The Power of Precision: Granular Energy Monitoring for Net-Zero Buildings

With the push towards a net-zero built environment landscape and process electrification, with buildings already consuming 40% of energy generated globally, granular energy monitoring is becoming a critical tool for industries and asset managers. This approach offers vital insights into operational efficiency and helps develop strategies ensuring they can cope up with future flexible demand response systems.

To align with net-zero pathways indicated in CRREM guidance and UKNZCBS standards for year-on-year energy intensity reduction targets, understanding current demand profiles and intensities is crucial to prevent assets from becoming stranded. In an efficient building, sub-metering enables granular consumption segregation for various components for lighting, HVAC, small power and additional critical loads. This detailed breakdown allows for distinguishing between tenant and landlord usage, providing a clear picture of energy consumption patterns.

Changing Energy Landscape:

The integration of eMobility solutions and advanced demand-side management systems are significantly changing the existing landscape. Buildings are transforming from passive consumers to active prosumers, introducing new complexities in net-metering, existing electrical architecture upgrades and load management due to additional EV charging infrastructure, heat pump upgrades and embedding flexible demand responsive and grid interactive upgrades to them.

To achieve low and zero-carbon buildings, it is essential to align electricity consumption with periods of low-carbon generation. This can be accomplished by leveraging flexible appliances and smart technologies, emphasizing the transition toward Grid-Interactive Efficient Buildings (GEBs). The reliability of wireless technologies such as ZigBee, LoRaWAN, and IoT systems has significantly improved, streamlining integration and data collection. These advancements have eliminated the need for complex wiring and substantial BMS controller upgrades where they are not feasible.

Planning for Infrastructure Improvements:

For the effective planning of infrastructure improvements, it is essential to audit the existing sub-metering system and evaluate its granularity against current building standards. Given that upgrades may result in significant downtime, conducting a gap analysis and budget assessment is advisable. Additionally, exploring relevant technologies that can automate data collection and seamlessly integrate with the organisation's data lake is crucial, as this enables low-carbon consultants to analyse the data and advice further.

Role of generative AI in embedding energy efficiency into operations:

Generative AI (GenAI) has significant potential to improve energy efficiency and asset management by analysing energy data to assess asset performance and develop operation guides. It can create asset-specific, energy-efficient recommendations and serve as a chatbot, providing instant feedback on building specifications and operational strategies. Financial institutions can harness trained large language models (LLMs) tailored to asset data to identify underperforming properties and implement strategies to enhance returns. However, the effectiveness of these applications depends on access to detailed, high-quality data, highlighting the importance of investing in advanced sub-metering infrastructure to support these innovations.

With the tightening of Minimum Energy Efficiency Standards (MEES), and growing emphasis on climate resilience and energy efficiency reporting including ESOS for the UK market and climate resilience reporting standards like GRESB—there is a critical need to diversify investments in sub-metering infrastructure over the coming years. Enhanced sub-metering facilitates accurate end-use breakdowns, supports capital planning for retrofitting initiatives, and aids in applying for green certifications, which can attract tenants and increase lease rates.

Gagandeep Singh Kukreja – Accenture, March 2025

Auditing metering infrastructure and granularity

- Aligning to TM39 – Metering strategy and reference to NABERS guidance to understand wider metering granularity upgrades required.

- Emphasise on addition of fiscal metering and pulse loggers collecting energy consumption data for Small Power, HVAC and Lighting components ideally at main plant and floor level.

- Heat Meters as distinct measurement points.

- Centralising main incomer electricity, natural gas and distributed energy resources (DER) metering.

Metering Implementation

- Primary Metering Network:

- Fiscal Meters: Direct Modbus/TCP connection to incomers and secure connected gateway pushing AMR to utility providers.
- Electric and Pulse logger submetering connected via BACnet/IP protocol for HVAC and DALI/KNX for lighting integrated to BMS system or platform head-end.

- Metering categorisation and edge2cloud connectivity to a centralised Energy Management System (EMS) system.

Retrofitting planning and embedding energy efficiency

- Utilise at least twelve month of granular data to understand existing operations and carry out analysis to understand scope of improvement.

- Prioritise retrofitting opportunities based on efficiencies abnormality, end of life and cash-flows.

- Leverage EMS and GenAI market ready solutions for efficient carbon reporting and enabling critical triggering systems to flag inefficient plant operations.

From audit to action pathway: Unlocking the full potential of sub-metering Infrastructure.

Reference Links:

- https://www.nzcbuildings.co.uk/pilotversion
- https://www.cibse.org/knowledge-research/knowledge-portal/tm67-electrification-of-buildings-for-net-zero
- https://www.cibse.org/knowledge-research/knowledge-portal/tm39-building-energy-metering
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