

Quick Start Guide to Smart Grid Success

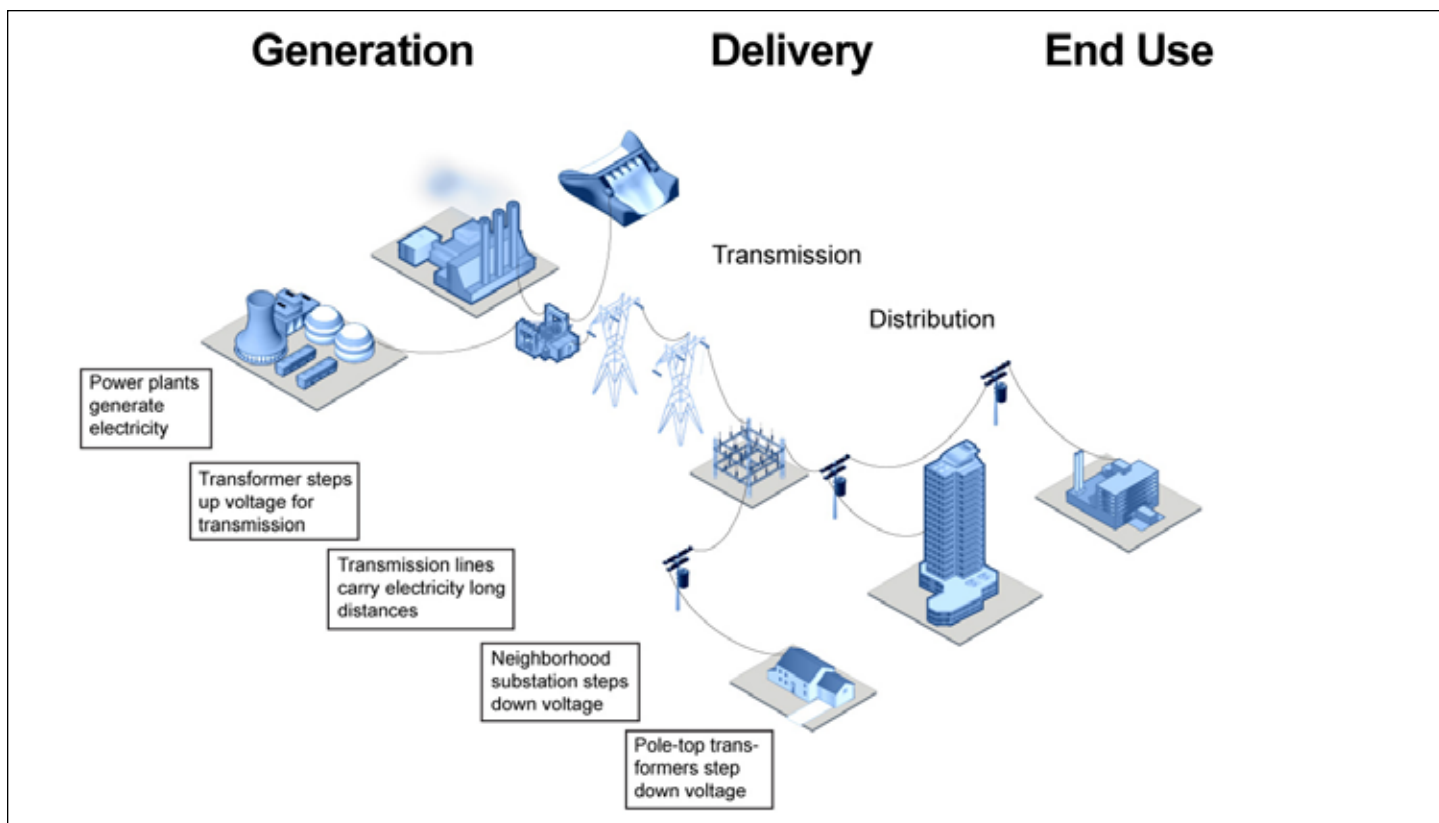
*A primer on
the “system of
systems” that
will ultimately
transform our
aging electric
infrastructure
into a modern,
intelligent grid*



Today's electric grid is based on design requirements written in the 1950s, back when the primary objective was to keep the lights on. Yet by some estimates, we are using 12 times more electricity today than we were in 1950. And at least three forces suggest demand will only increase:

