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A SYSTEMATIC REVIEW OF APPROACHES TO MODELING DIGITAL TECHNOLOGY, PRACTICES AND INFRASTRUCTURE IN ECONOMIC, ENERGY AND CLIMATE MODELS

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Extended Abstract

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Abstract Summary

Digitalization, the wider sectoral adoption of digital technologies and practices, is increasingly recognized as a key driver of energy demand and a critical lever for energy system transformation. Recent literature has documented the implications of deploying digital technologies such as artificial intelligence (AI), cloud computing (CC), and distributed ledger technologies (DLT) alongside emerging digital practices (e.g., platformization, virtualization, telework) and rapidly expanding infrastructures (e.g., 5G networks, hyperscale and AI-oriented data centers). In response, modelling communities across energy economics, climate science, and integrated assessment have begun incorporating elements of digitalization into scenario analysis. However, most long-term energy system models and integrated assessment models (IAMs) still rely on highly aggregated representations, typically capturing digitalization through exogenous electricity demand projections or stylized efficiency improvements. This abstraction constrains the ability to analyze the co-evolution of digital infrastructure, energy systems, and macroeconomic dynamics, and to assess alignment with policy objectives such as energy security, sustainability, and affordability. This study conducts a structured literature review combined with a model-based assessment of representation practices. The review covers peer-reviewed scientific publications indexed in the Scopus database over the period 2011–2026, ensuring coverage of the most recent phase of accelerated digitalization. Our preliminary analysis revealed a heterogeneous but fragmented modelling landscape. A subset of frameworks explicitly incorporates specific digital technologies (e.g., data centers, AI workloads) and related policy or behavioral assumptions. However, a large share of models continues to represent digitalization implicitly via aggregate productivity trends or exogenous electricity demand trajectories. Based on this work, we identify three key blind spots for improving the representation of digitalization in energy systems.