Smart Grids

Moving beyond the euphoria to achieve the vision

"Smart grids" is a popular buzz word associated with sustainability, carbon emissions reduction, renewable energy and next-generation energy management. These technologically advanced networks are heralded by many as an indispensible means for improving the power supply. Although the tangible benefits of improved grid management are clear, and the long-term outlook is hopeful, smart grids in Europe are still in their infancy. How can European countries move from euphoria about smart grids to actuality?

The prospects for smart grids are indeed promising, but achieving their ambitious vision will require investment in technology and infrastructure and managing wary stakeholders.

The prospects for smart grids—energy networks that coordinate supply and demand—are indeed promising, and new projects are arising around Europe. Germany has unveiled its e-Energy models for addressing select smart grid applications, while Amsterdam has begun implementing its comprehensive Smart City project. Italy and Sweden, meanwhile, have been pioneers in rolling out smart meters, with similar initiatives popping up around the world *(see figure 1 on the following page)*.

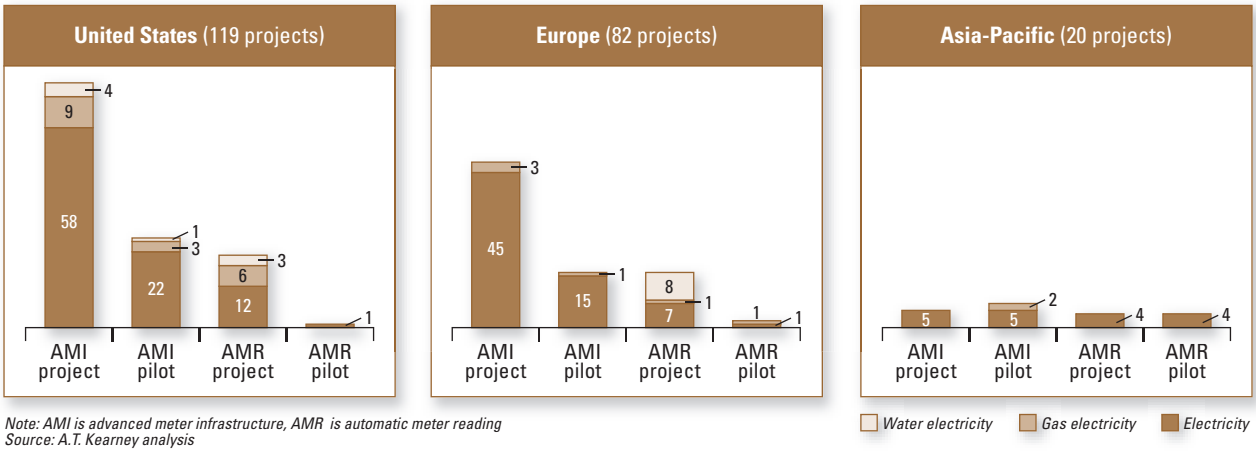
Still, European smart grids are in their infancy. Achieving the ambitious vision of smart grids will require further investment in technology and infrastructure and managing wary stakeholders. With current expectations running high—along with the risk of disappointment—developing sustainable smart grids remains a major challenge.

In fact, smart grid development seems to mimic the dotcom boom of the late 1990s, when years of steady progress developing powerful IT, Web software and communication infrastructures turned the Internet into a viable business market. The dotcom boom ended in a bust, and some wonder whether smart grids are headed down the same path. We believe the answer is no. There is increasing demand for better use of more sustainable sources of energy, and smart grids fill a crucial future need. Indeed, for stakeholders in Europe, there is no time to waste in bringing smart grids to fruition.

A "Prosumer" Focus

Smart grids are enabled by installing smart meters whereby households can manage their energy loads using demand-response mechanisms. Distributed generation units combine with mobile storage devices such as batteries and e-vehicles to form virtual power plants *(see figure 2 on the following page)*. Smart grids generate real-time, end-to-

FIGURE 1: Smart metering projects around the world



Note: AMI is advanced meter infrastructure, AMR is automatic meter reading
Source: A.T. Kearney analysis

end transparency and bring about more reliable energy production.

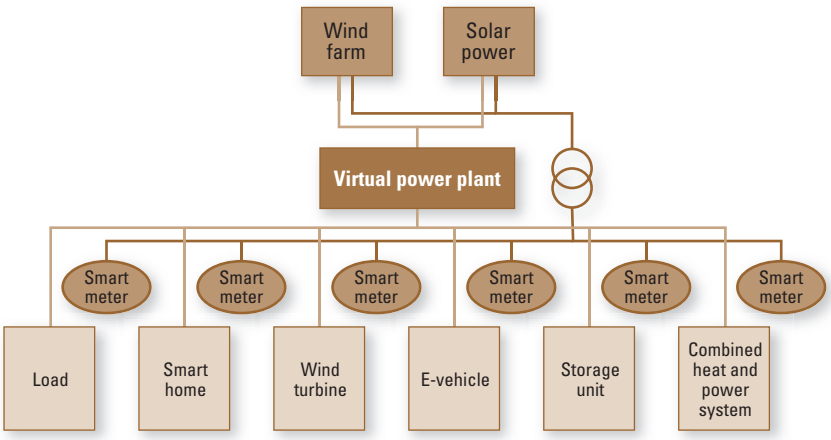
In many developed nations, consumers are beginning to embrace the possibilities of distributed generation by becoming producers themselves. These producer consumers, or "prosumers," are consuming energy while producing it, for example, with solar panels on their roofs. Prosumer behavior is hard to predict, however. As people learn to capitalize on market mechanics, the growing share of stochastic energy, such as solar or wind power, does not naturally match demand. The resulting power imbalances may lead to reverse power flows, in which energy is produced by traditional consumers and sent back to traditional transmitters *(see figure 3)*.

Because sufficient storage is not yet available, smart grids are necessary to balance supply and demand instantly and protect the grid from outages. This makes flexibility a core principle of smart grids and a necessity for managing future energy challenges.

A Darwinian Setting

In Europe and the United States, large-scale government initiatives and private-sector pilots are pressing ahead. However, we believe the strongest, most

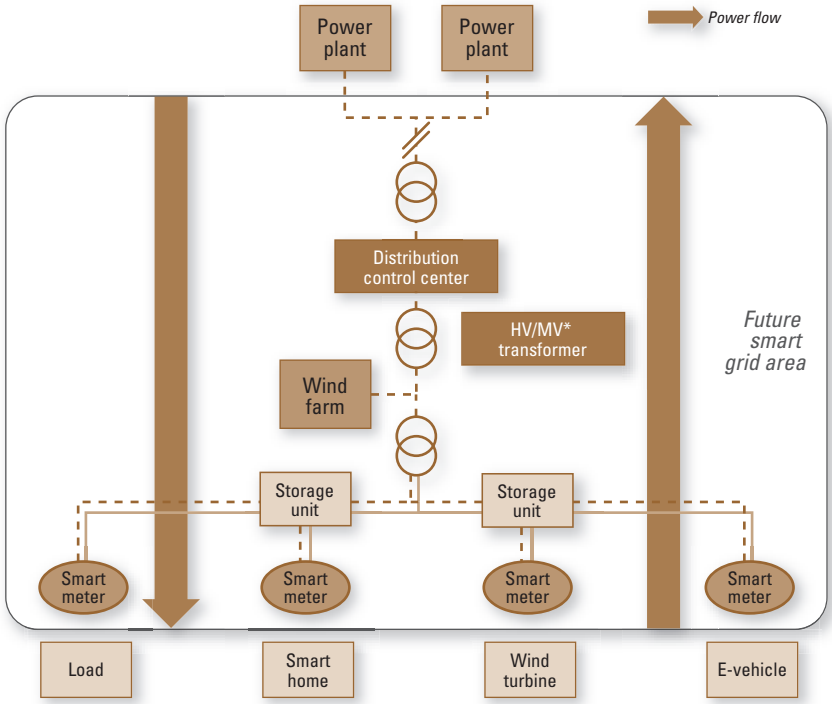
FIGURE 2: Multiple smaller generation units combine to create "virtual power plants"



Source: A.T. Kearney analysis

The strongest, most sustainable smart grid system will emerge from a "Darwinian" setting in which many smaller ventures compete.