1. The worldwide population explosion
2. The developing world's rapid adoption of the industrialized world's electricity-hungry lifestyle
3. The electrification of everything thanks to motors, microwaves and microprocessors that have increasingly made electricity the preferred form of energy. And next up: electric vehicles

But here's the rub: In the U.S., as the supply and demand for electricity has skyrocketed through the computer revolution, growth of the Internet, and proliferation of electronic devices, there has been no significant investment in the transmission and distribution infrastructure that connects the two. At a time when 60% of the U.S. gross domestic product depends directly on electricity (compared to 20% in 1950), we rely on an electric power infrastructure that is aging and outmoded. In fact, a report by The Brattle Group projected a \$298 billion investment is required between 2010 and 2030 to maintain the reliability of the nation's transmission system.



OUR POWER SYSTEM AT A GLANCE

For most of us, we think electric power when we drive by the neighborhood substation or the miles of towering transmission lines that crisscross the countryside. Of course there's much more to it than that. Our power system is broadly divided into three segments:

Generation – Electricity is created by converting other energy sources – for instance coal, natural gas, nuclear, hydro or renewables such as wind and geothermal. The bulk of our electricity comes from roughly 10,000 central power plants scattered around the U.S. Coal-burning plants – under fire for their greenhouse gas emissions – remain the predominant source of electricity generation in the U.S., followed by natural gas and nuclear.

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Delivery – The delivery segment is like an electricity highway that transports power from the point of generation to the point of use. Roughly 200,000 miles of transmission lines move bulk power at high voltages from generating stations to substations where the power is stepped down to medium voltages. The distribution system delivers power to end users and also handles metering, billing, and other functions associated with power sales to end users.

End use – Whether in homes, offices or factories, rapidly changing customer needs for electricity are among the biggest challenges facing the electric power industry. But eventually, in a digitally monitored and managed grid, there will be visibility and control all the way from generation through every section of the grid and all the way down to individual devices in those factories, offices and homes.

And that last point – the *digitally monitored and managed grid* – is how we get smarter about meeting the challenges of electricity supply and demand. **More >>**

SO WHAT IS THE SMART GRID?



Some call it the **modern grid**, the intelligent grid, Grid 2.0. But the term *smart grid* has taken hold, and now we actually have the makings of a *smart suite*. You hear politicians touting *smart energy*, we install *smart meters*, we build *smart homes* that will be filled with *smart devices*, and we anticipate the day when we will live in *smart cities*.

But to define *smart grid*? Sometimes simple is better. Think of it as:

Smart devices + smart communications + smart software = smart grid

Smart devices:

- Measure and monitor
- Talk and listen
- (Sometimes) “think” and act

Smart communications:

- Two-way
- Secure
- Standards-based

Smart software:

- Embedded in devices
- Substations
- Control centers
- (Talking to) back office

The transformation to a smart grid is not unlike transformations we’ve already witnessed in other industries.

	Devices	Communications	Software
Cable			
Cellular			
Smart grid			

What makes the “new grid” smart is a convergence of advanced technologies. The smart grid is equipped end-to-end with sensors and switches that can monitor, report back, and accept commands. Thanks to real-time information, system operators will be able to predict, diagnose and mitigate issues that might previously have caused an outage or blackout. End users will have more control over their energy consumption and costs.

WHERE DO YOU GO FROM HERE?

It wasn't all that long ago that the smart grid seemed like a concept off in the future. But we're there now. Thanks in part to the 2009 American Recovery and Reinvestment Act, utilities across the country are spending millions of dollars to begin the conversion to a smarter grid. In many cases they're rolling out smart meters, but that's just one slice of the smart grid pie. As we look at some of the applications and technologies that are part and parcel to a smarter grid, you'll see the opportunities for electrical distributors are extensive.

BUILDING EFFICIENCY

Automation systems will play a key role in managing electrical consumption. Commercial and industrial buildings will increasingly rely on automatic adjustments of lights, heat and cooling to reduce waste. Not only will automated switches be needed to control light and heat, but to open window blinds to harvest daylight, and shut them to conserve warm or cold air. Occupancy detectors are also part of the growing trend in office energy automation, switching on lights and other applications only when workers are present. *(Also see demand response)*

Electric motors are energy gluttons used in everything from HVAC to factory machinery. Traditionally these run at a constant speed instead of adjusting to fit the demand being placed on them. By varying the speed of electric motors and having a gradual spool-up to operating speed instead of an instant-on system, the average user could realize an estimated savings of 10 to 20%.



