

## GREEN SCHOOLS FROM A-Z

## Northeast &amp; Central United States

In the northeast and central parts of the country, given their more significant heating requirements, unit ventilators are common because of their heating efficiency and cost-effectiveness. Because the unit ventilator is a single-space system, one unit installed in the classroom handles only that room's airflow, thus minimizing the potential for cross contamination between classrooms.

## Southeast United States

In the southeast, water-source heat pumps are popular because they are quiet, meet high indoor air quality standards, and have high operating efficiencies to reduce total cost of ownership. Schools use the energy conscious water-source design because it is effective in this warmer, more humid region of the country.

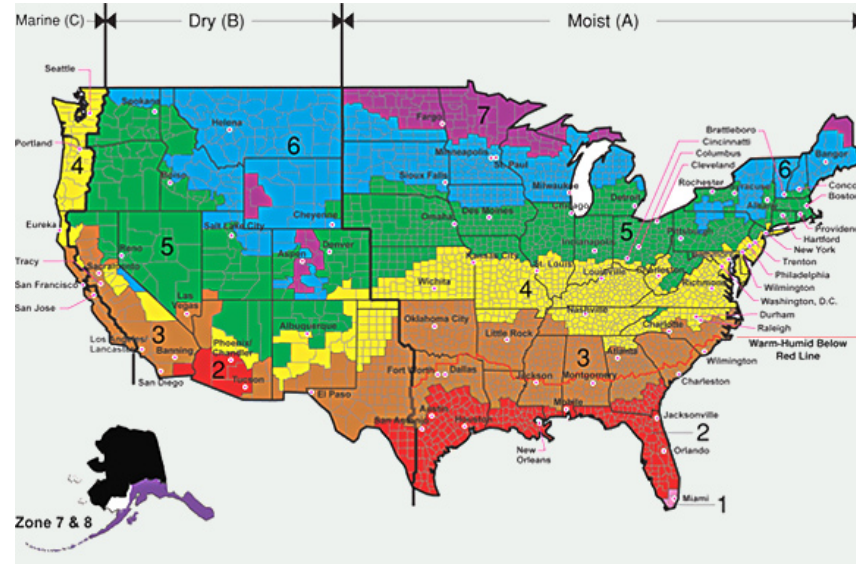
## Midwest and North United States

In the Midwest and North, with winters that can be frigid and summers that can be quite warm and relatively humid, chilled-water with a boiler and Variable Airflow Volume (VAV) air handlers are most common because they are proven to offer a flexible, cost-effective way to control temperature and humidity. This type of building system can deliver energy efficiency, environmental responsibility, and comfort.

Detailed installation and operation recommendations for these six HVAC system types are specified for each of the eight climate zones.

The six HVAC system types with zone-specific recommendations are:

- single-zone, packaged systems (combine heating, cooling, and fan sections all in one or a few assemblies) or split (separate indoor system and outdoor system linked by refrigerant tubing) system direct expansion (DX) units with gas or electric heat, or heat pump version;
- water-source (or ground-source) heat pumps that use the earth as a storage medium with a dedicated outdoor air ventilation system;
- unit ventilators with a chiller and a boiler that heats and circulates water



## ADVANCED ENERGY DESIGN GUIDE FOR K-12 SCHOOL BUILDING

The *Advanced Energy Design Guide for K-12 School Buildings* provides a wealth of design advice and information. The mechanics of navigating and using the information has been automated and simplified in a selection tool that is now available at [www.Trane.com](http://www.Trane.com). The tool uses the requirements of the guide and directly relates them to product specifications, catalogs, and other applicable design and selection information.

for cooling and heating;

- fan coil units located within the space with a chiller and boiler and a dedicated outdoor air system; and
- two types of multi-zone systems suggested — one that uses a large packaged Variable Air Volume (VAV) Direct Exchange rooftop unit with reheat terminals, and the other uses a water chiller and central station VAV air handler and reheat terminals.

Good-practice guidance for implementing the recommendations, as well as notes of caution about known pitfalls of green construction, are included to help designers achieve an energy-efficient structure.

We can integrate energy conservation and renewable energy strategies, high performance mechanical and

The illustration above shows the eight climate zones designated by the U.S. Department of Energy, as well as the subzones used by the DOE to indicate humidity levels.

lighting systems, water-efficient designs, environmentally responsive site planning, and environmentally preferable products to create high performance schools. Environmentally responsible building systems and services that save energy and provide optimal solutions to schools looking for ways to meet increasing demands for electricity, energy efficiency, and cost-effectiveness are here.

The public's desire and need for greener, more sustainable schools is clear. The benefits of building green schools are repeatedly being demonstrated in terms of operating cost savings, reduction in the use of natural resources, and performance and productivity gains by the occupants.

