**Template Bond Criteria for Healthy, Energy Efficient, Carbon Neutral Schools**

Lack of funding is the most often cited barrier zero energy and zero carbon. Yet, [research by the U.S. Department of Energy](https://www.nrel.gov/docs/fy20osti/77414.pdf) make clear that zero energy schools cost less to build AND less to operate. The key is starting early and ensuring that zero energy and zero carbon are integrated into the project throughout.

The following list of strategies can be used to inform the conceptual master planning process for any of the new construction or major renovation projects that may be included in a bond. This way, you can plan for adequate funding to achieve energy efficiency and carbon emission reduction goals, and they are less likely to be considered out of scope. This will also lay the groundwork, so they are incorporated into the planning, design, and construction process.

***Instructions:***

*These criteria can be directly given to your bond costing team. Any of the sections underlined in green will need to be customized to your climate zone. Your climate zone will have an impact on your building design and technical specifications. You can find information about your climate zone and the relevant technical specifications for it in the* [*ASHRAE Advanced Energy Design Guide (AEDG) for Zero Energy Schools*](https://www.ashrae.org/technical-resources/aedgs/zero-energy-aedg-free-download)*. If you do not know your climate zone, you can find it in Appendix B - International Climatic Zone Definitions. At the top of each section there will be a mention of the table to reference to find the correct technical specification for your climate zone. Replace the suggestion (blue highlighted) with the correct spec for your climate zone.*

*Feel to use the language provided about each specification or develop your own to make it more appropriate for your district.*

**General Criteria**

|  |  |
| --- | --- |
|   | *See Table 3-1 in the ASHRAE Advanced Energy Design Guide (AEDG) for Zero Energy Schools for climate specific Energy Use Intensity (EUI).* |

* Goal is a healthy, energy efficient, carbon neutral building with an Energy Use Intensity of 17-20 kBtu/SF-year for new construction and 25-35 kBtu/SF-year for major modernizations *(Note: EUI values exclude intense process loads like swimming pools)*
* No fossil fuel infrastructure in new construction; preference for all-electric in major modernizations
* Physical mockup to demonstrate quality construction techniques in building envelope
* Commissioning services starting in drawing phase with scope that includes building systems, building envelope and control system calibration
* An online energy monitor and dashboard system are to be developed for all new and modernized buildings. Consider adding a simply display such as a low-cost monitor or TV in the lobby to display the dashboard

**Envelope**

|  |  |
| --- | --- |
|   | *See Table 5-3 in the*[*ASHRAE Advanced Energy Design Guide for Zero Energy Schools*](https://linkprotect.cudasvc.com/url?a=https%3a%2f%2fwww.ashrae.org%2ftechnical-resources%2faedgs%2fzero-energy-aedg-free-download&c=E,1,WYcPf7pE5zx4caAd90GibxNaCYFhkZ0yliolN9Nm23BgbOQfbutTVBqBjjHOERK3Nhkz8oNEzri035AcdMBYMFO-pWpVdi__AWJiE9egB87y&typo=1)*for the Envelope Construction Factors in your Climate Zone. Include specifics for your climate zone. Examples from Climate 4 provided below. See Table A-1 for additional Envelope Thermal Performance Factors. See table 5-5 for Fenestration Criteria. See table 5-4 for Envelope Material Conductivity.* |

* Glazing area 30%
* Window insulation U=0.35 and Solar Heat Gain Coefficient ADD. (*Solar Heat Gain Coefficients are mentioned in section EN48 of the AEDG)*
* Southern facing horizontal sunshades and western and eastern vertical sun shading elements
* Deciduous trees on South façade to allow winter sun/heat in
* Wall construction is R-13 Batt insulation with R-10.5 mineral wool board continuous insulation
* Roof is R-38 polyisocyanurate insulation
* Skylights, sun tubes, or light wells may be considered in permanently occupied spaces without access to natural light provided that rooftop solar requirements can be met
* Thermally-broken and air-tight envelope:
	+ Under entire slab-on-grade, spread footings, and wrapping around and underneath the footings at the building perimeter is to be 4” molded polystyrene board Type II for R-10
	+ Thermal Insulated material is used as washers for bolted connections between external and internal steelwork
	+ Continuous air leakage control over all surfaces of the building envelope, including the lowest floor, exterior walls and the roof. Air barrier system should be provided for interior separations between conditioned spaces and semi conditioned spaces. Target air leakage rate is 0.25 cfm/ft2 of total envelope surface area at 75 Pa

