

Digitalization of Water Networks & Network Efficiency

A national opportunity for Italy



Executive Summary



Italy faces Europe's most severe water infrastructure crisis, losing 42.4% of its water before it reaches end users, 3.4 billion cubic meters annually, equivalent to the needs of 43 million people. This amounts to 9.3 billion liters wasted every day, costing utilities €1.5 billion in lost revenue and €300–400 million in energy costs. The crisis stems from chronic underinvestment: 60% of networks exceed 30 years old, replacement rates stand at just 0.39% annually. Moreover, regional disparities are stark: northern utilities achieve 15–25% losses while southern regions exceed 55%.

Digitalization offers the essential pathway forward. Italy's PNRR has allocated €900 million for network modernization, mandating 45,000 km of District Metered Areas by March 2026 as the foundation for sensor networks, SCADA systems, and predictive analytics. Machine Learning enables pipe failure forecasting and strategic investment prioritization, while Digital Twins allow scenario simulation before implementation. International benchmarks confirm measurable gains: China's Digital Twin achieved 38% operational efficiency and 26% energy savings. Success requires ARERA's output-based regulation, mandatory data standardization, accelerated utility consolidation in high-loss regions, and rigorous cybersecurity frameworks. The convergence of PNRR funding, proven technologies, and regulatory support creates an unprecedented opportunity to transform Italy's water infrastructure from crisis to resilience.



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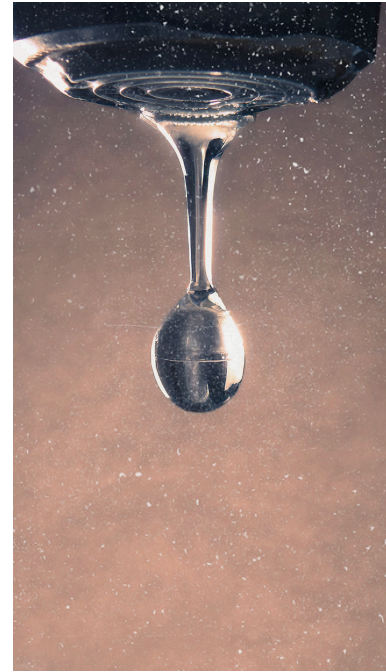
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Water Loss & Inefficiency in Italy

Italy confronts one of the most severe water loss crises among developed nations. According to ISTAT data from 2022, approximately 42.4% of water introduced into distribution networks is lost before reaching end users, 3.4 billion cubic meters annually, equivalent to the water needs of 43 million people for an entire year. This represents 9.3 billion liters of treated drinking water lost daily, enough to fill nearly 3,700 Olympic-sized swimming pools. The spatial distribution is highly uneven: while northern utilities achieve NRW rates below 25%, southern regions experience losses exceeding 55%, reflecting profound territorial disparities. Italy's fragmented landscape of approximately 2,300 water utilities, with 60% of networks over 30 years old and 25% exceeding 50 years, creates a systemic infrastructure crisis. The network replacement rate stands at just 0.39% annually, far below the 1-2% rate recommended by international best practices. The economic and environmental consequences are substantial. Italian water utilities collectively lose an estimated €1.5 billion annually in potential revenue, creating a vicious cycle where insufficient income constrains infrastructure investment. Italy requires €7-8 billion in annual water infrastructure investment over the next 20-30 years to achieve sustainability, compared to current levels of approximately €4 billion. Energy costs alone for treating and distributing lost water reach €300-400 million annually. Environmentally, compensating for network losses forces over-exploitation of groundwater aquifers, lowering water tables, depleting storage, and exacerbating saltwater intrusion in coastal areas. Decades of underinvestment have created an infrastructure deficit that grows more severe each year, requiring not only financial resources but also technological innovation, institutional reform, and sustained political commitment to address effectively.



Digitalization Strategies for Water Network Optimization



Italy's National Recovery and Resilience Plan (PNRR) has allocated €900 million for creating 25,000 km of new distribution networks and reducing water losses through digitized control systems, recognizing that digitalization is essential for network sustainability. This represents a paradigm shift from reactive operations to proactive, data-driven network optimization, enabling utilities to transition from crisis management to predictive operations.

