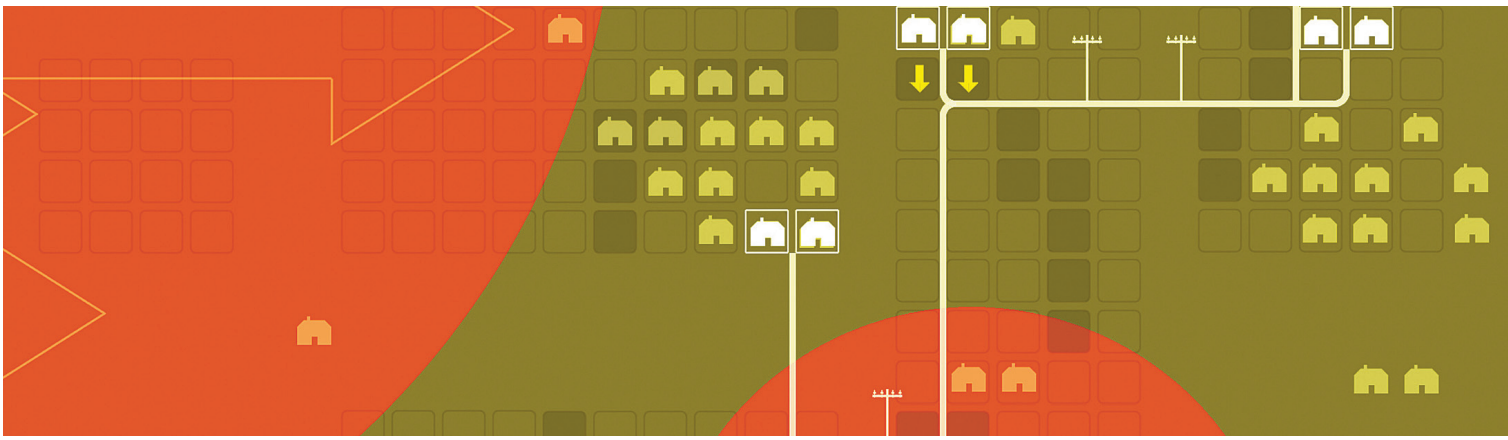


The smart grid opportunity for solutions providers

By 2014, the global market for smart grid technology and services will run into tens of billions of dollars annually.

Adrian Booth, Nuri Demirdoven, and Humayun Tai

Deployment of smart grid technologies is accelerating, particularly in the United States. Smart meters, often the first application deployed, should triple by 2014, reaching 50 million deployed meters. Despite such momentum, the size of the smart grid opportunity for solutions providers is still unclear. Research reports and forecasts abound. What is missing is a comprehensive overview of the developing applications and their interaction with the evolving market. What are the critical smart grid applications? How fast will the different applications develop? How will the maturing market alter that development?

To answer these questions, we analyzed the global smart grid market, assessing the development of various product and service segments, the potential in geographic markets, and the drivers of growth and profitability. We estimate that the global market potential for smart grid equipment manufacturers and solutions providers will total anywhere between $15 billion and $31 billion annually by 2014, with the value split among the three main business segments: customer applications, advanced metering infrastructure/smart meters, and grid applications. Just how big that market will be will depend on a wide range of variables, all of which smart grid players in this field will have to monitor carefully.

Across business segments, growth and value will be determined by the technology, the level of competition, and emerging regulation and policy.

Growth will likely be slower where existing energy infrastructure is highly developed, such as in Europe. Growth on a percentage basis in China and other areas where the transmission and distribution (T&D) infrastructure is still developing, will be faster as smart grid technologies will be used to leapfrog traditional infrastructure investments.

Development of the smart grid will create opportunities for traditional energy infrastructure vendors while opening the market to new players. Traditional vendors will benefit from large-scale renewal of utility assets as customer and grid applications are deployed and will be able to differentiate their product lines through increased functionality and integration with other smart technologies. New players—IT hardware providers, software firms, networking and telecommunications companies, semiconductor manufacturers, and systems integrators—will benefit from major technology investments. Capturing these opportunities, however, will not be easy. Competition will be stiff, and solutions providers will need to develop a market-entry approach that reflects the long sales cycles, technology obsolescence concerns and regulatory constraints that characterize utility procurement processes.

