



What is a Net Zero (Operational Energy) Building? Definition, Benefits and Strategies Explained

As the building sector strives to decarbonize, the drive towards net zero-carbon buildings has garnered increasing attention from both industry and policymakers.

Buildings are responsible for 38% of global energy-related carbon emissions. Of this, 28% are attributed to operational emissions, including direct energy use for heating and domestic hot water, and indirect electricity consumption for cooling, ventilation, power, and lighting. The remaining 11% is attributed to embodied carbon via material use and construction, with a significant portion arising from the production and transportation of buildings. In the United Kingdom, buildings are a major contributor to climate change, accounting for 23% of the country's carbon emissions, or an estimated 118 million tonnes of carbon dioxide (MtCO₂) per year.

This significant contribution highlights the urgent need for action. The UK's Sixth Carbon Budget's mandate of a 78% reduction by 2035 serves as a clear roadmap for the national economy's path to net zero.

To achieve ambitious goals, direct emissions should be tackled. These make up nearly half of all building emissions, primarily from fossil fuel use for space heating and hot water. This necessitates not only the construction of new net-zero buildings but also the comprehensive retrofitting and optimization of existing buildings to eliminate scope 1 and mitigate scope 2 and 3 emissions.

Achieving Net Zero Carbon in Existing Buildings: A Guide to Operational Energy

What exactly constitutes a net zero (operational energy) building, and how can existing non-domestic buildings achieve net zero operating emissions? Broadly, a net-zero carbon operational energy building functions without the incurrance of Scope 1 (direct) emissions, emissions typically generated by fossil fuel thermal energy systems (heating boilers and domestic water heaters).

Scope 2 (indirect) emissions must be mitigated via on-site renewables or carbon offset schemes, these emissions are typically attributed to systems using electricity from the grid (lighting, small power and data networks). Generally, Scope 3 emissions, generated via the supply chain associated with building operations are not considered in building net zero operational energy disclosures, although general awareness is increasing on the criticality of embodied emissions and viewing the entire asset from a 'whole life' perspective.

With tailored, technical, strategic upgrades, and shifts in policy providing support, the cost-effective delivery of net zero carbon operational energy buildings at scale is within reach in the coming years.



Navigating the Pathways to Net Zero Carbon Buildings

As the built environment decarbonizes, the specific criteria for achieving 'net zero carbon – operational energy' status remains an evolving discussion. Currently, a 'whole life carbon' methodology examines emissions across the full lifecycle of a built asset. This encompasses both operating and embodied carbon.

To attain net zero, total lifecycle emissions must be fully counterbalanced over time through energy demand reductions, electrification, renewable procurement, and offsetting supply chain emissions. Meeting this aim for both operating and embedded emissions poses multi-faceted challenges.

The UK Green Building Council's landmark Net Zero Carbon Buildings Framework defines a pathway for new and existing buildings to mitigate operational energy emissions.

Though not yet widespread, the industry aims to drive uptake of net zero buildings through improving technologies, rationalizing costs, evolving standards, and developing far-reaching policies. In the years ahead, experts foresee holistic net zero requirements becoming the norm through advances across the construction value chain.

Process Breakdown: Delivering Net Zero Upgrades for In-Use Buildings

To decarbonize operational energy, the initial focus is on cutting energy demand through intervention strategies and efficiency upgrades. After minimizing consumption, electrification of thermal energy systems can be considered, and the remaining electricity usage can be generated by renewable sources. Any residual emissions get offset through accredited schemes.

In practice, pursuing decarbonization requires a systematic methodology examining unique building characteristics and subsequently specifying tailored, costed and site-specific decarbonization pathways.

- Experts conduct a desktop review of critical inputs including, the classification, application and benchmark energy and emissions generation. This establishes a baseline carbon footprint to inform targets and show how decarbonization efforts are performing.
- Next, the team completes an on-site survey, documenting fabric, building envelope characterization, and installed equipment like lighting, HVAC, controls, existing thermal energy systems and other site-specific details.
- A raft of intervention strategies are then proposed, including LED upgrades, BMS and controls enhancement, building insulation and electrification of thermal energy systems.
- On-site renewable energy generation systems are also considered, including solar PV and solar thermal.
- The relative carbon reduction and return on investment are calculated for each intervention strategy and the viability of integration is assessed via quantitative analysis techniques.

