Critical Decisions

Balancing Net Zero Targets and Building Resilience

Buildings are responsible for 30% of global energy consumption, which means they have a major impact on most organizations' environmental footprints. Net zero buildings can help organizations achieve their sustainability goals and future-proof their buildings amid rapid regulatory, economic, and ecological changes. Developing resilience in energy availability is a concern for many facilities, as increasing extreme weather events and electrical infrastructure challenges in many regions strain the electrical grid and lead to power outages. Net zero buildings are particularly well-suited for adopting technologies and strategies that increase resilience.

As organizations strive to make their operations and infrastructure more resilient and to meet carbon reduction targets or net zero goals, they must make critical decisions to balance financial requirements, energy needs, and organizational goals for indoor environments, operations, and sustainability. To do this effectively, they must take a holistic approach that accounts for all of these variables so they can develop and implement solutions that will deliver value-creating outcomes.

Critical Decisions for Energy Efficiency

The term "net zero" can refer to net zero *energy* or net zero *carbon*. Net zero energy is a function of both energy consumption and energy generation. Defining net zero carbon can be more complex, depending on whether the goal is to achieve net zero *operational carbon* or net zero *whole life carbon*. In either case, the most sensible and cost-effective approach to designing a net zero building starts with identifying opportunities to increase *energy efficiency*, thereby minimizing overall energy consumption and carbon emissions.

When determining the best path for improving energy efficiency, a variety of factors must be considered. Each organization has a varied portfolio of equipment assets and infrastructure, all of which are at different stages of their lifecycle, with different replacement needs and timeframes. These assets perform core functions to support a facility's operation or space conditions. Understanding where equipment is in its lifecycle, its current impact on energy efficiency, its indoor environmental quality, and it operations and maintenance expenses is critical for fully evaluating the available opportunities for reducing energy consumption and associated costs. The next step is determining a plan to properly sequence optimizations, upgrades, and replacements while minimizing (or preventing) operational disruptions, accounting for financial investment requirements, and taking advantage of opportunities to leverage funding provided by time-sensitive incentive programs.

Outside of infrastructure and equipment improvements, operational interventions can also be implemented to reduce energy consumption in commercial, institutional, and industrial facilities. Understanding energy usage and operations patterns can help identify processes and practices that can be modified to improve efficiency. For example, if a school typically runs its high heat producing dishwashing equipment at 1 p.m. every day while the HVAC is struggling to keep the building cool, one mitigation strategy could be to modify operations and run the dishwashers at 4 p.m., when students are no longer in the building and the HVAC has lower load requirements. When feasible, operational or behavioral energy saving strategies can be implemented very inexpensively.

For any organization looking to enhance resilience while on the path to net zero emissions, energy efficiency not only helps reduce costs and carbon emissions, it also helps determine the critical load requirements a facility must meet with onsite generation to balance energy consumption with production or to offset it with renewable energy sources.

Critical Decisions for Fuel Sources and Electrification

Building electrification is also a crucial step in planning most net zero buildings, particularly in minimizing onsite carbon emissions. As opposed to equipment and building systems that consume fossil fuels, such as natural gas furnaces, boilers, and water heaters, electrified equipment can take advantage of electricity generated from cleaner onsite energy production sources or supplied by the grid, providing a pathway to a lower carbon future. In 2022, approximately 40% of electricity on the grid was generated from clean energy sources in the US, with expectations that this number will reach 80% by 2030 and 100% by 2035. Though facing legal challenges, some municipalities have banned natural gas hookups in new construction, and many cities are considering adopting building standards that would require electrification of existing buildings.

Electrification should be considered in the asset planning process alongside energy efficiency improvements to ensure that all choices are evaluated as they relate to *resilience* and *decarbonization* targets. Understanding critical energy load requirements and balancing them against the availability of onsite generation and grid stability may lead to different choices across geographies and sectors, as these factors and needs vary. While electrified equipment may be the most desirable option from a decarbonization perspective, looking at options such as dual-fuel equipment that supports near-term replacement requirements as well as future electrified operations may be more sensible in certain scenarios. Considering electrification and energy efficiency holistically can help maximize an organization's ability to take advantage of available incentives and funding opportunities and ensure operational resilience as equipment is upgraded to electrified options.

Critical Decisions for Onsite Power Generation

As climate change intensifies, power outages are expected to become more frequent. From 2000 through 2021, 83% of outages in the US were caused by weather-related events—an increase of approximately 78% from the previous decade. As this trend continues, increased disruptions to facility operations pose a growing threat to an organization's ability to fulfill its mission, and the resilience afforded by onsite generation and energy storage is likely to become more important.