It is simply the right thing to do. Laws and regulations are beginning to mandate these building practices and the construction industry is responding with some excellent guidelines and tools for executing green construction. We need to embrace them. [www.nvma.org](http://www.nvma.org)

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# SCHOOL

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WILDCATS

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Photo courtesy of Tame

# 'Green' Can Be Relative to Your Region

Gary Luepke

## Regional considerations for designing high-performance green schools.

School district decision-makers face a multitude of challenges, but possibly one of the biggest responsibilities they are charged with is creating schools that offer productive learning environments while being fiscally responsible to tax payers. They want to leave a legacy of a fine school without breaking the bank.

### State of K-12 Schools

More than 55 million students and staff are directly involved with K-12 schools in the U.S. each year, according to the National Center for Education Statistics (NCES). The market represents a huge infrastructure, much of which is

overcrowded and outdated — the average age of a public school in the U.S. is 42 years, and 75 percent of those are 30 years old or older. An NCES survey of school principals found that 15 percent of the primary and middle schools exceeded their maximum design capacity.

The good news here is that more than one-third of school districts had a major retrofit or new construction project within the last two years, according to McGraw-Hill Construction.

While some facilities are getting upgrades, most districts still base designs on minimum code requirements. This is unfortunate because it means that, in

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the future, many children and teachers will continue to spend their days in facilities that just barely meet minimum health and safety standards.

Most people associate higher construction costs with building greener buildings, but actually districts that have built green are reporting that their actual costs were just a few percentage points higher, and that the direct financial benefits far outweigh the additional investment and payback quickly.

### Why Go Green?

The benefits of green schools are many. One interesting metric is increased student and teacher attendance. A three to four student day per year improvement in attendance has been documented for classrooms with natural lighting and improved indoor air quality. And the students appear to be putting this increased classroom time to good use by scoring an average of four to 19 percentage points higher than students learning in conventional classrooms, according to the collection of studies cited by Kats' *Greening America's Schools*.

In the area of resource conservation, green schools use on average 30 to 50 percent less energy and consume 32 percent less water. In many cases, these savings can fund an additional teacher for an entire year. These aren't just projections or estimates. They are measured performance changes from operating green schools.

### Building Green Requires a Regionalized Approach

The need for, and benefits of, green schools are clear. So how does a school district go about designing and constructing them?

Designing and building the optimal learning environment is complicated because there's no "one size fits all" regarding mechanical systems.

Every school has unique needs and requires different design, systems, and layout considerations based upon the local climate conditions, the number of students and faculty, and the educational objectives of the district.

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In addition, the entire building and the interaction of the various sub-systems in the building, including the envelope (the roof, walls, windows, and doors of a building), lighting, HVAC, and water heating must be taken into account.

### Example: Heating, Refrigeration, and Air Conditioning Systems

The American Society of Heating, Refrigerating and Air Conditioning Engineers' (ASHRAE) *Advanced Energy Design Guide for K-12 Buildings* offers tailored solutions based on long experience and a collaborative effort with the U.S. Green Building Council, American Institute of Architects (AIA), the Department of Energy (DOE), and other industry associations.

The first step, according to the guide, is to locate the correct climate zone. This is critical because systems vary with regard to their heating and cooling efficiency and humidity control capability.

In fact, it's important to note that some system types are not appropriate for some climates. Each HVAC system type recommendation is based on practicality of implementation and a goal to reduce energy consumption by 30 percent.

The U.S. Department of Energy defines eight climate zones in North America. The zones follow county

borders and are based on temperature (see map on page 4). In some cases, the zones are further divided into sub-zones based on humidity levels:

- **A Subzones** – Characterized as moist, humid subzones. They include the Eastern half of the country.
- **B Subzones** – The dry sub zones comprise the central part of the country.
- **C Subzones** – The far western portions of the western states are classified as marine.

These subzone designations, along with the climate zone number define the building, equipment, and energy recommendations in the *Advanced Energy Design Guide for K-12 Buildings*.

Some states have multiple zones. In the case of California, four zones and two subzones are represented.

Each climate zone table in the guide includes a set of common building subsystems, which include envelope, daylighting, lighting, HVAC systems, and service water heating. Recommendations are included for each item and component within that subsystem. In some cases, the recommendations are also influenced by the construction type, HVAC system type, and even by the type of daylighting used.

### HVAC System Selections by Region

One challenge with creating a set of prescriptive HVAC recommendations for K-12 school buildings for all areas of the country is that different regions use different types of HVAC systems. Following are some of the system-type preferences by region.

### Western United States

In California and the southwest, the system of choice for schools is small packaged rooftop units or one small HVAC system per classroom. Small packaged rooftops units are entirely self-contained systems. They offer a flexible, cost-effective way to control temperature and humidity. They are engineered to deliver several benefits: energy efficiency, environmental responsibility, and comfort.