

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 secondary schools within their existing building portfolios. Secondary schools often include complex heating and cooling systems or packaged rooftop units and can include specialty equipment for gymnasiums, pools, and buses. 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	<ul style="list-style-type: none"> <li>Install <a href="#">Type B tubular LEDs</a> that meet <a href="#">DesignLights Consortium (DLC)</a> technical requirements</li> <li>Reduce overlit spaces</li> <li>Install occupancy sensors or vacancy sensors</li> </ul>	<ul style="list-style-type: none"> <li>Install <a href="#">dimnable LED retrofit kit or replace with LED fixture</a> that meets DLC technical requirements</li> <li>Install daylighting controls and occupancy / vacancy sensors</li> <li>Integrate with building automation system (BAS) if possible</li> </ul>	<ul style="list-style-type: none"> <li>Install retrofit kit or new luminaire with luminaire level lighting controls</li> <li>Include integrated daylight and occupancy sensor networked lighting controls that meet DLC requirements, load shed via Auto-DR interface, and integrate with BAS</li> </ul>
	Exterior and Parking Lot Lighting	<ul style="list-style-type: none"> <li>Install LED screw base replacement for HID lamps that meets DLC requirements</li> <li>Install photocell to control lighting</li> </ul>	<ul style="list-style-type: none"> <li>Replace with area luminaires that meet DLC requirements</li> <li>Install time clock and reduce lighting at night</li> </ul>	<ul style="list-style-type: none"> <li>Redesign using the <a href="#">Better Buildings Parking Lot specification</a> and include video-based occupancy sensors</li> </ul>
Space Conditioning and Water Heating	HVAC Cooling and Heating Equipment	<ul style="list-style-type: none"> <li>Clean condenser and evaporator coils</li> <li>Add a heat exchanger and water side economizer controls</li> <li>Optimize boiler combustion efficiency</li> <li>Install boiler energy recovery</li> <li><a href="#">Implement alternative water treatment system and optimize cooling tower performance</a></li> <li>Install advanced RTU controls retrofit (variable speed supply fan, integrated air-side economizer, and RTU-level demand-controlled ventilation (DCV))</li> </ul>	<ul style="list-style-type: none"> <li>Replace chillers with high-efficiency, low-GWP systems and consider heat recovery chillers</li> <li>Utilize a small or modular, high-efficiency chillers for highly variable loads</li> <li>Upgrade to high-efficiency condensing boilers</li> <li>Utilize a modular boiler configuration to avoid low part load operations</li> <li>Use dual fuel heat pump RTUs to target 90% of heating with heat pumps and 10% with gas heating</li> <li>Add evaporative cooling to air cooled condensers on chillers and RTUs</li> <li>Install active thermal energy storage systems for load shifting and system optimization</li> </ul>	<ul style="list-style-type: none"> <li>Replace chiller and gas/oil boiler systems with air source, water source, or ground source heat pumps or variable refrigerant flow (VRF) systems</li> <li>Install a small high-efficiency gas boiler in combination with heat pumps if difficult to meet 100% load with heat pumps</li> <li>Implement a building or district water loop heat exchange and heat pump system</li> </ul>
	HVAC Air and Hydronic Systems	<ul style="list-style-type: none"> <li>Rebalance air systems and set static pressure resets</li> <li>Verify and repair dampers</li> <li>Test and seal ducts</li> <li><a href="#">Install synchronous-drive fan belts</a></li> <li>Verify hydronic system operation and repair valves and controls</li> </ul>	<ul style="list-style-type: none"> <li>Install VFDs on fan and pump motors &gt;5 hp</li> <li>Replace fan and pump motors with variable speed premium efficiency motors</li> <li><a href="#">Install high-efficiency, intelligent distribution pumps</a></li> <li>Add energy recovery ventilators</li> </ul>	<ul style="list-style-type: none"> <li>Switch to radiant or chilled beam systems with a dedicated outdoor air system (DOAS) for ventilation</li> <li>Implement natural ventilation, controlled in coordination with mechanical ventilation</li> </ul>