After a facility has evaluated and sequenced electrification and efficiency optimization opportunities, the amount of energy generation needed to offset consumption can be determined. An assessment of an organization's risks, responsibilities, and priorities can identify a facility's critical load—the amount of power needed to ensure the safety and integrity of occupants, infrastructure, and data. This critical load dictates the minimum amount of power that must always be available to maintain critical operations. A facility's critical load and resilience requirements combined with its decarbonization goals will drive the appropriate choices for onsite generation technologies.

While a diesel or propane generator could technically be used to achieve net zero *energy* (and may be the best option for stringent uptime requirements), the adoption of renewable energy sources is critical for reaching net zero *carbon*. Renewable energy sources such as solar panels and wind and water turbines may be the first options building owners consider as they try to meet decarbonization goals, but cogeneration processes that utilize waste heat or biomass are also low emissions or zero-emissions alternatives that can be used to generate onsite power in limited applications. Guidehouse Insights estimates that, globally, solar currently accounts for more than 93% of total onsite renewable generation capacity for commercial, institutional, and industrial buildings, and that share is expected to grow over the next decade.

If an organization chooses to implement renewable energy generation onsite, considering battery storage to ensure resilience during a power outage is critical. For utility worker safety reasons, when the electrical grid suffers an outage, solar panels or wind turbines must automatically disconnect and cannot supply power to grid-connected buildings that do not have energy storage. However, solar panels connected to batteries can continue to charge them, and the batteries can supply power to buildings during an outage event, enhancing resilience.

Onsite energy storage may also have benefits beyond the provision of backup power by acting as a potential revenue-generating resource or by insulating a facility from peak demand charges. In most places, grid-connected buildings with onsite solar panels can send any generated power that is not immediately consumed back to the grid. This process, called net metering, can help customers capitalize on excess production. Additionally, buildings can choose to store renewable energy production when utility-supplied energy is inexpensive and use stored energy during times of high utility demand to avoid peak demand charges. Depending on the dynamics of a given utility, its net metering programs, its peak demand and utility rate scheme, and local regulations, organizations may be able to use renewable energy and storage to generate income or manage energy costs.

The Path to a Resilient, Net Zero Future

For an existing facility, the journey to net zero typically occurs in stages, and the exact path taken varies depending on each organization's needs, priorities, and limitations. A sampling of case studies can illustrate how these issues apply among different building contexts, organizational strategies, and resource constraints:

The Bergdorf Goodman flagship store underwent a major efficiency and electrification upgrade when its inefficient, natural gas absorption chillers were replaced with energy efficient electric chillers from Trane. Located in New York City, this historic building will be subject to the building performance standards specified by Local Law 97 when it goes into effect in 2024. The project eliminated all natural gas use in this building, ensured that it will comply with Local Law 97, reduced energy costs by $61,000 per year, and is a crucial step toward Neiman Marcus Group's goal to transition to 100% renewable energy use by 2030.

The U.S. Forest Service (USFS) engaged Trane to equip five remote, off-grid fire and ranger stations in California national forests that had been powered by diesel or propane generators, which were plagued by maintenance and operational problems, with mobile solar and battery systems. To increase energy efficiency, LED lighting was also installed. The USFS elected to use an energy savings performance contract (ESPC) to avoid any upfront capital costs. The increased reliability of the renewable energy system, relative to the generators previously used, enhanced the resilience of these facilities and will create nearly $3.8 million in guaranteed cost savings over the life of the 14-year ESPC.

Also using an ESPC, the state government of New Mexico was able to reduce its annual costs by $1.1 million by upgrading the energy efficiency of 32 government buildings and installing rooftop solar panels. Trane conducted extensive audits of the Santa Fe buildings to determine the best way to improve energy efficiency. The upgrades included LED lighting, increased window insulation, intelligent building controls, and efficient HVAC systems, which not only reduced energy consumption but also improved occupant comfort.

Dighton-Rehoboth Regional School District in Massachusetts was suffering from comfort issues and ventilation problems due to failing HVAC equipment when it engaged Trane to implement a comprehensive energy efficiency and renewable energy upgrade. Among other facility improvements, the project included new HVAC equipment, a digital building automation system, a biomass (woodchip) boiler, and solar panels, yielding a simultaneous improvement in the district's learning environment and a 62% reduction in energy spending.

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