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Wind Power: An Emerging Choice for Schools

By Lisa Hiserodt

The recent Copenhagen Climate Summit simultaneously highlighted worldwide concerns regarding climate change and international hope for collaborative efforts to re-align the path of human development with the natural systems that sustain it. Nowhere is hope more concentrated than in the education of future generations.

Providing students of every age an opportunity to learn about alternate energy sources can provide justification beyond typical financial cost analysis. Providing opportunities for creating curricula around live sources of alternative energy is an investment in itself.

Windmills have a long history as a symbol of rugged American individualism, from the image of the West where water was pulled up from aquifers to make settlements otherwise uninhabitable areas to the self-sufficient pioneers of the 1970s in off-grid homes in every state.

Now, windmills are making a national comeback. Wind power has the potential to generate 20 percent of our national power needs by the year 2030, according to the Department of Energy. In Denmark, 20 percent of all energy produced is generated by wind, putting the United States about 20 years behind.

Wind farms are used throughout the world to generate large quantities of electricity that are then mixed with other sources to supply the grid. For example, the Middelgruden Wind Farm just outside the harbor of Copenhagen was the first and best-known wind power farm of its kind. The farm, co-owned by a local cooperative and the utility company, began production in 2000 and generates 350,400 megawatt hours annually. Within the first five years of operation, the wind farm generated 6.5 percent more energy than originally anticipated.

Recently the United States was listed as the country with the largest installed capacity of wind-generated power: over 157.68 million megawatt hours of wind power in 2008, roughly enough to serve over 4.9 million households.

While the numbers appear to be quite large, it is important to consider them in context. The United States is also the world's largest consumer of electricity and surpasses China — the second-largest consumer — by over 30 percent in overall annual consumption. For comparison,

overall annual consumption for the United States in 2005 was 3.8 million megawatt hours a year, meaning the amount generated last year was less than 5 percent of the total consumed. Nationally, we have some work to do.

The Wind Powering America project was initiated by the DOE with such statistics in mind, and the Wind for Schools program is looking forward to a time when we are less dependent on foreign oil to meet our energy needs.
Currently, most of the installed school wind projects that have made use of the program are located in rural areas of the Midwest. A quick glance at a map of national wind speed potential explains why. Large areas in the plains are capable of supporting sustained wind speeds that translate into greater energy capacities. The program is therefore aimed at the area most likely to be developed for harvesting wind.

The Wind for Schools program requires that each school be financially responsible for its turbine, so while the primary goal may be curriculum based, there is still a need for financial prudence.

It is important that a wind turbine installed in an educational setting provides an example of energy efficiency and carbon reduction by contributing to energy savings for the school via energy production data, as well as expose students to the mechanics of power generation.

It is useful to have a basic understanding of the factors that contribute to wind power, including the overall turbine market and what to look for.

The variety of turbines can be overwhelming and selection should be guided by a careful understanding of site conditions, output targets and efficiency goals. Some of the more affordable turbines do not perform well once installed and result in underutilized capacity. When investigating turbines it is important to look for measured output data as opposed to rated output data. Rated data can be misleading because it is determined by idealized conditions and turbines usually perform at a much lower capacity.

It is also critical to be aware of the specific wind conditions used to generate each rating, as they will vary from one manufacturer to another. Output numbers generated at 6 mph versus 12 mph, for example, are actually much further apart than they appear. Wind-energy capacity is proportional to the cube of its speed; this means that doubling the wind speed results in an energy output that is eight times greater.

Conversely, far less energy is produced at lower wind speeds. For this reason, some engineers will recommend not installing wind turbines if the Wind Power Class for the area is less than 2, which translates to an annual potential wind speed of less than 9.8 mph at of height of 33 feet above the ground. It is important to note that variables that influence wind speed can be quite site specific and can be significantly impacted by very localized conditions.

Turbines are generally divided into two categories: horizontal axis and vertical axis. Most large-capacity turbines used for wind farms are horizontal axis. Vertical axis turbines are futuristic looking, and manufacturers are trying to build a reputation for them as the quieter option. Each type is further divided into subcategories.

The National Renewable Energy Lab’s definition of net-zero buildings rates power-generation sources that are physically attached to a building above power generated on site or purchased from renewable sources. This gives the photovoltaic market an edge over wind turbines because photovoltaic systems are usually installed on the roof of a building.

Recently, manufacturers have begun to create building-integrated wind turbines in both horizontal and vertical axis models, and some building-integrated turbines were designed specifically to take advantage of the updraft along the face of buildings.

However, noise, vibration and air turbulence provide significant challenges to overcome. While some of the building-integrated turbines are quite elegant and visually appealing, their overall performance must be taken into account.

Wind Resistance

Wind power continues to meet resistance within the population, despite its potential as a clean and renewable resource. Some concerns include opposition to aesthetics or concern for local wildlife. The concern most often cited, however, is noise. Understanding why turbines make noise can help mitigate concerns about installing a wind turbine.

Factors that impact noise levels can be either mechanical or aerodynamic. Mechanical noise can be addressed by understanding the unit you are buying and comparing different turbines. Generally speaking, measured noise levels can range from 30 to 89 decibels, with many falling in the range of 35dB to 40dB. To put that in context, typical urban street traffic is measured at around 85dB, while an occupied living room is generally about 35dB.

Manufacturers should be able to tell you what the expected noise levels are, but they are likely to provide data for mechanical noise only. Aerodynamic noise is more difficult to predict and is best addressed by knowing the speed, direction and consistency of wind potential on the site. Air turbulence is created by physical impediment to air flow and can vary widely in how much it adds to the noise a wind turbine generates.

Over the past 20 years, the term sustainability has lodged itself firmly in the language of everyday life. Combining that with a growing understanding of the impact of carbon output on the global environment, many institutions are now looking more seriously at ways to reduce their impact.

Wind turbines can be an effective and elegant way to introduce power generation to a site. In some instances, energy produced from turbines can exceed the energy needed, resulting in an income source by selling excess energy to local utilities. Wind power has the potential for being one of the best long-term investments for our country, and our schools. The future is listening.

Lisa Hiserodt is an intern architect with HMFH Architects, a Cambridge, Mass., architecture firm focused on the academic market.

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