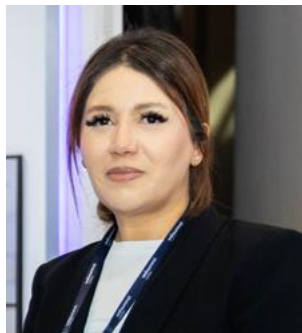


HBKU Thematic Research Grant 3rd Cycle— Project Highlight

Project Title: QGreenTwin+: A Federated 3D Digital Twin and AI Platform for Campus-Wide Renewable Forecasting, PV Tracking, and Climate Intelligence in Qatar Foundation



Dr. Ameni Boumaiza

Executive Summary (limit to 200 words)

Qatar Foundation’s Education City campus provides a unique testbed for sustainable infrastructure and digital innovation. Building on the success of the Q-Green energy trading platform, QGreenTwin+ advances this foundation into a federated 3D digital twin platform for campus-wide forecasting, optimization, and resilience. Unlike earlier prototypes focused on PV prosumer trading, QGreenTwin+ addresses the broader challenge of integrated sustainability—linking renewable generation, energy consumption, predictive maintenance, and resilience planning in one intelligent system.

At its core, QGreenTwin+ will create a dynamic 3D replica of Education City, integrating real-time data from PV systems and smart meters. The system will extend QF’s PowerBI campus dashboard, offering unified visualization and decision support for operators and policymakers.

Key innovations include an AI-driven performance-analytics engine that boosts solar generation efficiency by 10–15% through adaptive learning and real-time asset intelligence, and a predictive-maintenance engine for rotating machinery that leverages augmented-reality (AR) diagnostics to cut downtime by 30–50%. Using federated machine learning, QGreenTwin+ will achieve 85–95% forecast accuracy while preserving data sovereignty.

By merging digital intelligence with campus operations, QGreenTwin+ positions HBKU–QEERI and QF as regional leaders in AI-enabled, climate-resilient infrastructure and operational excellence.

Expected Outcome (limit to 100 words)

QGreenTwin+ will deliver a federated 3D digital twin prototype integrating energy and operational data across Education City.

Expected outcomes include:

- AI-based forecasting achieving >90% accuracy for energy demand and 85–95% for PV generation.
- Intelligent asset performance analytics reducing downtime by 30–50% and cutting asset lifecycle costs by 20%.
- AR-guided diagnostics enhancing fault response times by 25–40%.
- Integrated digital twin platform enabling $\geq 10\%$ reduction in CO₂ emissions and 8–12% lower annual energy consumption.
- Establishes Qatar Foundation as a regional leader in digital sustainability innovation through scalable, AI-driven campus operations.

Collaborating HBKU entities:

- College of Science and Engineering (CSE)
- Qatar Foundation Facilities Management (QF City Operations)
- KAHRAMAA, Innovation and Scientific Research Incubator



QGreen Twin+: Integrated Smart Campus Digital Twin for PV Generation, CO₂ Reduction, and Rotating Machinery Predictive Maintenance Analytics