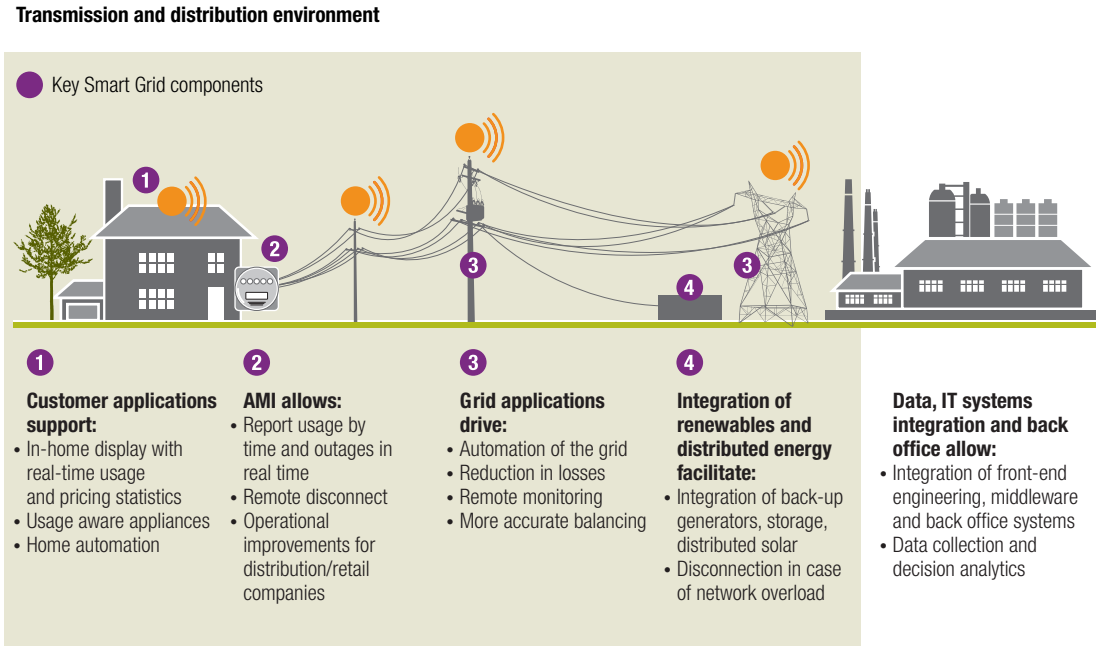
Estimate of the smart grid market in 2014

We began by defining three main business segments for smart grid technologies: customer applications, AMI/smart meters, and grid applications (Exhibit 1). We did not include in this analysis a fourth and more distant opportunity that includes enablement of renewable generation, plug-in electric vehicle (PHEV) integration, and

Exhibit 1

Smart Grid segments

The smart grid can be broken into key segments that have different drivers and potential profit pools



energy storage. This fourth category was excluded due to the current absence of actual defined solutions combined with the likelihood that the market for these solutions will hit an inflection point after the assessed time period to 2014. A fifth category—data collection, processing and back-office integration—was also excluded from this analysis due to the overlap with technologies in other segments (e.g., AMI). Also many of the new opportunities arising from data mining and more sophisticated applications are longer-term opportunities that will mature post 2014.

These applications require a range of components across the value chain—transmission and distribution infrastructure, a communication network, and a computing platform. These components are the foundation that will enable smart grid applications (Exhibit 2).

The costs associated with updating these components for a smart grid system are included in our market-sizing analysis. Implementing these components will also require utilities to change their business processes, as the added level of technology will require new management and oversight procedures.

Our estimates for the annual global revenue opportunity for 2014 in each of the three applications areas are given and discussed below.

