Renewable Energy: Clean, Secure, Reliable

The Value of Electricity When It's Not Available

The cost of power disturbances to the U.S. economy is large and growing.

The U.S. electric power system is among the most dependable in the world, delivering to most of its customers a nearly uninterrupted flow of power with over 99% reliability each year. High reliability is a central guiding principle for the U.S. electric power supply, and a key requirement for efficient commerce and industry, as well as a high standard of living.

Despite the system's longstanding history of successful operations and customer satisfaction, recent highly publicized outages, customer alerts, and requests for load shedding in certain regions have led to changing perceptions and uncertainty about its reliability. There is a growing awareness that continuous power supply and improved power quality are critical underpinnings of the nation's post-industrial, digital economy. That economy is increasingly based on the continuous real-time flow of information and increasingly dependent on machines controlled by digital components, such as microprocessors. This can also translate to increased vulnerability. For many high-tech businesses, power outages are unacceptably expensive. The following anecdotal, real cases are sobering.

Cost of Power Outages for Selected Commercial Customers

Brokerage Operations
$6,480,000 per hour

Credit Card Operations
$2,580,000 per hour

Airline Reservations
$90,000 per hour

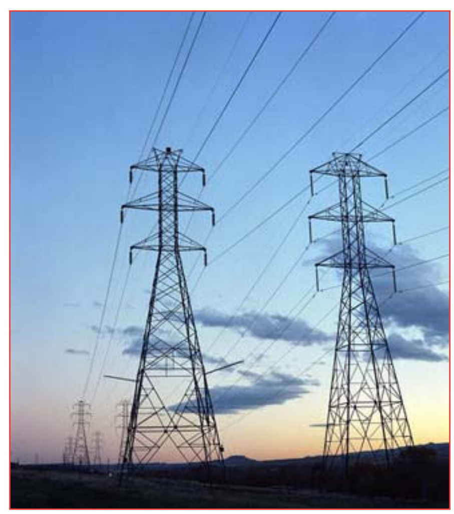
Telephone Ticket Sales
$72,000 per hour

Cellular Communications
$41,000 per hour

Source: *"Reliability and Distributed Generation,"* a White Paper by Arthur D. Little.

The Digital Economy is Vulnerable

According to Larry Owens of Silicon Valley Power, a blackout costs Sun Microsystems "up to $1 million per minute." A recent rolling blackout in the greater San Francisco Bay Area caused an estimated $75 million in losses in the Silicon Valley, some of which were connected to clean-room operations. The economic impact of electric reliability on customers can continue even after power is restored. Hewlett-Packard reported that a 20-minute outage at a circuit-fabrication plant would result in a day's production loss at a cost of $30 million (Silicon Valley Manufacturing Group).



Warren Gretz/PIX00001

Businesses of the modern electrical era need to come to terms with power disruptions and related economic costs.

Further, credit card processing centers can lose over $2.5 million per hour from power interruptions.

When the Chicago Board of Trade lost power for an hour during the summer of 2000, trades worth about $20 trillion could not be executed. During this power disruption in Chicago, loss of refrigeration at the Field Museum put DNA samples in danger of being destroyed.

The importance of reliable power for the industrial and digital sectors is further underscored in a recent report from the Electric Power Research Institute's (EPRI's) Consortium for Electric Infrastructure for a Digital Society. EPRI reports that U.S. digital economy firms lose $13.5 billion to electric outages annually, primarily from lost productivity and idled labor.

Inclusion of continuous-process manufacturing, fabrication, and essential services such as transit, water, and gas industries increases the annual U.S. economic loss to $45.7 billion from power outages, plus another $6.7 billion from power-quality issues. Finally, when all business sectors are included, the U.S. economy is losing between $119 billion and $188 billion annually from power outages and power-quality issues.

Roger Taylor/PIX00015

When local electrical subsystems fail, the cost to business can be substantial.

When the Chicago Board of Trade lost power for an hour during the summer of 2000, trades worth about $20 trillion could not be executed.

