

FAIRVIEW

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CLEAN TECHNOLOGY: AN INTRODUCTION TO SMART GRID

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Industry Overview

America's Electric Infrastructure Today

Given the importance of electricity in sustaining economic growth and maintaining optimal living standards, many have argued that the U.S. electrical grid was one of the most important achievements of the 20th century.

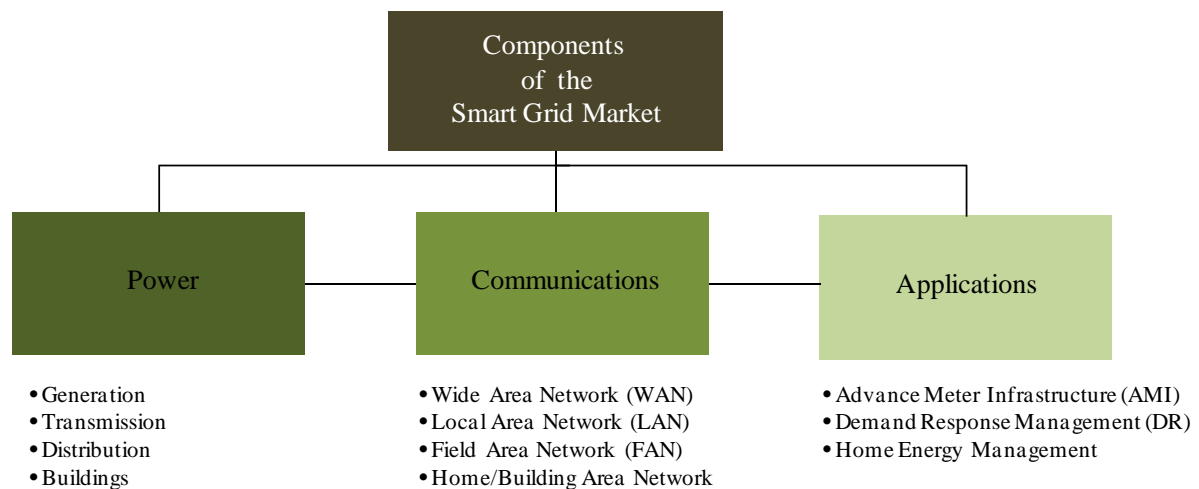
Built over the past 100 years, the U.S. transmission grid is a vertically integrated system capable of carrying over 850 gigawatts of energy over an interwoven network of high voltage power lines – delivering electricity from generators to consumers. Unfortunately, over the last decade, the reliability and efficiency of the grid has declined due to compromises made in transmission network investment. Although electricity demand and power generation facilities have grown over the past decade, the existing transmission grid utilizes the same technology that it did back in the early 20th century.

Pressures to modernize the electrical transmission grid have been mounting in recent years. In fact, many of the involved parties (U.S. government, utilities and technology companies) have been brainstorming on ways to bring the grid into the 21st century. Dubbed the Smart Grid, this revamped grid would feature the convergence of electric power, telecommunications infrastructure and information technology. In fact, many energy experts and venture capitalists are calling Smart Grid the “Energy Internet” – it is the “...marriage of information technology and automation technology with the existing electricity network.”

The Layers of the Smart Grid Market

In order to appreciate the vision for and the ultimate goals of a Smart Grid, one needs to understand the layers that comprise the grid market. All told, the Smart Grid market consists of three sub-components: Power, Communications, and Applications.

Figure 1: Components of the Smart Grid Market

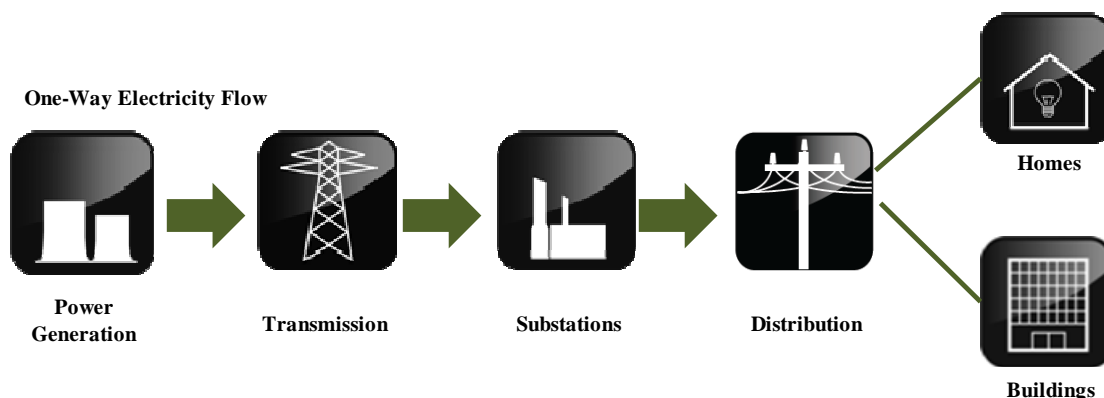


Source: GTM Research and Fairview Capital

Power Component

The power component consists of legacy grid infrastructure that connects consumers to electricity generators – utilizing technology from the early 20th century. As consumers draw electricity from the grid, the basic generators must respond to the load in real time and pass energy through a one-way infrastructure. This method of power transmission offers little to no data, control or buffering.

