Better Buildings®
U.S. DEPARTMENT OF ENERGY

Low Carbon Technology Strategies

HOSPITAL

Driving our nation's buildings to low and zero carbon saves money, creates jobs, and leads to a healthier environment and more resilient economy. The table below includes steps that building owners and operators can implement to achieve smart, healthy, and low-carbon hospitals within their existing building portfolios. Hospitals typically include complex heating and cooling systems and specialty medical equipment. Assess current conditions in your building against the simple, intermediate, and advanced options to begin planning your next steps to reduce carbon emissions. If you have a commercial kitchen, include low carbon strategies for kitchens (equipment, ventilation, refrigeration, and water heating).

Technology		Simple	Intermediate	Advanced
Lighting	Interior Lighting	• Install Type B tubular LEDs that meet DesignLights Consortium (DLC) technical requirements • Reduce overlit spaces • Install occupancy sensors or vacancy sensors	• Install dimmable LED retrofit kit or replace with LED fixture that meets DLC technical requirements • Install daylighting controls and occupancy / vacancy sensors • Integrate with building automation system (BAS) if possible	• Install retrofit kit or new luminaire with luminaire level lighting controls • Include integrated daylight and occupancy sensor networked lighting controls that meet DLC requirements, load shed via Auto-DR interface, and integrate with BAS
	Exterior and Parking Lot Lighting	• Install LED screw base replacement for HID lamps that meets DLC requirements • Install photocell to control lighting	• Replace with area luminaires that meet DLC requirements • Install time clock and reduce lighting at night	• Redesign using the Better Buildings Parking Lot specification and include video-based occupancy sensors
Space Conditioning and Water Heating	HVAC Cooling and Heating Equipment	• Clean condenser and evaporator coils • Add a heat exchanger and water side economizer controls • Optimize boiler combustion efficiency • Install boiler energy recovery • Implement alternative water treatment system and optimize cooling tower performance	• Replace chillers with high-efficiency, low-GWP systems and consider heat recovery chillers • Utilize a small or modular, high-efficiency chillers for highly variable loads • Upgrade to high-efficiency condensing boilers • Utilize a modular boiler configuration to avoid low part load operations • Use dual fuel heat pump RTUs to target 90% of heating with heat pumps and 10% with gas heating • Add evaporative cooling to air cooled condensers on chillers and RTUs • Install active thermal energy storage systems for load shifting and system optimization	• Replace chiller and gas/oil boiler systems with air source, water source, or ground source heat pumps or variable refrigerant flow (VRF) systems • Install a small high-efficiency gas boiler in combination with heat pumps if difficult to meet 100% load with heat pumps • Implement a building or district water loop heat exchange and heat pump system
	HVAC Air and Hydronic systems	• Conduct periodic air balance checks to maintain required pressurization (e.g., negative for infectious disease wards; positive for surgery suites and patient rooms) • Set static pressure resets • Verify and repair dampers • Test and seal ducts • Install synchronous-drive fan belts • Verify hydronic system operation and repair valves and controls	• Install VFDs on fan and pump motors >5 hp • Replace fan and pump motors with variable speed premium efficiency motors • Install high-efficiency, intelligent distribution pumps • Add energy recovery ventilators	• Switch to radiant or chilled beam systems with a dedicated outdoor air system (DOAS) unit for ventilation

Technology		Simple	Intermediate	Advanced
Space Conditioning and Water Heating (cont.)	Water Heating	• Reduce water heating demand through various technologies like low-flow faucets and showerheads	• Install point-of-use electric water heaters for small, distributed loads • Install high-efficiency, connected heat pump water heaters	• Install CO_2 air-to-water heat pumps
Controls and Analytics	Install or Upgrade Controls	• Upgrade or install new BAS with digital controls to the zones • Implement existing building Cx (EBCx) or building Re-tuning™ process • Optimize schedules based on occupancy • Widen zone temperature control deadband • Implement controls to utilize existing thermal mass and storage systems to shift and reduce heating or cooling needs	• Implement demand-controlled ventilation (DCV) • Integrate luminaire-level occupancy sensors with HVAC controls to reduce airflow when zones are unoccupied • Implement control strategies that shed/shift load to minimize demand charges	• Implement controls that integrate building loads, thermal/battery storage, on-site co-generation plants, PV, and EV charging to provide demand flexibility (Market Brief)
	Install Energy Management and Information System (EMIS) (EMIS Primer, Specification)	• Install energy information system (EIS) with whole building interval meters • Submeter critical loads to verify operation • Compare whole building EUI among portfolio or against similar buildings	• Install fault detection and diagnostics (FDD) software and implement monitoring-based Cx (MBCx) program to support implementation of findings (MBCx Plan Template)	• Install automated system optimization (ASO) software (optimal chiller / AHU control) • Utilize EMIS as an integrated platform for monitoring and control to provide demand flexibility (Market Brief)
Building Envelope	Opaque Building Envelope	• Use reflective roof materials • Use cool roof coating, climate dependent • Identify thermal bridges with IR camera and mitigate (complexity varies)	• Add or increase level of continuous insulation when replacing roof membrane • Install phase change material (PCM) panels in dropped ceiling (multiple technologies available)	• Add continuous insulation to exterior walls • Insulate spandrel/plenum space facing the exterior • Use advanced techniques to fill gaps with spray foam • Install PCM on walls
	Building Airtightness	• Seal obvious cracks • Install weather stripping • Seal around receptacles	• Caulk and seal above dropped ceiling	• Install air barrier (preferably combined with other retrofit measures, such as adding exterior or interior insulation) • Install liquid or sheet applied air barrier with continuous insulation
	Windows and Attachments	• Install applied films • Caulk/seal windows • Install window shading or attachments • Automate interior attachments	• Add storm window/secondary glazing or replace existing windows with double-pane or Low-E • Automate existing exterior attachments • Add automated exterior attachments/awnings	• Install dynamic windows • Install thin triple windows • Install vacuum glazing
Plug and Process Loads (PPLs)		• Procure ENERGY STAR® rated or better products • Enable low-power or sleep settings • Consolidate and reduce loads • Avoid using once-through water cooling for medical equipment • Avoid using film systems for imaging equipment • Include efficiency requirements in medical equipment RFPs, such as the ability to turn off equipment or enact low power states when not in use	• Integrate smart PPL controls with other building systems or the BAS • Integrate selected non-critical PPLs into demand response • Load shift by implementing advanced scheduling technologies for charging EVs	• Integrate PPL controls to shed, shift, and modulate during times of peak fossil generation • Implement power over ethernet (PoE) systems

Technology		Simple	Intermediate	Advanced
Plug and Process Loads (PPLs) (cont.)		• Add insulation to dryers • Program washers/dryers to use the shortest cycle and lowest water/air temperature needed to sufficiently clean/dry the laundry • Procure and install PPL control technologies: – Advanced Power Strips – Wireless Meter and Control Systems (aka Smart Outlets) – Automatic Receptacle Controls		
Renewables and Battery Storage		• Participate in a community solar program or access renewables via a power purchase agreement (PPA)	• Purchase on-site PV to cover roof area (verify roof structure and age) and parking as needed • Integrate electric batteries and additional thermal energy storage to balance PV production	• Integrate renewables, battery storage, and building loads into demand flexibility controls (EMIS platforms often provide this integrated-control capability)

Need additional support? See the Path to Zero: Getting Started Guide. Reach out to Better Buildings for support on your path to low carbon.

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