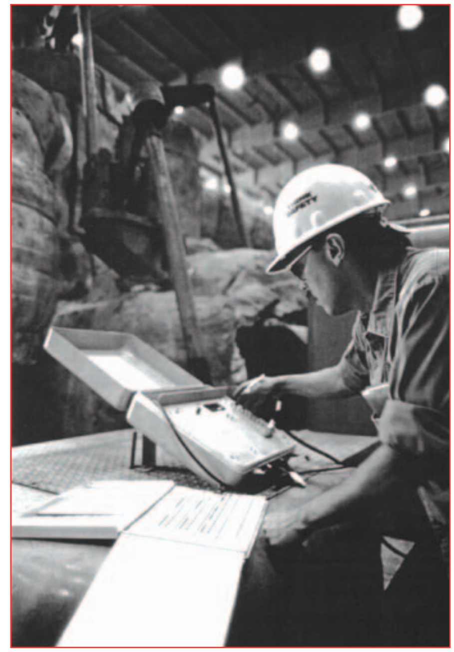
Other Business Sectors Take Hits

"The risk of not having supply and the risk of not being able to predict the shutdowns is much greater than the risk of increased price," says Brad Spahr, chief executive of Composite Structures LLC, a $65 million-a-year aircraft-parts maker in Monrovia, northeast of Los Angeles.

In mid-January of 2001, after a week of persistent power interruptions in California, Composite Structures moved most of its production to an overnight shift beginning at 9:30 p.m., "when there's the most electrons available," Spahr says. The company also rented four diesel-powered generators, at a total cost of $14,500 a week, to keep its factory operating if the power went out.

During one phase of production, Composite Structures' parts must sit in huge pressure cookers for as long as 8 hours at a time. Even a brief power failure can ruin $500,000 worth of spoilers and rotor blades. So, the rented generators are what Spahr calls "a very expensive insurance policy."

McNeal Enterprises, a 115-employee machine shop in San Jose, California, lost power for 90 minutes during a January blackout, costing the company $200,000 in lost production and damaged parts.



Ron May/PIX01772

Troubleshooting continuous-process manufacturing glitches following power disruptions is costly, too.

Businesses Will Relocate

In a survey conducted by the Connecticut Business and Industry Association, 34% of respondents said they would shift business operations out of their state if they experienced ten or more 1-hour to 1-day unanticipated power losses over a quarter of a year.

Miller Brewery in Irwindale, California, laid off 160 workers and moved some production out of state, rather than having to choose between losing power or paying the lower rates associated with "interruptible power contracts (i.e., an agreement where, in exchange for lower rates, a user agrees to allow the power provider to shut off or greatly reduce electricity demand during times of tight supplies).

Intel Corp. Chief Executive Craig Barrett made headlines during the summer of 2001 when he said that the world's largest chipmaker would not locate a new factory in California until power supplies became more reliable. Intel hasn't built a factory in California since 1988.

The Moving Power-Reliability Target

Reliability is often measured against a baseline maximum of 100% for 365 days per year. The power system is designed typically to deliver between 99.9% (or "three nines") and 99.99% (or "four nines") reliability. There is no definitive industry statistic that measures the overall reliability of the U.S. electric power system, although industry surveys are conducted periodically. In practice, the reliability of the system varies by location, but is generally over 99%.

The U.S. economy increasingly relies on computer networks, particularly for e-commerce applications. These telecommunications and computer network applications have extremely high demands for reliability (minimal 99.999%) that exceed what the electric power system is currently capable of delivering (approximately 99.0%–99.99%). A reliability level of 99.999% equals 5 minutes each year of unreliable power or power outages.

The value of reliability varies by customer type. Today, there are many companies and other organizations for which the effects of outages are relatively acute. For these customers, outages can cost from tens of thousands of dollars to millions of dollars per incident.

Solutions for Today

Customer-oriented solutions powered by solar electricity are emerging, especially as business owners and operators confront the economic losses of not having power when they really need it. Consumers already pay an average of 40¢/kilowatt-hour for uninterruptible power supplies (UPS). A solar electric system (i.e., with minimal battery capacity) integrated with the UPS for a relatively small incremental cost can extend the power outage

Case Study: California Firm Banks on On-Site Power Generation

RealEnergy Corp. of Century City, California, is banking on what it believes will be an exploding market for on-site power generation among U.S. commercial property owners, who together spend an estimated $40 billion annually on energy. RealEnergy is marketing its distributed generation systems as a supplemental energy source for building owners whose tenants—many in the high-tech sector—depend on a steady supply of reliable power. Building owners would not incur any up-front costs, and would generally contract with RealEnergy for the on-site power for a period of 15 years.

Arden Realty of Fountain Valley, California, uses this 240-kW solar electric system for its 110,000 square-foot City Center office building and company headquarters. RealEnergy and Arden Realty claim that this system is the largest commercial solar power system in the Western Hemisphere.

Byron Stafford/PIX10727

Arden Realty of Fountain Valley, California, uses this 240-kW solar electric system for its company headquarters.

back-up time, particularly during the worst outages.

Solar electric power systems transform sunlight into electricity. Sunlight is an abundant resource—every hour the sun bathes the Earth in as much energy as the world consumes in an entire year.

Solar cells employ special materials called semiconductors that create electricity when exposed to light.

NC Solar Center/PIX09382

The Central Carolina Bank, Bessemer City, North Carolina, uses a 2.75-kW solar electric system to produce electricity and heat for this building.

Solar electric systems are quiet, easy to use, and require no fuel other than sunlight. Because they contain no moving parts, they are durable, reliable, and easy to maintain.

Distributed energy resources (DER) refer to a variety of small, modular power-generating technologies that can be combined with energy management and storage systems to improve the operation of the electricity delivery system, whether or not they are connected to an electricity grid. The primary fuel for many distributed generation systems is natural gas, but hydrogen may well play an important role in the future.

DER technologies consist primarily of energy generation and storage systems placed at or near the point of use. DER provides the consumer with greater reliability, adequate power quality, and the capability to control price fluctuations.

Distributed energy encompasses a range of technologies including fuel cells, microturbines, reciprocating engines, load reduction, and other energy management technologies. Combined heat and power systems provide electricity, hot water, heat for industrial processes, space heating and cooling, refrigeration, and humidity control to improve indoor air quality and comfort. DER also involves power electronic interfaces, as well as communications and control devices for efficient dispatch and operation of single generating units, multiple system packages, and aggregated blocks of power.

Web Sites and Information Resources

U.S. DOE Office of Energy Efficiency and Renewable Energy
Through this site, you can access literally hundreds of pages containing information and resources on renewable energy technologies.
www.eere.energy.gov

Power Topics
This section of the above-mentioned site provides information about power technologies (including those powered by renewable sources) that maximize the efficient generation, transmission, and storage of energy.
www.eere.energy.gov/EE/power.html

National Center for Photovoltaics (NCPV)
The NCPV site offers considerable information and resources about solar electricity, ranging from basic R&D, to industry contacts, to case studies, to cost- and performance-estimation tools.
www.nrel.gov/ncpv

DOE's Distributed Energy and Electric Reliability Program (DEER)
The DEER Web site provides extensive information and resources about a rapidly increasing array of distributed energy technologies and applications.
www.eere.energy.gov/deer.html

"The Cost of Power Disturbances to Industrial and Digital Economy Companies," pages 9–10, Consortium for Electric Infrastructure to Support a Digital Society, Electric Power Research Institute.

This report presents the latest research on the substantial economic impacts of power disruptions to industrial and digital businesses.
http://ceids.epri.com/ceids/Docs/outage_study.pdf

"Homeland Security: Safeguarding America's Future with Energy Efficiency and Renewable Energy Technologies"
This August 2002 report by the State Energy Advisory Board (STEAB) focuses on how we can make our energy infrastructure more resilient and less vulnerable.
www.steab.org/docs/STEAB_Report_2002.pdf

NREL

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