Lighting. Sales and interest in LEDs and CFLs is taking off as office buildings, retailers, factories and warehouses switch to brighter, more efficient light sources that last longer than conventional bulbs.

Smart homes will eventually have an array of gadgets that help homeowners monitor and manage their energy consumption, including smart thermostats and in-home displays. As more "grid-aware" appliances become available and affordable, homes will become

smarter still and opportunities will exist both in new home construction and older home retrofitting.

CONNECTING TO THE GRID

Electric vehicles and hybrids are not new, but with major American automakers starting to roll them out for the mass market the game is changing.

There is an increasing market for the installation of charging ports at homes and workplaces and integration with devices that will help consumers avoid charging up during expensive peak demand periods. Taking a broader view, there may be opportunities to add value with safety products that help protect EV owners from shock, fire or other potential dangers from charging.



Demand response technologies allow utilities to talk to devices inside the customer premise. They include such things as load control devices, smart thermostats and home energy consoles. Demand response programs allow customers to reduce or shift their power use during peak demand periods. Today many commercial entities are using demand response as a means of getting additional revenue from energy efficiency.



Renewable energy is one of the most visible signs of the future smart grid. Wind farms, solar panels and geothermal captures are the fastest-growing sources of energy. And that is increasing the demand for automation and integration systems that will get the renewable power from the farms onto the grid and to the end users. The other piece of the renewable opportunity is working with contractors and/

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No single entity owns, operates or regulates the electric grid.

More than 3,100 public or privately owned utilities and cooperatives distribute power, another 2,000+ non-utility companies produce, market and/or transmit power, and armies of regulators and policy makers at many levels of government share a role in the interconnectivity and overall vitality of their “piece” of the grid.

WHERE DO YOU GO FROM HERE continued ...

or solar firms to supply the basics required to install solar on a rooftop or office complex.

Smart meters are capturing a lot of attention and there's a reason for that. They are a key component to the success of the smart grid from a consumer and supplier standpoint. Smart meters measure energy consumption in a household or business and send that data directly to the utility, which in turn can make it available online to consumers in near real-time, allowing them to monitor and adjust their energy use for more efficiency and/or lower pricing. By some estimates household consumers could cut their electric bills 12% by monitoring their energy use through smart meters and implementing conservation measures based on what they see.

WORKING WITH UTILITIES

Physical security is another essential as concern over energy theft escalates. Security equipment and services will be needed to monitor where the energy is going, and protect substations and other plants against sabotage, vandalism and material theft.



Substations are part of the existing grid and they aren't going to disappear with the new grid. But they are getting older. There are a lot of upgrades in substation and distribution automation going on, some of it traditional control cables and hardware and some of it smart.

Transmission investments will be a major piece of the smart grid rollout as utilities and system operators upgrade aging infrastructure in part to bring renewable energy onto the grid and get it where it's needed.



FOLLOW THE MONEY ...

In 2009, the American Recovery and Reinvestment Act authorized \$3.5 billion in Smart Grid Investment Grants and another \$685 million in regional smart grid and energy storage demonstration grants.

According to the Department of Energy which administers the programs, as of February 2011, approximately \$800 million of the \$3.5 billion in investment grant money had been paid out. Factor in the matching requirements for grant recipients and clearly the smart grid wave has only just begun.

Worth noting: Millions in additional stimulus money was provided directly to the states for a variety of energy efficiency programs that are being administered at the local level.

TIPS FOR WINNING IN THE SMART GRID SPACE



The following are suggestions from manufacturers and distributors who are active in today's smart grid market:

Leverage existing relationships. Plant seeds with contractors you already work with. What are valid upgrades? If solar or EV charging isn't an option now, are there things you can/should put in place to accommodate future upgrades?

Start in home and building automation. These are smart entry points for distributors as you can leverage existing products (and relationships) and add more value as you go. Look for opportunities where the installed base already exists and do the ROI on the investment it would take for incremental improvements in efficiencies.

Think off-the-shelf: While some smart grid technologies require complex integration or customization in the field, sensors may be a smart area for distributors as they are largely going to be off-the-shelf products.

Read the signals. If solar is taking off where you are, introduce yourself to the boutique solar firms that are doing the work. Any solar application is going to need basics – meter sockets, conduit, wire, safety switches, etc. Bottom line, if your business is supplying products for general electrical infrastructure, you can leverage your existing lines, existing channels to participate in the smart grid rollout and up the ante

into complete packages/solutions once you're more familiar with the space.

