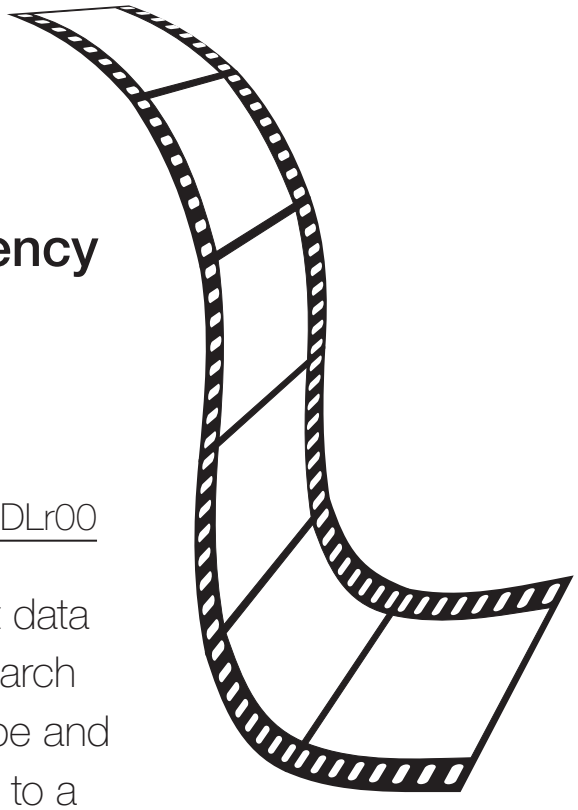
video case



chapter 2 E-commerce Infrastructure

case 1 **Google Data Center Efficiency Best Practices**

watch the video at http://www.youtube.com/watch?v=voOK-1DLr00

summary Google operates some of the largest data centers in the world to support its search engine, Gmail, Google Maps, YouTube and a host of other applications delivered to a global audience. Google's Technical Program Manager describes how Google manages the energy consumption of its data centers using industry best practices. *L=10.01*

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Consumers of technology constantly demand devices that are smaller, more efficient, and more powerful than the ones they have. But most consumers don't understand the massive back-end infrastructure that powers their "front end" devices, like mobile phones, smartphones, tablets, and desktop computers, nor the impact that this infrastructure has on the environment.

Take, for example, the smartphone and tablet computers. iPhones, Androids, BlackBerrys, iPads, and other tablets represent a trend in all forms of mobile technology towards smaller devices that perform an increasingly large number of functions. But every time a smartphone or tablet user connects to the Internet, places a call, or sends an instant message, it uses power not only on their phone, but at every step of the infrastructure used to perform that

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function. More often than not, data centers, also called "server farms," are intimately involved in any Internet-based communication. These data centers are growing not only in number, but also in sheer size. IBM has a data center which covers approximately forty thousand square feet (three football fields) and contains ten thousand servers. Major data centers require such a large amount of energy to power and maintain that only large corporations are able to build them up. The cost of running large data centers is a significant component of the overall IT budget of firms. There are two components to the energy cost of data centers: the cost of running the computers, and the cost of cooling them. In the large data centers, temperatures would reach 120 degrees in just two minutes if the cooling system were disabled. At this temperature, processors and hard drives begin to malfunction.

In 2014, according to the Natural Resource Defense Council, 12 million computer servers in 3 million data centers deliver nearly all U.S. online activities. The growth of cloud computing is expected to accelerate data center growth and power consumption in the next ten years. In 2014, the NRDC estimated that data centers in the U.S. consumed energy equivalent to the output of 34 coal-fired power plants.

Due to these increasing power demands, by 2020, the world's computer servers will match or exceed the carbon emissions of the airline industry. Making computers greener won't just be environmentally beneficial. It will also relieve the financial burdens of companies that maintain these server farms. There is plenty of incentive for online e-commerce companies like Amazon, Apple, Google, Facebook, and Microsoft to reduce their data center power consumption. In addition, competition among the industry's largest providers of data centers (IBM, Oracle, HP, and Intel) are incentivized to help their customers "go green" and reduce costs.

One method that companies use to conserve energy is to distribute their data centers worldwide, placing them in areas where it's more efficient to power them. For example, placing data centers in areas of the world where ambient temperatures are lower lessens cooling requirements. An area in high demand is Iceland, and other Scandinavian countries, where the temperature is much lower and cooling needs are reduced. In addition these countries make extensive use of hydropower, which does not contribute to global warming and is much less expensive than coal and nuclear power. In the United States, the hydropower produced by the Columbia River makes the northwest a popular data center location, along with southeastern states that rely on hydropower produced by the Tennessee Valley Authority and the Tennessee River.

Another method for reducing the IT-component of power consumption is virtualization. This technique allows servers to perform multiple tasks at once and is one of the more prominent "green" initiatives for reducing emissions and increasing efficiency. Using this technique, a single machine can run more than one operating system at the same time, and operate at a much higher duty cycle, reducing the number of computers required to perform the same number of tasks, and reducing the overall cooling requirements of data centers. On the other hand, increasing the duty cycle (the amount of time a computer is actually doing work rather than idling) also increases the heat generated by processors.

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Google is considered to be an industry leader in data center efficiency, in part because it builds its own custom data centers rather than rely on standard industry equipment and practices. However, although "going green" can be both financially and environmentally beneficial, companies that develop unique technology are given an incentive not to share them to gain a competitive advantage. For example, Google has proprietary virtualization technology that it won't share, and is secretive concerning the number of servers it operates. However, as demonstrated in this video, Google takes many other steps to share its energy efficient best practices with other firms and the public.

video case questions

1. What is PUE, and why is it an important place to start when considering how to reduce data center power consumption? What value of PUE should data center managers strive for?
2. Describe the five methods recommended by Google for reducing power consumption.
3. How much of the world's global greenhouse gases are the result of computing? List several factors that will tend to retard or accelerate data center power consumption both globally and in the United States.
4. Where do you suspect that data center power consumption will be greatest: developing and emerging economies or already-developed economies. Why?
5. Imagine that a company has developed an advanced technology that allows it to reduce its data center requirements by an unprecedented amount, and creates a competitive advantage for the company in the data center market. Why should it share that technology with other data center firms? If this firm does not share its techniques, the rest of the industry will continue to operate less efficient centers, and increase global emissions of green house gases above what they would otherwise be.
6. Should the government or an industry association regulate the carbon emissions of the data center industry as they do the airline industry? Or the automobile industry? Or is it sufficient to rely on the competitive market place to drive down energy consumption in data centers?