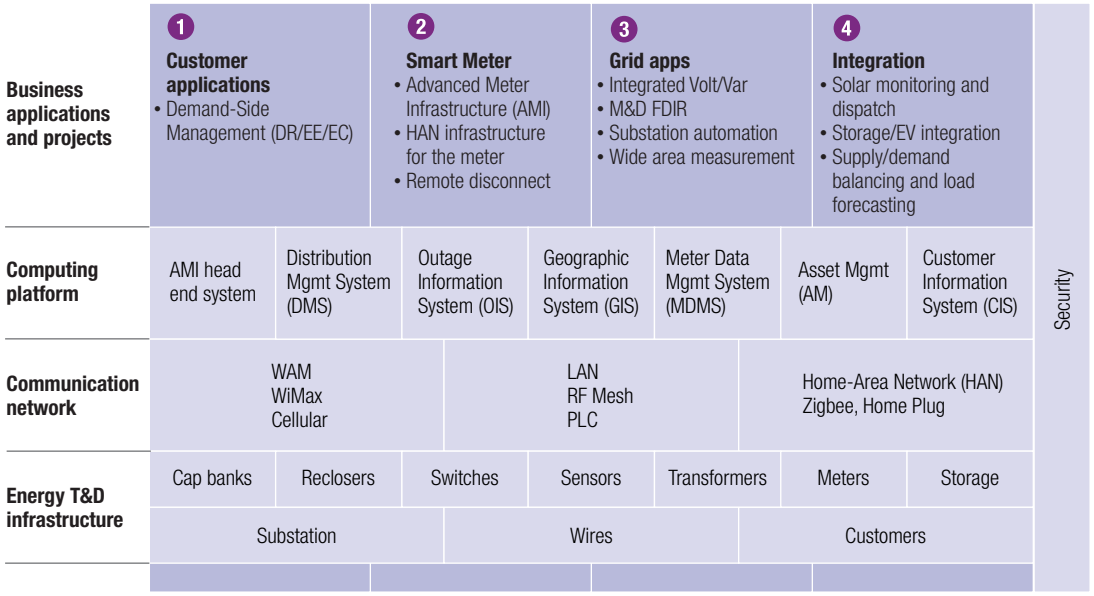
Customer applications: $3 billion to $10 billion

The level of functionality can vary from a simple in-home display (IHD) that shows energy consumption to a fully automated home with smart appliances and a centralized energy-management system. Even the basic functionality option would receive usage and pricing

Exhibit 2

Common elements

Smart grid business applications have common components across grid systems



information and data readouts through a home-area network (HAN), enabling customers to adjust energy consumption to fit their price sensitivity and usage patterns.

The wide range in the projected market size for customer applications reflects the range in our assumptions about adoption rates for home, commercial, and industrial energy-management tools and the types of devices used. Our analysis assumes per-customer costs range from $120 to $340 for residential solutions, inclusive of hardware, communication network systems, installation, and program costs, such as customer education. Some regions, such as Asia-Pacific, will have lower prices and penetration rates.

The speed of penetration will depend on the nature of the customer application technology and whether the regulatory framework supports demand-side management programs. Customer applications will likely be adopted more rapidly in North America and Europe, while in markets like China the focus will be almost exclusively on meters and the grid. Some utilities in developed countries may be able to recover the cost of basic IHDs or programmable communicating thermostats (PCTs) through rate-base mechanisms, driving up adoption and reducing the per-unit price.

Smart meters and advanced metering infrastructure (AMI): $7 billion to $13 billion

These meters support two-way communication between the meter on the customer premises and the utility and between the meter and the HAN. AMI systems use a variety of communication technologies to connect with the utility, including radio frequency mesh, power-line carrier, and cellular. This technology usually allows utilities to connect or disconnect service remotely, creating operational benefits. They can also alert utilities to the magnitude and location of outages and can help detect theft.

The AMI market is the most developed segment of the smart grid value chain, with an estimated value in 2009 of $3 billion to $4 billion. Our estimate for 2014 assumes strong growth in the United States and China, which will provide sufficient scale to continue to drive down production costs. AMI costs range from $200 to $400 per endpoint in the United States. The factors accounting for this wide cost range include the types of communications technology, the ratio between gas and electric meters, and functionality such as whether it has remote disconnect/reconnect capability. Cost will also vary across regions. Estimates suggest that systems deployed in China will cost on the order of 50 percent less than those deployed in the United States.

Grid applications: $5 billion to $8 billion

These are applications that automate the grid to make its infrastructure more efficient and flexible. They include the following elements.

- Volt-VAR optimization (VVO) and conservation voltage reduction (CVR), which use capacitor banks and sensors with communication capabilities to reduce reactive losses on power lines and reduce load by operating the distribution network within a narrower and lower voltage band.

