

## Integrated Indoor Air Quality and Utility Metering Platform for Predictive Building Decarbonization

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### Abstract:

This paper presents a partial outcome of the REBECCA decarbonization project at the Slovak University of Technology in Bratislava, proposing a data platform where indoor air-quality (IAQ) sensing becomes a primary feature set for predictive analytics in building decarbonization. Moving beyond a hardware description, we detail an end-to-end pipeline from PoE-based sensing to AI-ready time-series data. Modular nodes measure CO<sub>2</sub>, particulate matter (PM), temperature and relative humidity, with ambient light used to derive occupancy proxies and segment operating regimes. IAQ dynamics are fused with electricity and gas meter streams to form cross-domain labels for ventilation demand and HVAC load. Data are transported via MQTT over TCP/IP to an in-house Remote Terminal Unit (RTU) that performs secure aggregation, buffering, automated quality checks, and time alignment before storing unified signals in a time-series database. This structure enables downstream models such as anomaly detection for ventilation faults, short-horizon forecasting for demand-flexibility windows, and interpretable drivers analysis that links IAQ excursions to schedule patterns and utility peaks. Initial operation across an academic semester showed stable connectivity and measurement consistency and surfaced repeatable IAQ events suitable for training and benchmarking models. The contribution is a reusable architecture and methodological baseline for integrating IoT, data analytics, and optimization, providing the measurement backbone for the next REBECCA phases targeting carbon-aware control strategies that reduce energy use while preserving healthy indoor environments.

### Keywords:

Building energy monitoring, building decarbonization, IoT data platform.