Effective digitalization begins with establishing District Metered Areas (DMAs), the PNRR mandates restructuring 45,000 km of network by March 2026, which enable next-generation sensor networks (pressure, flow, acoustic) to feed real-time data into modernized SCADA systems. Machine Learning models convert this IoT and Advanced Metering Infrastructure data into actionable intelligence, integrating operational metrics, historical failures, and environmental factors to forecast pipe failure probability and prioritize investments strategically. Digital Twins create dynamic virtual replicas integrating live data and predictive models, enabling "what-if" scenario analyses that allow operators to test responses to high-impact events before implementation, transitioning from emergency response to predictive climate adaptation.



Lessons from Advanced Digital Water Utilities

International Benchmarks



Singapore utilizes AI-based programs that analyze data from IoT devices, factoring in weather forecasts, demand projections, system constraints, and financial costs, to optimize the daily procurement and allocation of water from its multiple sources.

This centralized, data-driven decision-making drastically reduces the time required for critical water allocation and infrastructure repair decisions.

In China, the deployment of a Digital Twin for a wastewater collection network achieved significant, quantifiable operational gains: a 38% improvement in operational and maintenance efficiency and a 26% improvement in energy efficiency. Confirming the value of digitalization extends far beyond just NRW reduction, delivering substantial savings in operational expenditure and contributing to sustainability goals.

These global examples demonstrate that digitalization offers structural, measurable improvements in energy consumption, resource allocation, and CAPEX prioritization, validating the comprehensive scope of Italy's modernization ambition.



Policy & Future Outlook

Successful national deployment of Digital Twins and Machine Learning in Italy's water sector depends on data quality, security, and integrity, requiring regulatory alignment to build public trust, particularly regarding public health outcomes under the *Drinking Water Directive* (EU 2020/2184). Given Italy's fractured utility market with approximately 2,300 operators, ARERA and the Ministry of Infrastructure must mandate standardized data collection and communication protocols to ensure interoperability, a necessary precondition for national digital platforms.

The PNRR has allocated substantial resources in 2026 for network loss reduction and digitalization, with the critical milestone of districtualizing at least 45,000 km by March 2026, requiring aggressive administrative support to accelerate execution. ARERA is already leveraging output-based regulation (OBR) that rewards efficiency improvements, favoring digital technology adoption. Achieving national water resilience requires accelerating utility consolidation, especially in regions with losses exceeding 40%, as larger entities can better attract capital and employ specialized talent, data scientists, ML experts, and OT security managers. Mandatory cybersecurity measures, including dedicated budgets and compliance with EU stress testing directives, are essential given the critical nature of digitalized water infrastructure.





Opportunities for foreign companies

Italy's water network digitalization crisis presents substantial opportunities for international technology providers. The PNRR has allocated €900 million for network modernization, while broader government investment reaches to modernize aging water infrastructures and support innovative solutions. Italy's fragmented landscape of approximately 2,300 operators creates diverse entry points for companies offering smart metering, SCADA platforms, IoT sensors, leak detection, predictive analytics, and digital twin solutions. However, success requires deep understanding of local procurement processes, regulatory frameworks, and Italian business culture beyond superior technology alone.

Proaxxes has specialized in empowering businesses to enter and thrive in the Italian market, offering comprehensive services from market analysis to commercial management. Successfully connecting international providers with leading Italian utilities, Proaxxes offers the local presence, established utility relationships, and operational infrastructure necessary to transform market opportunity into sustainable revenue while navigating the complexities of the Italian landscape.

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Conclusion

The high-water loss rate of 42.4% is an unsustainable drain on Italy's economy and environment, exacerbated by a fragile, aging infrastructure and intensifying climate volatility. Digitalization, accelerated by the PNRR funding and driven by the technical maturity of solutions like Digital Twins and Predictive Analytics, represents the only viable path to structural resilience and national efficiency.

Successful precedents set by Italian utilities, particularly ACEA's rigorous DMA implementation and Napoli's proactive DT deployment, confirm that these strategies yield quantifiable results, including significant reductions in physical and apparent losses.

The strategic imperative now is to translate financial allocation into rapid, unified national implementation. This requires stringent regulatory guidance from ARERA to standardize data, mandate robust cybersecurity protocols, and accelerate utility consolidation to ensure that all regions, particularly the fragmented South, can build the technical capacity necessary to operate a modern, resilient, and intelligent water network. The convergence of technology and strategic policy offers Italy a national opportunity to secure its water future.

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