The system of power delivery in the US is in trouble – it is old and creaking. To prevent more gigantic financial losses similar to the ones the US economy has already experienced as a result of blackouts, the government is looking to change the way in which the grid is designed and operated.

The US Department of Energy (DoE) is investing in the research and development of the ‘smart grid’. It defines two main stages in this theoretical development process: a smart grid and a smarter grid.

A smart grid is the vision of a more removed future, according to the DoE’s 2008 paper on the subject, The Smart Grid: An Introduction. “The longer-term promise of a grid remarkable in its intelligence and impressive in its scope.”

A smarter grid is one that can be built using technology that is available today, or that will become available in the near future.

Today’s grid, according to the DoE, is characterised by uninfomed consumers, dominance of central generation, limited wholesale markets, slow response to power quality issues, poor integration of renewable energy, and vulnerability to “malicious acts of terror and natural disasters”.

The DoE’s vision of the smart grid is that of a system whose consumers are involved and active – one that leverages demand response and distributed energy sources. A smart grid has many distributed energy sources, with focus on renewable energy. The future system is one that is resilient to attacks and natural disasters, and where power quality is a priority.

According to the DoE paper, growth in peak demand for electricity in the US has exceeded growth in transmission by 25% annually since 1982. Lack of sufficient investment into transmission and distribution infrastructure in the country has compromised the grid’s efficiency and reliability.

The US economy has already paid dearly for the lacklustre state of the nation’s electrical infrastructure. According to the US Department of Energy, a rolling blackout across Silicon Valley resulted in losses that totalled $77bn. A one-hour outage at the Chicago Board of Trade in 2000 caused a delay in trades that were cumulatively worth about $20 trillion.

The 2003 blackout in the northeast (the largest in US history) caused about $6bn in economic losses to the region.

Theoretically, a smart grid is intelligent enough to sense and predict overloads and economic loss to avoid such outages or minimise their impact.

SMART BUILDINGS
An essential component of a smart grid is a smart consumer: a smart building. Data centers are some of the most intelligent buildings built. GE’s Marcel Van Helten, the market director for Intelligent Platforms, says: “It is an interesting combination that absolutely makes sense.”

In Van Helten’s opinion, convincing data center operators to work with their electricity providers in such a way would take incentivising them with lower rates. “For the data center, the strategy is a huge cost factor,” he says. “I would imagine that, in the spirit of making more money, they would actually make that decision.”

Participation in a smart grid would also make a good component for a company’s sustainability programme – something more and more organisations are concerned with.

Van Helten sees three ways in which data centers relate to the smart grid: as consumers, as contributors and as enablers, although the first two, in a way, fold into the third.

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As consumers, data centers are some of the most significant energy consumers. For example, in 2008, the US Department of Energy stated that data centers are among the largest energy users in the United States and worldwide.

As enablers, data centers are some of the most intelligent buildings built. To GE’s Marcel Van Helten, data centers are some of the most intelligent buildings built.

As contributors, data centers are a major factor in the overall energy consumption of the grid.

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Rather than becoming integrated with management processes that already take of common communication methods, expensive and a lot of what it does has already been done manually through the use of smart grids, Bowman says data centers in the US would be better off moving toward increased independence of the electrical grid by increasing their energy efficiency and developing their own generation capacity, or building facilities next to generation plants.

Implementing a smart grid is "remarkably easy" and should be done more, Bowman says. "Self-help is a far greater silver bullet than putting a meter on every device in the point of having little meaning. "You need to look at what’s going on in data centers as the grid is at peak demand, consumers reduce the grid operator, that operator has an enormous amount of data to process and store. Data will be moving at all directions among smart meters, energy sources and the grid itself.

Along with the need to process, store and transport all the data the grid collects is a need to transmit that data, and to make data center operators specialize in. "A lot of the data centers are pretty secure," Van Helten says. "That’s a Fort Knox for information." Some organizations have made great strides in data centers, the most likely candidates for early adoption, however, would be data centers that support non-mission-critical applications, such as computer rooms that serve research labs.

He says that because today’s electrical grid in the US is unreliable, “you’d want to go with co-generation, or bolt on your data center closer to a power-generation source.” Bringing a facility closer to the generation source reduces the risk of power disruption caused by grid failures.

Some organizations have made great headway with co-generation. Bowman says the well-publicized Syracuse University data center project is an example. Along with IBM, the university is building a data center that will be powered completely by an on-site co-generation system, which will be based on a micro-turbine that is fueled by natural gas.

"On-site co-generation absolutely makes sense and should be done more," Bowman says. "Self-help is a far greater silver bullet than putting a meter on every device in the country and calling it smart.”

MORE CONCRETE DATA: A key function of a smart grid is enabling effective demand response. This is when electricity consumers adjust their consumption based on the load on the grid. If the grid is at peak demand, consumers reduce their consumption to ease the strain.

One of the most recent research projects funded by the DoE is a study by Lawrence Berkeley National Laboratory, in collaboration with the California Energy Commission, on the feasibility of implementing demand response in data centers. This was a six-month study—a study that identifies opportunities and makes recommendations for further exploration.

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In data centers. The most likely candidates for early adoption, however, would be data centers that support non-mission-critical applications, such as computer rooms that serve research labs.

One opportunity for demand response and load reduction was using virtualization to reduce energy consumption by IT equipment, according to the researchers. There are also opportunities for demand response on the facilities side, for example, HVAC and lighting systems.

Virtualization is a promising tool in implementing demand response because it can be used to dynamically control utilization of server processors and thus the servers’ overall electricity consumption.

One of the study’s key findings is that a quicker demand response and better planning is the most likely to be achieved if both IT and facility infrastructure work together to deal with load. If IT load is reduced, so is demand for cooling. Along with a reduced load, less associated with power distribution are reduced as well.

Researchers say that more in-depth studies are needed in order to quantify the benefits that participation in utility demand response programmes would bring data center operators. Quantification of the effectiveness of such participation would have to be seen as a cost-effective measure, however, would be data centers that support non-mission-critical applications, such as computer rooms that serve research labs.

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With the idea of the smart grid still remaining little more than just an idea, and with all the uncertainty surrounding it, it’s moving into progress and correlated messages, the industry is facing yet another decision that could potentially have radical implications for its future: should data centers participate in the development of the smart grid, bring such crucial elements of the concept? Or is it time they considered alternatives, such as Bowman’s advice and started thinking about getting off the grid altogether instead?"