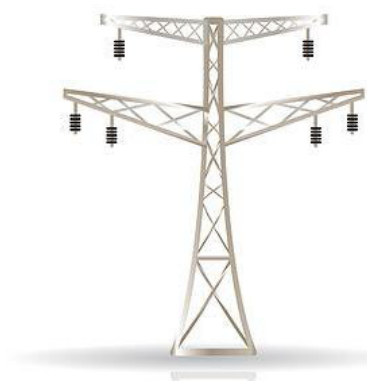
Take advantage of OEM training. It's a win-win if you can generate a revenue stream based on the product expertise they provide. Many manufacturers are actually training contractors via distributors.

Consider follow-on opportunities: Even if you weren't involved in the initial installation of demand response technologies or deployment of smart meters, there may be follow-on and/or maintenance opportunities to pursue.

Keep an eye on your backyard: Where major players may have an advantage in large urban areas, a smaller, local distributor can have that with regional cooperatives and municipals. Also look for companies with headquarters in your territory; they may prefer dealing locally. And leverage your knowledge of local regulations and requirements; that will be increasingly important as pilots and demonstration projects move into full-scale deployments.

Finally, do the math. Not every smart grid opportunity is going to make sense. If you haven't been involved in metering, for instance, resources required to bring your team up to speed on the technology may not be worth it if there's only going to be one or two smart meter rollouts in your region and no guarantee you'll win either of them.

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PLAY ON A WINNING TEAM

There are a lot of manufacturers with their sights firmly planted on the smart grid market. Many are leveraging existing products as well as rolling out new solutions. It's to your advantage to know who they are and take action. For example:

- Get on their preferred provider lists so you are considered when programs roll out.
- Some manufacturers are creating nationwide networks of certified distributors and contractors; get certified and help contractors you work with do the same.

If you don't have relationships with any of the major manufacturers in the smart grid space, you may want to explore opportunities with some of the following:

[ABB](#) is a Swiss firm that provides power and automation technologies to a broad base of utility and industrial customers. Its product lines span transmission, distribution, turnkey substations, and industrial automation

[Cooper Industries](#) is a Houston-based holding company that makes tools, lighting, and electrical components. In recent years, it has acquired several smaller companies with smart grid capabilities, expanding past its traditional utility business.

[Eaton](#) is a Cleveland-based company that provides services and solutions to make new and existing buildings more efficient, upgrading infrastructure, reducing emissions and increasing reliability on alternative energy and energy-efficient projects. Eaton also offers solar, wind and electric vehicle solutions.

[General Electric](#) is a leader in electric turbines and generators (including wind turbines) and also has a long-standing business in transmission and distribution components. The U.S. based conglomerate is also

involved in metering, home energy management and EV charging.

[Philips](#) provides advanced energy-efficient lighting solutions for all segments: road lighting, office & industrial, hospitality and home. The Netherlands-based company has focused on enhancing sustainability through innovations in lighting technology.

[Rockwell Automation](#) offers energy optimization tools that allow manufacturers to perform real-time load-balancing of their industrial processes, bring renewable energy sources online and execute demand response strategies connected to the smart grid.

[Schneider Electric](#) is one of the world's largest manufacturers of equipment for electric power distribution and industrial automation. Although it sells to electric utilities, both its products and its acquisitions have focused on electrical equipment for industrial customers, including process automation, industrial submetering, and energy efficiency.

[Siemens](#) is a manufacturer of electronics and industrial components. The German company markets a wide range of energy-related products, including T&D components, substation automation, industrial automation, lighting, HVAC, building automation and more

Sources & Resources

Electricity consumption

[Changing Trends: A Brief History of the US Household Consumption of Energy](#)

Lawrence Berkeley National Laboratory

[Short-Term Energy Outlook](#)

U.S. Energy Information Administration

Electricity as portion of GDP

[The Manhattan Institute for Policy Research](#)

Transmission requirements

[Transforming America's Power Industry](#)

The Brattle Group

Stimulus spending

[Contributing to Our Nation's Recovery](#)

Department of Energy

Electricity and the U.S. economy

[Electricity Overview](#)

Pew Center

Population growth and energy demand

[The Electricity Economy](#)

Global Environment Fund