By carefully assessing baseline usage, identifying savings opportunities, electrifying remaining loads, specifying suitable intervention strategies, and integrating clean energy supply, we develop customized roadmaps to provide a net zero carbon transition pathway for existing buildings.



Realizing Net Zero: Roadmaps and Offset Programs

This systematic assessment and planning process produces a customized Net Zero Carbon masterplan, outlining the required transition process for each building asset, which develops a fund-level decarbonization strategy. This strategic document guides owners and operators in phasing interventions to coincide within their specific organizational climate goals and targets.

The roadmap plots expected carbon reduction across outlying years as various measures get implemented in a sequenced order reflecting budget and existing equipment lifecycles. Initial reductions come from trimming energy demand through enhancements like lighting upgrades, automated controls and streamlined operations. Further gains are realized via energy efficiency enhancements and significant reductions are garnered via electrification of building heating systems.

With a customized transformation plan underpinned via data analysis and expert guidance, existing buildings can embark on the pathway to achieve net zero operational energy status.

The Costs and Benefits of Achieving Net Zero Carbon Buildings

Pursuing net zero carbon building upgrades demands careful financial considerations from the outset. Initially, capital costs can be substantial due to the complexity and CAPEX of holistic retrofit initiatives. However, methodical planning and supporting grants may help avoid shortsighted investments that fail to significantly cut emissions.

By plotting specific costs of each intervention along the net zero pathway, owners can prioritize quick wins before approving more cost intensive renovations. Teams would typically target inexpensive adjustments like LED lighting upgrades, insulation enhancement, and controls optimization first. Though simple, these measures may rapidly enable 5-20% energy savings.

As the transition advances, more costly but impactful steps are phased in following proper analyses that weigh expenses against carbon mitigation. These include electrifying heating through heat pumps, enabling distribution system uplifts to support demand, and integrating on-site renewable generation.

Nonetheless, through deliberate sequencing of operational enhancements and equipment changeovers grounded in technical and financial analysis, organizations can navigate the complexities of steering existing buildings towards net zero status.

Overcoming Key Obstacles to Net Zero Carbon Building Delivery

Though pathways and incentives exist, converting existing buildings to net zero carbon status remains a challenge demanding perseverance. Facility managers cite concerns including high-costs, extensive timelines, policy uncertainties, suitability constraints, reporting intricacies, and offset program credibility.

Holistic retrofits can require significant investments, with ROI periods stretching up to 5 years. Meanwhile, policy frameworks enabling building upgrades lack development, as standards and compliance measures are expanding.



Technically, integrating new equipment like heat pumps or solar PV arrays proves difficult given aged infrastructure and limited space. Once operational, documenting performance comes with administration needs as reporting protocols mature. Teams also struggle to identify reputable and meaningful offsets to counter any Scope 2 or 3 emissions.

Strategies must be extensively customized based on distinct asset characterization via specific decarbonization studies. However, despite technical barriers and the risk of poorly considered intervention strategies the path to Net Zero (Operational Energy) buildings.

Realizing Net Zero Goals Through Rigorous Monitoring

With customized net zero roadmaps available, building owners can embrace consistent tracking to ensure decarbonization remains on pace against the established timeline. Quantifying emissions across buildings at least annually enables assessing actual performance against projected reductions from planned initiatives.

From comprehensive evaluations, operators can determine if they still expect to achieve net zero by the target operational year based on intervention strategy implementation. If trajectories show gaps emerging, responsive action becomes possible through revisiting financing assumptions, securing leadership alignment, or refining technical plans.

This monitoring also produces ESG reporting to communicate progress to stakeholders like investors, shareholders, and the public. As concepts around net zero buildings continue maturing, being able to highlight measurable emissions cuts and performance data will grow in importance.

By combining extensive planning with vigilant monitoring processes, management teams can feel confident in both pursuing and credibly achieving net zero carbon building outcomes across portfolios. With data-driven insight, existing structures can transition successfully from fossil fuel dependence to models of sustainability leadership.



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