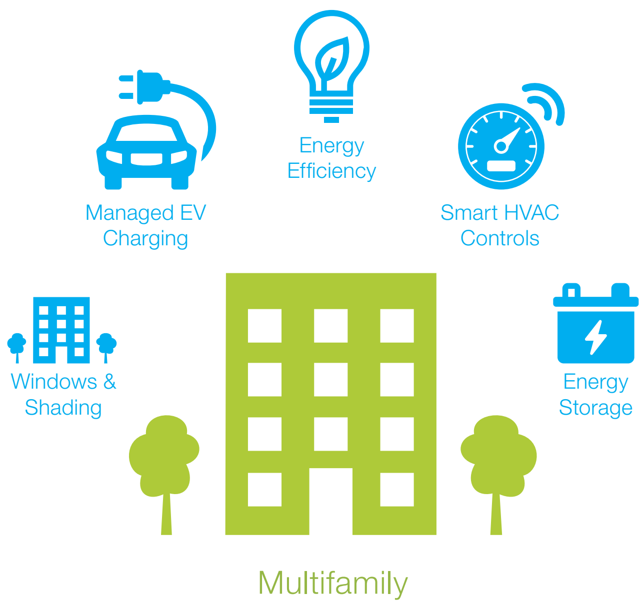
Optimizing Building-Grid Integration in Multifamily Buildings

This factsheet recommends selected high-impact building design and operational strategies for multifamily buildings.

As we transition to a clean energy future, building equipment will need to optimize opportunities for grid integration and demand flexibility. Through three years of study, the GridOptimal Initiative has developed recommendations for selected high-impact building design and operational strategies for homes and buildings. They are based on a wide variety of research, including building-scale and grid-scale simulation modeling and on-the-ground GridOptimal pilot project experience.

Factsheets are available for other building types and for specific regions across the U.S. Multifamily buildings can save costs, reduce carbon emissions, and help advance energy system decarbonization through time-of-use energy efficiency, smart devices, connected controls, and distributed energy resources such as onsite/community solar and energy storage. The recommendations in this factsheet are based on a wide variety of research, including building-scale and grid-scale simulation modeling and on-the-ground GridOptimal pilot project experience.



While the recommendations outlined in this factsheet are specifically tailored for multifamily buildings, factsheets are available for other building types and for specific regions. Visit **newbuildings.org/resource/gridoptimal-design-guidance**

Top 5 GridOptimal Building Design and Operation Strategies:

Multifamily Buildings

Efficiency and demand flexibility strategies have widely varying impacts across multiple building types, climates, and grid paradigms. High-impact strategies like these can deliver time of-use energy efficiency and demand flexibility while minimizing or avoiding occupant disruption.

Energy efficiency. Envelope measures like insulation, air-sealing, high-performance windows, and mechanical systems (HVAC and water heating) offer both year-round savings and peak demand reduction during times of high grid demand and carbon emissions. Energy efficiency is an enabler and often an impact multiplier for demand flexibility.

Smart HVAC controls. Temperature setpoint and schedule adjustments such as setbacks, precooling, and preheating can deliver peak demand savings and shift load toward low-cost, low-carbon hours. Communications standards such as OpenADR 2.0b enable current and future participation in demand response and similar programs.

Managed EV charging. Electric vehicles are a key decarbonization solution but charging adds substantial demand. Charging during off-peak hours, and reducing or staging charging during peak hours mitigates the impact. Special rates and generous incentives are often available for smart EV chargers.

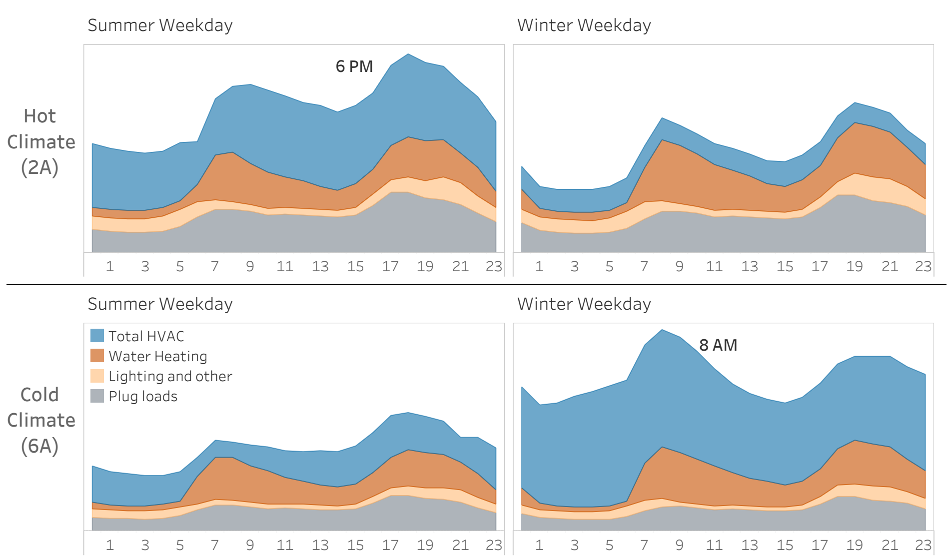
Energy storage. Both battery electric and thermal (e.g., ice, hot water) storage systems can enable load shifting away from high-cost, high-carbon hours. Key benefits include energy cost savings, emissions reductions, and resilient operations. Co-optimize schedules to achieve cost, emissions, and resiliency benefits, and specify grid-integrated communications.

