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# **The Cost of Power Disturbances to Industrial & Digital Economy Companies**

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**Consortium for Electric Infrastructure to Support a Digital Society**

*An Initiative by EPRI and the Electricity Innovation Institute*



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# ▶▶ The Cost of Power Disturbances to Industrial & Digital Economy Companies

## Executive Summary

**The importance of power reliability and power quality continues to increase for U.S. businesses, particularly industrial and digital economy companies**

The importance of reliable, high-quality electrical power continues to grow as society becomes ever more reliant on digital circuitry for everything from e-commerce to industrial process controllers to the onboard circuitry in toasters and televisions. With this shift to a digital society, business activities have become increasingly sensitive to disturbances in the power supply. Such disturbances not only include *power outages* (the complete absence of voltage, whether for a fraction of a second or several hours), but also *power quality phenomena* (all other deviations from perfect power, including voltage sags, surges, transients, and harmonics).

The Consortium for Electric Infrastructure to Support a Digital Society (CEIDS) commissioned this study to obtain a definitive estimate of the direct costs of power disturbances to U.S. businesses. Rather than extrapolating from anecdotes or studies confined to a single utility service territory or single outage event, the intent was to survey a representative sample of U.S. business customers in key sectors about their costs from outages and PQ phenomena.

Three sectors of the U.S. economy are particularly sensitive to power disturbances:

- **The digital economy (DE).** This sector includes firms that rely heavily on data storage and retrieval, data processing, or research and development operations. Specific industries include telecommunications, data storage and retrieval services (including collocation facilities or Internet hotels), biotechnology, electronics manufacturing, and the financial industry.
- **Continuous process manufacturing (CPM).** This sector includes manufacturing facilities that continuously feed raw materials, often at high temperatures, through an industrial process. Specific industries include paper; chemicals; petroleum; rubber and plastic; stone, clay, and glass; and primary metals.



- **Fabrication and essential services (F&ES).** This sector includes all other manufacturing industries, plus utilities and transportation facilities such as railroads and mass transit, water and wastewater treatment, and gas utilities and pipelines.

These three sectors account for roughly 2 million business establishments in the U.S. Although this is only 17 percent of all U.S. business establishments, these same three sectors account for approximately 40 percent of U.S. gross domestic product (GDP). Moreover, disruptions in each of these sectors – but especially DE and F&ES – have an almost immediate effect on other sectors that depend on the services they provide.

### **EPRI's Consortium for Electric Infrastructure for a Digital Society (CEIDS) contracted Primen to conduct a national survey of business establishments to quantify the cost of power disturbances to industrial and digital economy firms**

The survey employed a statistically representative sample of 985 establishments to reflect costs of the roughly 2 million industrial and digital economy establishments in the U.S. An initial screening identified at each establishment sampled an individual who was knowledgeable about the facility's energy usage and how power disturbances affect their operations. These individuals were then invited to complete the survey online or by mail, depending on their preference. The survey presented respondents with a set of hypothetical outage scenarios and asked them to estimate the costs they would incur from each outage across different categories. This approach, called *direct costing*, has been widely used by utilities to develop estimates of outage costs. The survey also captured information on the number and duration of outages experienced (which allowed for estimating annual outage costs), the number and cost of power quality phenomena experienced, and descriptive information about the business.

### **Industrial and DE firms are collectively losing \$45.7 billion a year to outages**

Power outages cost each of the roughly 2 million establishments in these three sectors more than \$23,000 a year. The bulk of this loss (\$29.2 billion) is concentrated in the F&ES sector, which is particularly vulnerable to equipment damage. DE firms lose \$13.5 billion to outages annually, primarily from lost productivity and idled labor. The greatest losses per establishment are among CPM firms, which suffer the loss of raw materials as well as the costs incurred by other sectors.

## **Costs vary with the length of the outage but even short outages are costly**

Even a one-second outage can damage equipment and disrupt highly sensitive operations to the point where labor becomes idled as systems are reset and brought back online. The average cost of a one-second outage among industrial and DE firms is \$1,477, vs. an average cost of \$2,107 for a three-minute outage and \$7,795 for a one-hour outage. Brief outages are also more frequent than outages of an hour or more; industrial and DE establishments report that 49 percent of the outages they experience last less than 3 minutes.

## **Industrial and DE companies lose another \$6.7 billion each year to PQ phenomena**

DE firms have lower power quality (PQ)-related losses, per establishment, than either of the industrial sectors. The F&ES sector seems to be particularly sensitive to PQ phenomena, losing more than \$9,600 annually per establishment and accounting for 85 percent of the aggregate losses across all three sectors. Once again, equipment damage seems to play a large role in the costs to industrial facilities.

## **These data suggest that across *all* business sectors, the U.S. economy is losing between \$104 billion and \$164 billion a year to outages and another \$15 billion to \$24 billion to PQ phenomena**

California has the highest costs for both outages and PQ phenomena (between \$13.2 billion and \$20.4 billion), followed by Texas (\$8.3 billion to \$13.2 billion) and New York (\$8.0 billion to \$12.6 billion). California's costs are based on a typical year of power disturbances; costs are likely to increase dramatically if the state experiences the level of rolling blackouts predicted for summer 2001. Projections to all business sectors are extrapolations from the survey data based on the assumption that per-establishment costs from outages and PQ phenomena for firms outside the DE and industrial sectors are anywhere from 25 percent to 50 percent as high as the costs reported by these sectors, and are statistically valid as long as this assumption is correct.