**Electrical**

* All high efficiency LED lighting with installed lighting power density of 0.4 Watts/square foot or less. (*See Table 5-10 in the* [*Advanced Energy Design Guide for K-12 School Buildings*](https://www.ashrae.org/about/news/2018/new-advanced-energy-design-guide-available-to-help-k-12-schools-achieve-zero-energy) *for LED specifications and Table 5-11 for appropriate lighting power densities for each space type.)*
* Daylighting and vacancy controls for space lighting
* Tablet charging closets will route circuits through relay panels on each floor so that power to those circuits can be turned off during determined hours
* 50% of plug load receptacles are controlled by an automatic shut off divide and separately metered low voltage power to allow for easy measurement and identification
* Right sized transformers and switchgear. They will be evaluated based on future high-efficiency heat pump electric heating and solar loads wherever possible
* EV charging capability shall be incorporated for a minimum of Level 2 Charging Infrastructure for 10% of the current parking spaces for staff and visitors. *(Or in accordance with current state or local EV charging requirements)*
* Renewables with appropriately sized breakers, panel and conduit will be included in the base bid. Renewable energy system panels and equipment will be considered as an add alternate in new construction and major modernization construction projects. Projects will use the [PV Watts Calculator](https://pvwatts.nrel.gov/) to calculate the solar capacity for your project location and compare against the modeled energy use to correctly size the PV array. Or, use Table 5-2 in the[ASHRAE Advanced Energy Design Guide for Zero Energy Schools](https://linkprotect.cudasvc.com/url?a=https%3a%2f%2fwww.ashrae.org%2ftechnical-resources%2faedgs%2fzero-energy-aedg-free-download&c=E,1,WYcPf7pE5zx4caAd90GibxNaCYFhkZ0yliolN9Nm23BgbOQfbutTVBqBjjHOERK3Nhkz8oNEzri035AcdMBYMFO-pWpVdi__AWJiE9egB87y&typo=1) for the PV Area as percent of gross floor area by climate zone

**Mechanical**

|  |  |
| --- | --- |
|   | *See Table 5-28 in the* [*ASHRAE Advanced Energy Design Guide for Zero Energy Schools*](https://linkprotect.cudasvc.com/url?a=https%3a%2f%2fwww.ashrae.org%2ftechnical-resources%2faedgs%2fzero-energy-aedg-free-download&c=E,1,WYcPf7pE5zx4caAd90GibxNaCYFhkZ0yliolN9Nm23BgbOQfbutTVBqBjjHOERK3Nhkz8oNEzri035AcdMBYMFO-pWpVdi__AWJiE9egB87y&typo=1) *for HVAC systems recommendations.* *Project teams should additionally consult the CDC recommendations for ventilation best practices to increase the delivery of clean air and dilute potential contaminants.* |

* Heating and cooling shall be provided by HFC-free (when available), centralized, all-electric systems that meet [CEE Tier 2](https://library.cee1.org/content/consortium-energy-efficiency-cee-high-efficiency-commercial-air-conditioning-and-heat-pump-0/) levels of efficiency
* CO2 demand control ventilation (DCV)
* Ensure 5 Air Changes per Hour (ACH) to ensure superior indoor air quality
* Displacement Ventilation System
* Heat recovery in kitchen and locker rooms
* Low pressure loss air distribution
* High efficiency equipment. All electric where possible
* All-electric, low global warming potential equipment and no fossil fuel infrastructure in new construction
* For major modernization or retrofits that do continue with fossil fuel equipment, ensure that any systems are right-sized and as efficient as possible

**Plumbing**

|  |  |
| --- | --- |
|   | *Refer to 5-25 in the* [*ASHRAE Advanced Energy Design Guide for Zero Energy Schools*](https://linkprotect.cudasvc.com/url?a=https%3a%2f%2fwww.ashrae.org%2ftechnical-resources%2faedgs%2fzero-energy-aedg-free-download&c=E,1,WYcPf7pE5zx4caAd90GibxNaCYFhkZ0yliolN9Nm23BgbOQfbutTVBqBjjHOERK3Nhkz8oNEzri035AcdMBYMFO-pWpVdi__AWJiE9egB87y&typo=1) *for domestic and service hot water performance indicators.* |

* Low flow fixtures throughout
* Solar domestic hot water heating
	+ *Section WH7 and Table 5-27 of the AEDG refers to Solar Hot Water Systems. Determine if this is appropriate for your district*

**Appliances**

|  |  |
| --- | --- |
|   | *The CA Energy Wise website provides* [*design guides*](https://caenergywise.com/design-guides/) *and* [*equipment recommendations*](https://caenergywise.com/rebates/) *for kitchen appliances, walk-ins, and cooking hoods. The* [*Food Service Technology Center*](https://fishnick.com/) *provides best practices on all-electric kitchens.*  |

* All appliances and equipment are the most efficient tier of Energy Star
* All kitchen equipment, appliances, and equipment are latest version of Energy Star and are all electric

**Specialty Equipment**

* Low energy elevators

**Materials**

* Finishes and other materials shall be durable, contain recycled/bio-based content, lead and PVC-free, recyclable at end-of-life, and meet low emissions criteria outlined in CalGreen and CA Section 01350. This applies to paints, coatings, adhesives, sealants, flooring/carpet, composite wood/panels, acoustical ceilings, insulation, and furniture
* Adopt low, embodied carbon materials including structural steel (hot-rolled, hollow structural sections, and plate), Concrete reinforcing steel, flat glass, mineral wool board insulation (light and heavy density mineral wool.)