Windows & shading. Carefully planned shading and window treatments can reduce afternoon and evening cooling loads that lead to increased energy demand during system peak. West-facing shading, exterior louvers, and electrochromic glass in conjunction with high-performance glazing are effective solutions to increase a building's grid-friendliness.

Where the Energy Goes: Typical Multifamily End-Use Demand Profiles

To find the highest-impact opportunities for time-of-use energy efficiency and demand flexibility, identify key hours in terms of energy cost, carbon, and/or overall grid net load, then search for opportunities when those times overlap with high building demand.

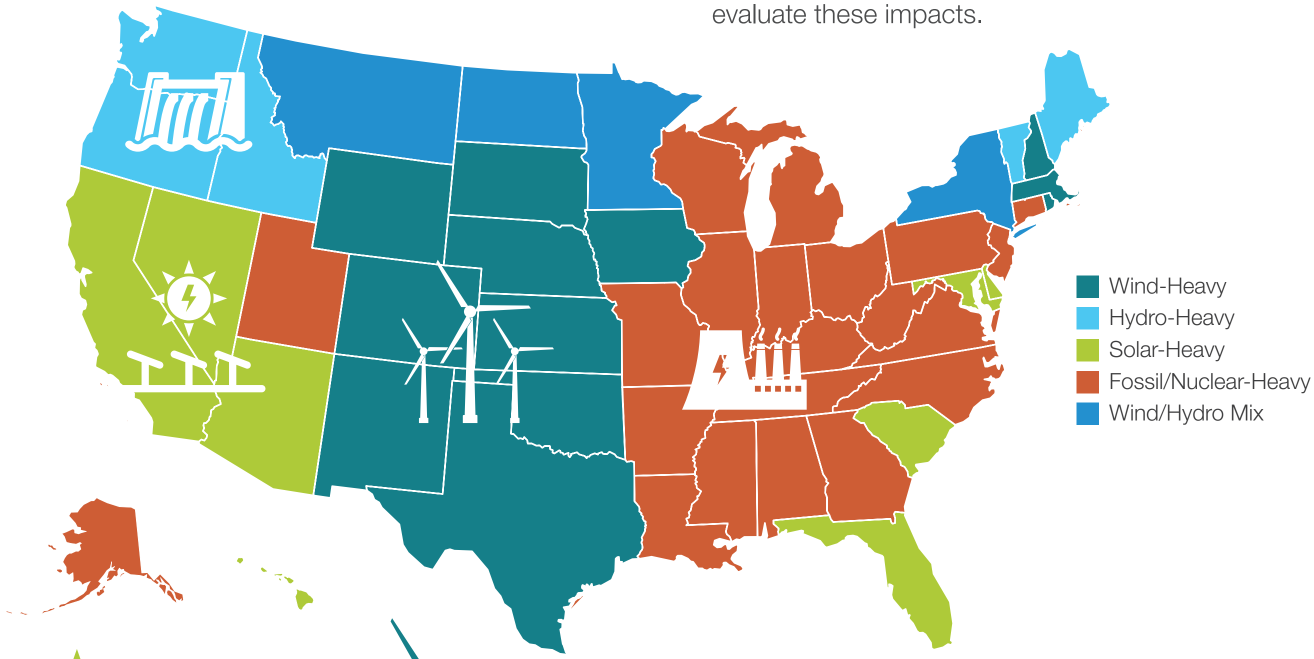
These charts show typical summer and winter demand profiles for a multifamily building in a hot climate (zone 2A) and a cold climate (zone 6A).