FIGURE 3: Smart grid with reverse power flow



*Note: *LV, HV, MV is low voltage, high voltage, medium voltage*

Source: A.T. Kearney analysis

FIGURE 4: An emerging market for smart grid-related ventures (smart homes)

alertme	greenbox	ecodog	control4
(U.K.)	(U.S.)	(U.S.)	(U.S.)
$12 million in funding	Acquired by Silver Spring	$5.6 million in funding	$17.3 million venture capital funding
Tendril	**EnergyHub**	**Qurrent**	**Onzo**
(U.S.)	(U.S.)	(Netherlands)	(U.K.)
$30 million in funding	Early-stage financing	$650,000 in funding	$4 million venture capital funding

Note: All monetary figures are in U.S. dollars

Sources: Company information, A.T. Kearney analysis

Large-Scale Projects Are Not a Silver Bullet

The ambiguity of sustainable business models, technological setups and stakeholders makes it difficult to predict how smart grids will emerge in the coming years. We do know, however, that large-scale projects have several challenges:

- Cost. Large-scale projects often begin by setting a technological direction that is costly to adjust.
- Existing projects. Existing major projects (such as the $1.3 billion Amsterdam project) may deter other ventures, as their return on investment cannot be guaranteed.
- Limited opportunity. If regulators and big companies pull the strings on smart grid deployment, there will be little room for smaller ventures to bring in that innovative, entrepreneurial spirit, which has been at the forefront of the U.S. smart grid movement.
- Complexity. The complexity of large-scale projects is a major challenge, especially considering their novelty, need for trial-and-error, and the large number of stakeholders involved. Varying interests and coordination issues could hamper progress and efficiency.
- Slow-arriving results. Large-scale rollouts may delay early success stories while too few "quick wins" may deter the skeptics.

sustainable system will emerge from a "Darwinian" setting in which many smaller ventures compete, for example, as in smart homes *(see figure 4)*. A Darwinian approach has five advantages:

Decreased project size. Breaking projects down to the cell level—ranging from individual facilities to entire substations—will be easier and more sustainable. These cells could include integrated energy systems, in which interconnected loads, storage devices and distributed energy resources operate in parallel with the grid, or in an island mode, depending on what works best. Regulators orchestrate and set standards where necessary, cutting red tape, cultivating business, while amassing expertise and small-scale funding.

Gradual, isolated implementation. Rolling out smart grids all at once

would be akin to fixing a fast-moving train. We envision an organic approach of smaller initiatives in which each element is implemented in isolation. Rather than wholesale change, it is a gradual smart grid deployment; independent smart cells and smaller projects can be linked together later. This would enable evolutionary (instead of revolutionary) development, and ensure that the overall power supply is never endangered.

Reduced investment volumes. By reducing investment volumes, major players, such as utilities, could reduce risks, while smaller players encounter fewer barriers to entry.

Consumer satisfaction and participation. Consumers affected by the changes can benefit from reduced scope and complexity. This might lead to a self-energizing effect in which consumers become producers, and their enthusiasm leads to more powerful smart cells derived from more distributed generation units.

Repeatable results. As cellular technology advances, best practices could be gradually accumulated and replicated to enable better performance for other cells.

The Next Big Thing

Smart grid development is inevitable as economic, regulatory and social forces push the technology forward. While the pressure is high, and the window of opportunity is wide, changes in the energy market will create stronger business models with new levels of transparency, more points of interaction among players, and more favorable regulations.

For example, in a few years consumers may be financially encouraged to adjust their energy loads upon request—using business models that have worked in the United States. By 2015, the business case for distributed generation will be stronger, as virtual power plants will allow the commercialization of resources similar to large-scale power plants, but benefiting from profitable energy market opportunities and a better supply-demand balance.

Smart grids may truly be the next big thing. Like the Internet's growth more than a decade ago, smart grid functionality is likely to become indispensible.

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