- Monitoring and diagnostics (M&D), which use sensors with advanced communication capabilities to monitor grid performance and enable condition-based maintenance, resulting in reduced maintenance costs and improved decisions on capital investment.

- Fault detection, isolation, and restoration (FDIR), which automates switching and routing, allowing utilities to reduce the cost of manual switching and improve response times. The ability to isolate and locate faults more quickly improves reliability and outage response for customers.

- Wide area measurement (WAM), which works at the transmission level by using synchrophasors that measure the electricity's phase to improve grid reliability and prevent cascading outages.

Our projections suggest that the deployment of these grid applications will lag behind the installation of advanced metering infrastructure (AMI) by approximately 3 to 5 years, because the benefits from AMI are relatively easier for the utility to capture.[1] In addition, many utilities plan to use the AMI network for grid applications as well. We estimate that utilities on average will invest $160 to $300 in incremental capital per customer to enable grid-side applications, depending on the level of functionality deployed.

Regional differences in market potential

The growth of the smart grid and the value it creates will considerably vary across geographies, depending on a number of factors, including the condition of the existing grid, the level of development and wealth of the economy, and the makeup of its regulatory regime. The impact of these factors is most visible when contrasting the likely growth paths of Europe and China relative to that of the United States (Exhibit 3). What follows is a brief overview of key regional market differences.

Europe

Europe has achieved a higher level of grid automation than the United States, but smart meter deployment has lagged due to Europe's deregulated market. Fragmentation across the value chain has reduced the incentive for any single player to invest in smart meter or customer applications. Regulators will have to align incentives for society and industry, but a lack of standards has delayed efforts. In the Netherlands, for example, smart grid efforts were suspended in 2008, pending adoption of EU-wide standards, which will not likely come until 2011 at the earliest.

China

State Grid, the larger of China's two state-owned grid companies, has pledged to roll out a smart grid system with AMI and improved grid applications by 2020. Transmission grid applications are getting particular attention in the short term, as China seeks to develop an ultra-high voltage transmission system to improve the relay of electricity from energy-rich central and western regions to power-hungry coastal markets.

Current meter models are of relatively low functionality and quality, with an expected lifetime of 7 to 10 years versus 10 to 25+ years in other regions. China may allow margins of 10 to 15 percent for smart meters, as opposed to 5 percent in the past, in recognition of the need for future generations of meters to have higher functionality and be of higher quality. Nonetheless, the price of smart meters in China is expected to be about half of what it is in the United States or Europe, on a per-endpoint basis. The lower cost is attributable to cheaper labor and installation costs, shorter meter life span, no import taxes and lower transportation costs, and use of power line communications, which require few changes to existing transmission infrastructure.

[1] See the accompanying article "U.S. Smart Grid Value at Stake: The $130 Billion Question," pp. 4–11, for more details about smart grid benefits.

Exhibit 3

A fast-moving market

The smart grid market is growing fast, especially in China

Annual smart grid market growth in 2007 and 2014
$ Billions

Source: ABI; McKinsey analysis

Other regions

Other regions are also developing different parts of the smart grid value chain. India, for example, is focusing on grid and line loss applications and has a greater issue around electricity theft, which a smart grid could help address. Brazil is demonstrating increasing interest in grid applications, and Australia is at the forefront of WiMax technology.[2]

What it will take to win

The smart grid market is in a relatively early state of development, though broad themes are emerging which may affect the growth of profit pools for different applications and regions.

All players—utilities, equipment providers, service providers, and investors—must consider how these trends will affect the market as a whole, as well as their potential position in that space. Utilities, for example, need to decide whether or not to expand the number of products and services they offer customers. Retailers must evaluate which customers are likely to be the most profitable. Solution providers should consider managed services as an offering.

Finding attractive opportunities

Identifying the applications that will offer the greatest profit potential depends on a number of variables.

- *Who plays?* Many new companies have entered the market. Low-cost suppliers, such as Asian OEMs, are beginning to offer low-cost, low-functionality products, so the ability of established players to maintain margins will depend on how well they can differentiate their products. They will need to build breadth by integrating into other business applications outside of smart meter or build depth by providing additional products and services. Utilities can also adopt more service-oriented business models, which would allow them better to match customer needs with a set of products and services.

- *Who pays?* The main customer segments will be utilities (and indirectly ratepayers) and

[2] "WiMax," which stands for *"worldwide interoperability for microwave access,"* is a telecommunications technology that provides wireless transmission of data.

industrial and commercial consumers. The utility segment is attractive because it can buy at scale. However, if an end-user market develops for home-area network products such as IHDs, "smart plugs," and home energy monitors, market size and margins will likely be higher than if these products are bought by utilities, which will leverage their buying power to drive down prices. Niche markets for specific applications are emerging across regional markets. Local customer preferences and strategic priorities of regulators and utilities will play a critical role.

- *What will regulators and policy makers decide?* As governments and regulators drive adoption of smart grid technologies through mandates or incentives, the pace and scale of deployment is increasing, accelerating market development while driving margins lower through greater scale. The nature of policy instruments deployed and the timing of specific interventions will vary widely by region.

- *Where are the margins?* Margins have already begun to shift from smart grid hardware to the software and network layers. The value from software applications increases as the information transmitted to the utility becomes more complex, allowing for more detailed analyses and quicker responses to changes on the grid. It is likely that this trend will continue, as vendors provide additional functionality and integrate multiple devices, reducing the lock-in effect associated with physical devices. At the regional level, margins are being driven by the intersection of global equipment and solutions market dynamics and local electric power industries.

Building the capabilities to win

In order to capture the smart grid business opportunity, smart grid players must build a deep understanding of where the value is in the evolving smart grid, and they must also develop a compelling business model to pursue this value. To win utilities as a customer segment, a number of requirements will have to be met.

- *Deep understanding of full value at stake.* Utilities are demanding more clearly articulated value propositions, and their direct linking to underlying value drivers (e.g., reduced operating expenses, increased grid efficiency, improved capital productivity).

- *Consultative solutions-selling.* Utilities now face the prospect of dealing with dozens of providers to implement a single smart grid project. The winners will recognize the need to start packaging solutions, which will require a more consultative approach to sales and marketing and coordination across traditionally siloed business units within a utility (e.g., distribution operations and IT).

- *Deep understanding of government and regulatory incentives, and impact of legislation.* As traditional equipment providers in the U.S. know well, the patchwork of state-based regulatory frameworks, utility ownership structures, and existing and pending state and federal legislation, can create significant complexity in any providers go-to-market strategy. Understanding the nuances of government policies (stimulus efforts, national road maps and targets) is critical. Developing or maintaining a competency here will be a key differentiator.

- *Core architecture principles of standards, interoperability, security, flexibility, and scalability.* Gone are the days of selling proprietary products with minimal security. Vendors are quickly being categorized as those that "get it" and those that are holding onto legacy products. From the utility perspective, getting secure, future-proofed products has become a top priority.

- *Seamless capabilities across power engineering and information technology.* The smart grid embodies the intersection of power engineering and information technology. Building a culture that encourages rich dialog and compelling solutions across these competencies is difficult, but required in order to win. Few companies can or should develop the full suite of capabilities in-house. The ability to identify, convene and manage partnerships, alliances and more informal consortia is growing in importance.

- *Willingness to take risk on a forward looking market.* The market is growing rapidly. In a rapidly changing environment, utility customers are attaching greater importance to flexibility offered to incorporate future smart grid elements (e.g., distributed generation, electric vehicles, distributed storage). Adopting a "wait and see" attitude may be costly, as other players will begin to get traction.

The growth of the smart grid will create opportunities up and down the industry value chain, as well as in related industries. The potential to help customers manage home energy use will create opportunities for white goods manufacturers, consumer software providers, and energy services companies. Companies are identifying the complexity of managing meter data as an opportunity, and looking at options to use a "software-as-a-service" model to reduce the cost and complexity of maintenance.

A compelling business model will be one that aligns with utility goals by creating rate-based opportunities and reducing operating expenses, while also reducing risk. Concerns about risk emanate from a number of areas, including uncertainty around standards and interoperability as well as the capability of utilities to deploy the new technologies successfully.

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In the next 5 years, the smart grid market will grow rapidly. This growth will occur across the value chain, from customer-side applications to grid-wide automation upgrades and will vary regionally around the world. The fundamental growth of this market, however, will depend on the building of large, sustainable, and profitable smart grid business models.

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