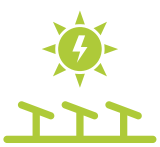


Designing for the Local Grid

Across the nation and the world, electricity grids are changing fast, and variable wind and solar are the fastest-growing resources. There are many pathways to decarbonization, and which resources are dominant at the regional level impacts both rate structures and carbon emissions patterns. Broadly, most regions can be considered either solar, wind, hydro, or fossil-heavy (in reality, all grids use a unique mix of resources; this framework is intended mainly for at-a-glance comparisons).

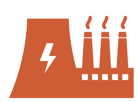
In general, buildings should seek to **minimize demand during the highest net load hours** on the grid and **shift load toward periods of low net demand.** High net load occurs when less renewable energy is on the grid—often evenings in summer. The times of low net load vary depending on the local grid conditions. Buildings can co-optimize targeted energy efficiency and flexibility strategies to achieve both cost savings and carbon emissions reductions by considering both their cost and carbon implications; the GridOptimal Buildings LEED Credit calculator spreadsheet can help designers evaluate these impacts.





Solar-Heavy: PV panels produce more energy during mid-day hours, but grid peak demand often comes later in the day, especially in summer. Consider strategies that enable the building to shift energy away from morning and evening and toward 10am-2pm, such as grid-integrated heat pump water heaters and batteries. Target energy storage duration of 2-8 hours.

Wind-Heavy: Onshore wind in many locations tends to be stronger at night; offshore wind tends to be stronger during the day. Day to day variability can be high: prioritize demand flexibility. Consider strategies to leverage abundant, clean daytime and/or overnight energy for use during afternoons and evenings, with energy storage durations in the 8-16 hour range.



Fossil/Nuclear-Heavy: Emissions are typically highest during grid system peak demand hours but often remain relatively high during off-peak hours. Overnight and baseload hours may be very carbon-intensive (coal) or lower-carbon (nuclear). Focus on deep energy efficiency and target demand flexibility during grid peak hours, typically during summer afternoons and evenings.

Hydro-Heavy: Abundant clean energy is available during spring and early summer months as snow melts and rivers run high but limited during summer and fall. Large dams offer grid balancing and buffering ability to minimize electricity demand and supply variability. Electrification offers high carbon savings impacts. Target energy efficiency and demand reduction during summer afternoons.

Key Considerations: Multifamily Buildings

Resiliency

As severe weather events become increasingly frequent, investment in resiliency becomes critical for individuals and communities to mitigate the negative impacts of intermittent or long-term power loss. Air-tight and well-insulated buildings have prolonged passive survivability, providing shelter and hospitable spaces for longer periods, especially in areas with extreme hot or cold climates. For buildings with behind the meter solar and/or storage, the capability to island from the grid can permit key systems and circuits, such as refrigerators and freezers, to remain online during a power outage. Systems designed only for resiliency may not deliver cost and carbon savings: co-optimize system design and dispatch to achieve the right balance of resiliency, cost savings, and carbon reductions.

Electrification

Electrifying end-uses such as transportation, space and water heating, as well as cooking is a critical pathway to a carbon-neutral future. Transitioning to high-efficiency systems such as heat pumps, heat pump water heaters, and induction cooking offers significant energy and carbon savings, particularly long-term as emissions associated with grid-delivered electricity continue a steady course toward zero. Air-tight, energy efficient homes enjoy improved air quality from eliminating indoor gas combustion in the kitchen.

Internet of Things

Many appliances and devices coming on the market can connect to local networks and participate in the Internet of Things (IoT). In multifamily buildings, many devices can connect to a central node and participate in demand response, including thermostats, refrigerators, water heaters, and electronics. Taken together, the relatively minor load-shifting potential from each device can aggregate to form a large enough block to participate in demand response programs and deliver financial benefits for both tenants and owners.

Program Information

The GridOptimal Buildings Initiative aims to improve building-grid interactions across the built environment by empowering building owners, designers, utilities, and other key players with dedicated metrics, tools, and guidance.

Up to three LEED points are available for buildings that improve their building-grid integration outcomes through the GridOptimal Buildings Pilot Alternative Compliance Path. See: usgbc.org/credits/gridoptimal-152-v4.1

For more information, contact alexi@newbuildings.org

Read more: newbuildings.org/gridoptimal

nbi new buildings institute

New Buildings Institute (NBI) is a nonprofit organization driving better energy performance in buildings. We work collaboratively with industry market players—governments, utilities, energy efficiency advocates and building professionals—to promote advanced design practices, innovative technologies, public policies and programs that improve energy efficiency and reduce carbon emissions. We also develop and offer guidance and tools to support the design and construction of energy efficient buildings. Learn more at newbuildings.org

NBI developed this GridOptimal design guidance factsheet.

The GridOptimal Buildings Initiative is supported by these organizations: