, and consumer-oriented energy sector requires simultaneous advancement in smart metering technologies and regulatory modernization. Strategic investments, legislative reform, and coordinated stakeholder collaboration are necessary to reduce technical and non-technical losses, strengthen operational efficiency, and support alignment with European Union energy objectives. Successful smart metering implementation has the potential to stimulate economic growth, enhance transparency, and improve overall system performance within Albania's energy market.

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