Chapter 1
Digital Governance Assisted by Artificial Intelligence in the Energy Sector:
Between Algorithmic Autonomy and Technological Sovereignty

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ABSTRACT

Digital transformations in the energy sector have brought artificial intelligence to the forefront as a structuring force for decision-making, efficiency, and operational architecture. In the context of smart grids, automation of distribution flows and consumption forecasting, artificial intelligence not only assists but also configures new relationships between data, infrastructure, and regulation. The chapter analyzes how algorithmic systems influence the functioning of the energy ecosystem, examining the challenges related to transparency, auditability, and digital security. At the same time, the need for technological autonomy is discussed in a regulatory framework undergoing metamorphosis, in which the balance between innovation and the protection of the public interest becomes a matter of institutional architecture.

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INTRODUCTION

The digital transformations that are reshaping the energy sector indicate a profound mutation in which algorithms become part of the fabric of decision-making and the architecture of critical infrastructures. In the context of the climate transition, the pressure for decarbonization is intertwined with the need to manage, in real time, huge volumes of data, distributed processes, and fluctuating renewable sources. Beyond efficiency, the integration of artificial intelligence into energy systems redefines the control model, the transparency of operations, and the distribution of responsibility between actors. The answers provided by intelligent platforms are not only technical results but also manifestations of codified choices, influenced by commercial interests, public policies, and opaque algorithmic architectures.

In contemporary energy networks, artificial intelligence (AI) structures energy flows, shapes the balance between demand and supply, and supports fine-grained adaptability to climatic or economic variations (Pan et al., 2025). Experiences in Northern Europe confirm that automated predictions contribute to continuity of supply and reduction of losses, but they also introduce a new grey area in terms of auditability of decisions (Le Coq & Jaunziems, 2025).

In parallel, emerging regulations at the European Union level (AI Act, GDPR) configure a regulatory landscape that requires not only technical compliance but also explicit mechanisms for legal, ethical, and procedural control (Ilias et al., 2023). The process of digitalization, far from being linear or neutral, also amplifies tensions related to technological sovereignty. Energy infrastructures become dependent on software platforms developed outside the European space, and the outsourcing of decision-making to black box systems raises questions related to autonomy, security, and fundamental rights. In the United Kingdom, the energy regulator has issued warnings about the possibility of algorithmic collusion that escapes traditional monitoring (Ofgem, 2024). Such scenarios are becoming increasingly likely in the absence of a conceptual and normative framework adapted to digital realities.

Experiences from Central and Eastern Europe highlight a hybrid landscape: investments in infrastructure are often fragmented, and digital skills are not equitably distributed among actors. However, some local initiatives have demonstrated that AI can be used in a way that respects both the logic of efficiency and the demands of algorithmic transparency and democratic control (Smith et al., 2024). The success of such efforts depends on the capacity of institutions to understand the dynamic nature of AI, to implement continuous audit tools, and to impose clear real-time verification criteria.

Artificial intelligence has penetrated deep into modern energy systems, reshaping the processes of balancing, adapting, and intervening in smart grids. In this context, algorithms constantly capture the vast volume of data coming from smart meters

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