Technology		Simple	Intermediate	Advanced
Space Conditioning and Water Heating (cont.)	Water Heating	<ul style="list-style-type: none"> <li>Reduce water heating demand through various technologies like low-flow faucets and showerheads</li> </ul>	<ul style="list-style-type: none"> <li>Install point-of-use electric water heaters for small, distributed loads</li> <li>Install high-efficiency, connected heat pump water heaters</li> </ul>	<ul style="list-style-type: none"> <li>Install CO<sub>2</sub> air-to-water heat pumps</li> </ul>
	Controls and Analytics	<ul style="list-style-type: none"> <li>Install or Upgrade Controls</li> </ul>	<ul style="list-style-type: none"> <li>Upgrade or install new BAS with digital controls to the zones</li> <li>Implement existing building Cx (EBCx) or building Re-tuning™ process</li> <li>Optimize schedules based on occupancy</li> <li>Widen zone temperature control deadband</li> <li>Implement controls to utilize existing thermal mass and storage systems to shift and reduce heating or cooling needs</li> </ul>	<ul style="list-style-type: none"> <li>Implement demand-controlled ventilation (DCV)</li> <li>Integrate luminaire-level occupancy sensors with HVAC controls to reduce airflow when zones are unoccupied</li> <li>Implement control strategies that shed/shift load to minimize demand charges</li> </ul>
	Install Energy Management and Information System (EMIS) ( <a href="#">EMIS Primer, Specification</a> )	<ul style="list-style-type: none"> <li>Install energy information system (EIS) with whole building interval meters</li> <li>Submeter critical loads to verify operation</li> <li>Compare whole building EUI among portfolio or against similar buildings</li> </ul>	<ul style="list-style-type: none"> <li>Install fault detection and diagnostics (FDD) software and implement monitoring-based Cx (MBCx) program to support implementation of findings (<a href="#">MBCx Plan Template</a>)</li> </ul>	<ul style="list-style-type: none"> <li>Install automated system optimization (ASO) software (optimal chiller / AHU control)</li> <li>Utilize EMIS as an integrated platform for monitoring and control to provide demand flexibility (<a href="#">Market Brief</a>)</li> </ul>
Building Envelope	Opaque Building Envelope	<ul style="list-style-type: none"> <li>Use reflective roof materials</li> <li>Use cool roof paints, <a href="#">climate dependent</a></li> <li>Identify thermal bridges with IR camera; mitigate (complexity varies)</li> <li>Add loose fill insulation in the attic space</li> <li>Deploy radiant barrier or spray applied low-E paints/coatings in attic spaces (where applicable)</li> </ul>	<ul style="list-style-type: none"> <li>Add or increase level of continuous insulation when replacing roof membrane</li> <li>Add attic ventilation, hot climate</li> <li>Install phase change material (PCM) panels in dropped ceiling (multiple technologies available)</li> </ul>	<ul style="list-style-type: none"> <li>Add continuous insulation to exterior walls</li> <li>Use advanced techniques to fill gaps with spray foam</li> </ul>
	Building Airtightness	<ul style="list-style-type: none"> <li>Seal obvious cracks</li> <li>Install weather stripping</li> <li>Seal around receptacles</li> <li>Apply window flashing to prevent moisture penetration</li> </ul>	<ul style="list-style-type: none"> <li>Conduct blower door test along with smoke test to locate and seal where needed</li> <li>Caulk and seal above dropped ceiling</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">Install air barrier</a> (preferably combined with other retrofit measures, such as adding <a href="#">exterior</a> or interior insulation)</li> </ul>
	Windows and Attachments	<ul style="list-style-type: none"> <li>Install applied films</li> <li>Caulk/seal windows</li> <li>Install window shading or attachments</li> <li>Automate interior attachments</li> </ul>	<ul style="list-style-type: none"> <li>Add storm window/<a href="#">secondary glazing</a> or replace existing windows with <a href="#">double-pane</a> or <a href="#">Low-E</a></li> <li>Automate existing exterior attachments</li> <li>Add automated exterior attachments/awnings</li> </ul>	<ul style="list-style-type: none"> <li>Install dynamic windows</li> <li>Install thin triple windows</li> <li>Install vacuum glazing</li> </ul>

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<b>Plug and Process Loads (PPLs)</b>		<ul style="list-style-type: none"> <li>Procure ENERGY STAR® rated or better products</li> <li>Enable low-power or sleep settings</li> <li>Consolidate and reduce loads</li> <li>Improve efficiency of pool equipment, such as <a href="#">replacing single-speed pumps</a> with VFD pumps</li> <li>Procure and install PPL control technologies:               <ul style="list-style-type: none"> <li><a href="#">Advanced Power Strips</a></li> <li><a href="#">Wireless Meter and Control Systems (aka Smart Outlets)</a></li> <li><a href="#">Automatic Receptacle Controls</a></li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Integrate smart PPL controls with other building systems or the BAS</li> <li>Integrate PPLs into demand response</li> <li>Load shift by implementing advanced scheduling technologies for charging EVs</li> <li>Schedule electricity-intensive classes during times of high renewable penetration</li> </ul>	<ul style="list-style-type: none"> <li>Integrate PPL controls to shed, shift, and modulate during times of peak fossil generation</li> <li>Implement power over ethernet (PoE) systems</li> <li>Improve electric infrastructure to prepare for electrification of school bus fleet</li> </ul>
<b>Renewables and Battery Storage</b>		<ul style="list-style-type: none"> <li>Participate in a community solar program or access renewables via a power purchase agreement (PPA)</li> </ul>	<ul style="list-style-type: none"> <li>Purchase on-site PV to cover roof area (verify roof structure and age) and parking as needed</li> <li>Integrate electric batteries and additional thermal energy storage to balance PV production</li> </ul>	<ul style="list-style-type: none"> <li>Integrate renewables, battery storage, and building loads into demand flexibility controls (EMIS platforms often provide this integrated-control capability)</li> </ul>

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