Chapter 7
Green Technology for Green Schools

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ABSTRACT
Technology systems typically are high-energy consumers especially when considering the distinct number of systems encountered in education. Efforts at curbing this consumption to create an efficient technology environment require well-developed tactical and strategic plans. Organizations can begin this journey by developing a road map for a sustainability program. Three technologies, cloud computing, server virtualization, and desktop virtualization, offer great promise and should be a part of the green roadmap for schools. Cloud computing capitalizes on the power of broadband networking to engage needed resources regardless of location and thus creates synergies to reduce energy consumption. Server virtualization allows the school to reduce the number of servers needed while increasing server optimization within the organization. Desktop virtualization meets multiple goals and objectives; it reduces energy and lowers related costs, while at the same time providing more control and flexibility in meeting the technology needs of the organization. This chapter discusses these technologies, their impact, and encourages school administrators to develop strategic as well as tactical plans for creating an energy efficient technology approach.

INTRODUCTION
In today’s information technology (IT) environment, senior management is increasingly tasking IT professionals to reduce energy costs while managing their energy needs more efficiently. This requires utilizing systems that consume less power while gaining full functionality of the power consumed. Technology systems typically are high-energy consumers especially when considering the distinct number of systems encountered in education and the companion environmental systems common to the data center. This total consumption grows when you add all of the individual computers needed for modern academic needs in a school and across school systems. Technology,
given its elevated energy consumption rate, offers great potential for energy reductions as well as ways to lower CO₂ emissions. Meeting these desired outcomes requires schools to re-think existing approaches for providing IT services and to consider emerging and modern technologies to meet the needs of our individual users, whether in the classroom or office.

Three areas of technology offer great promise to schools in their drive to reduce energy consumption and lower CO₂ emissions, and all while reducing costs. Cloud computing, or services provided across the network, provides economies of scale for energy consumption while also reducing local infrastructure needs. Cloud computing usually enhances service availability and functionality and there are opportunities to reduce local technology hardware/service costs. Server virtualization is an effort to maximize service availability from local resources. Virtualization allows the bundling of separate services onto one physical hardware device, thus saving energy and equipment costs associated with multiple devices. Server Virtualization, also, enhances functionality and service offerings. Desktop virtualization is a new approach at providing classroom and individual personal computing resources. Individual computing devices are most numerous in the local school location; therefore, they become a key target for reducing the higher energy requirements of older technology. For example, older desktop computer power supplies, just one component in desktop machines, are in general 70-75% efficient, while the newer, certified Energy Star desktops must meet standards of 80% efficiency. Monitors and video cards are other components that consume considerable amounts of energy (Clark, 2008).

These three technologies, cloud computing, server virtualization, and desktop virtualization offer great promise, however schools should carefully consider these and other approaches for reducing technology energy consumption. Well-developed tactical and strategic plans grounded in successful practice dictates the best approach (Russell, 2009). Organizations can begin this journey by developing a road map for moving towards a sustainability program. First steps include developing a base line for current hardware energy performance. That data enables school officials to compare current performance data to the energy performance of possible new devices. This comparison can identify “low hanging fruit,” or those technology changes readily implemented so energy savings commence realization. The comparison can also inform as to the greatest opportunities for focusing limited resources on those items promising the larger return.

To maximize energy savings, school leadership, while addressing gains with desktop virtualization, should consider an overall services approach for providing computer resources. Engaging cloud and server virtualization strategies could realize a more energy efficient solution for school computing resources.

**COMPUTER VIRTUALIZATION**

Computer virtualization refers to the concept of one physical hardware device running software that shares internal resources to simulate multiple unique, logical computer systems. This model originated with IBM in the 1960s, but the industry only commercialized the model in the 1990s. Most advances in this area of IT have been in the area of data centers and servers, but these technologies can extend to the classroom by virtualizing the individual desktop. Schools may find “in the cloud” one key enabler for virtualizing the desktop, rather than operating the necessary virtualization infrastructure locally. Many service providers offer virtualized desktop services across the network or “in the cloud,” or the school district can provide these services by the school’s internal “cloud.” Regardless of the “where” the services originate, virtualization offers great potential to reduce energy requirements. Cloud computing availability