



The 23rd International Asset
Facility and Maintenance
Management Conference

Predictive Maintenance and Sustainable Energy Systems

The Role of Artificial Intelligence in the Maintenance of Assets for Transmission
Substations to Enhance the Efficiency of Electricity Networks in the GCC

12-14 January 2026

Riyadh, KSA

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The Role of Artificial Intelligence in the Maintenance of Assets for Transmission Substations to Enhance the Efficiency of Electricity Networks in the GCC



Motivation Background & Problem

- **Transmission Substations** are indispensable assets for continuous and reliable energy provision in the GCC
- **Urgent need to enhance network efficiency** due to the escalating integration of Renewable Energy Sources (RES) and rapid digital transformation
- **AI presents profound opportunities** for innovative maintenance and management of critical assets (e.g., transformers, circuit breakers)



Aim of Study

- Systematically explore the role of **AI in revolutionizing asset maintenance** within substations
- Evaluate **operational, economic, and environmental benefits** of AI
- Identify specific **challenges and propose viable, actionable solutions** for large-scale AI adoption in the GCC



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Method/Approach

Methodology: Descriptive Analytical Method, involving a comprehensive review of current AI applications in the GCC power sector and comparison with international leading practices.

Focus: Rigorous analysis of existing academic literature and industry reports to understand the direct impact of AI on asset reliability and network efficiency.

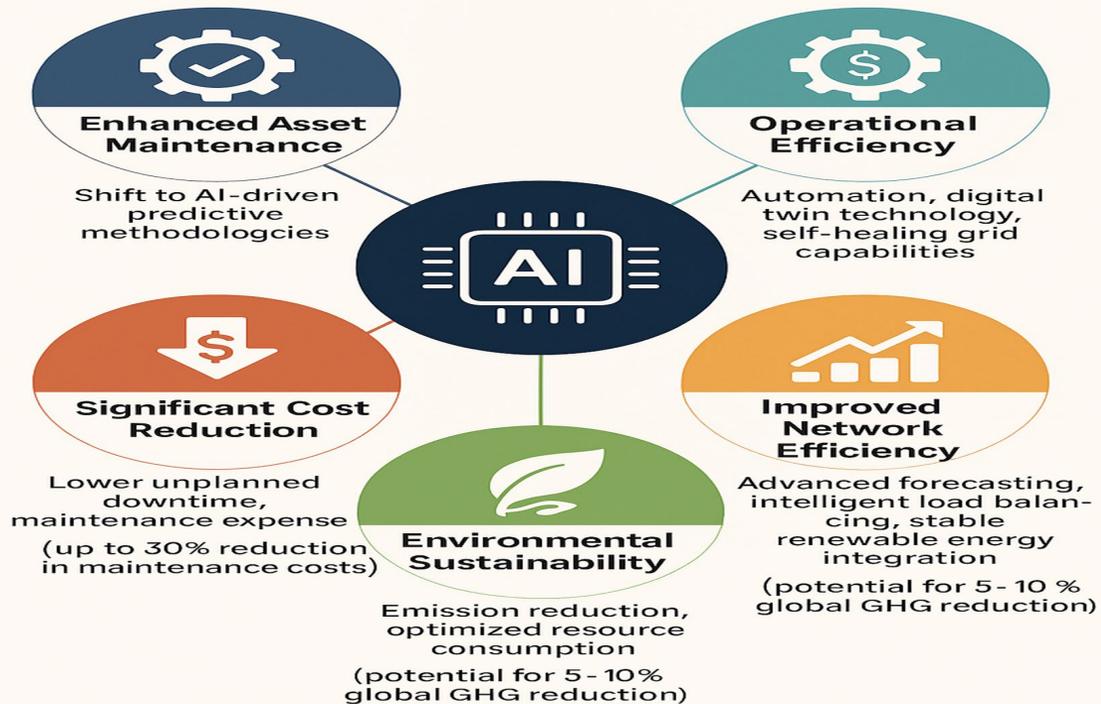
Objects of investigation

The study focuses on critical assets within the GCC electricity networks:

- **Transmission Substations** (Overall system efficiency and resilience)
- **Key Assets:** Transformers, Circuit Breakers, OHL & UGC
- **Broader Assets:** Wind Turbines, Solar Panels, and Energy Storage Systems

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The Five Principal Outcomes of AI Adoption



AI in Predictive Maintenance: Key Examples and Benefits

Asset Type	AI Technique	Predicted Failures/Issues	Key Benefits/Gains
Transformers Circuit Breakers	Predictive Maintenance (ML/DL) Anomaly Detection	Component Degradation, Overheating	Reduced Unplanned Downtime Cost Savings (up to 30%) Extended Lifespan
Solar Panels Wind Turbines	Predictive Analytics Optimization Algorithms	Dirt accumulation Mechanical Failures	Optimized Repair Costs Improved Energy Output
Overall Grid Assets	Real-time Monitoring AI-driven Drone Inspections	Grid Failures Anomalies	Increased Grid Reliability Enhanced Operational Efficiency

Experimental Setup & Test Results

The Five Principal Outcomes of AI Adoption

AI in Predictive Maintenance: Key Examples and Benefits

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Key Challenges to AI Implementation in the GCC



Digital Infrastructure Gaps

Need for robust, AI-specific digital infrastructure at scale.



Human Capital Shortage

Acute shortage of specialized AI researchers and data scientists



High Investment Costs

Substantial initial capital required for building AI ecosystems



Data & Cybersecurity Risks

Ensuring data quality, privacy compliance, and mitigating state-sponsored cyber threats



Cultural Resistance

Organizational resistance to automation and changes in established workflows

Strategic Recommendations for Accelerated Adoption



Sustained and Targeted Investment

in AI-specific digital infrastructure (powered by renewables).



Comprehensive Programs for Human Capital Development

to foster Human-AI Synergy



Active Promotion of Public-Private Partnerships

to share investment burdens and expertise



Widespread Adoption of AI-driven Predictive Maintenance

across the sector



Vigorous Commitment to Research and Development (R&D)

in energy-specific AI solutions

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Conclusion

- The strategic integration of AI is **pivotal** for achieving unparalleled efficiency and long-term sustainability in GCC electrical networks.
- AI fundamentally transforms asset management from a **reactive** approach to a **proactive, value-creation** model.
- The profound benefits underscore the **imperative** for large-scale adoption, despite formidable challenges like infrastructure gaps and talent shortages.
- By embracing strategic recommendations, the Gulf countries can solidify their position as leaders in the global energy transition



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THANK YOU!



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