Figure 2: Power Grid Today



Source: GTM Research and Fairview Capital

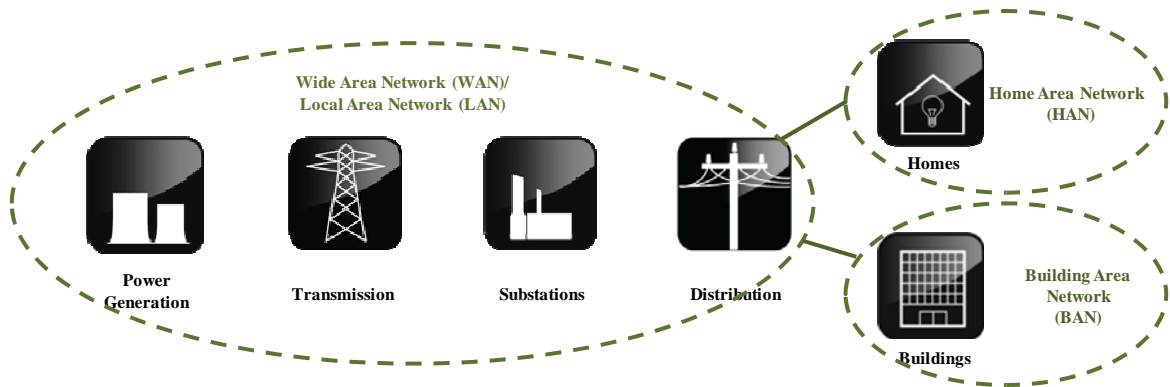
In fact, grid operators cannot access their customers' real time electricity consumption data unless they physically travel to the endpoint and take a reading from the electric meter. This process is inefficient and outdated, especially in a connected society that demands instant information. Players in the Smart Grid industry are eager to transform the aging system of power lines to the digital age - the first step of which is to set up communication standards between utilities, vendors and consumers.

Communications Component

Many constituents have been working hard to establish a communications framework that will support multiple protocols for communication and data flow between utilities, vendors and consumers. Unlike the already established Local Area Network (LAN) and Wide Area Network (WAN) that facilitate communication between utilities and their distribution stations, there are no operating standards for the network between homes and distribution centers, and also within homes. Companies working to solve the networking problem fall into the following categories:

- Field Area Network (FAN) / Advanced Metering Infrastructures (AMI) Vendors – working to connect neighborhoods to distribution substations so that data can flow freely between utilities and consumers. Smart meters are installed in homes to provide data to that connection.
- Home Area Network (HAN) / Building Area Network (BAN) Vendors – implementing networks that will allow heating / air conditioning units, electric cars, and major home appliances to connect to smart meters.

Figure 3: Communications Network



Source: GTM Research and Fairview Capital

The majority of venture-backed Smart Grid investments to date have been in the FAN/AMI industry. Companies such as Silver Spring Networks, Trilliant, EKA Systems and Smart Synch have raised more than \$500 million in venture capital to develop these communication networks.

Application Component

As the communications layer continues to develop, entrepreneurs and innovators are working simultaneously to build applications for the Smart Grid. There are three general categories of applications being developed: Advanced Meter Infrastructure, Demand Response, and Home/ Building Energy Management.

- Advance Meter Infrastructure (AMI) is the backbone of Smart Grid. A sophisticated AMI solves the utilities' need for real time consumption information without physically interacting with meters.

In its simplest form, AMI allows installed smart meters to utilize communication networks, including cellular, mesh WiFi, WiMax or broadband, to communicate directly with utilities. With an infrastructure in place, a multitude of software suites and analytical packages would be needed to i) transport data back and forth between energy users and the utility, and ii) parse and manage usage data.

Since 2009, U.S. utility companies have been aggressively rolling out smart meter programs. The Obama administration projects that the number of U.S. homes with smart meters will increase from 8 million to 40 million by 2016. The large-scale deployment underway will establish a foundation for more advanced Smart Grid applications.

- Demand Response (DR) management addresses the issue of managing energy consumption during “peak” times. Since electricity cannot be economically stored, it must be generated and delivered at the moment it is needed by consumers. Thus, maintaining a reliable power system requires a “just in time” balance between supply and demand.

The proper implementation of DR applications would allow grid operators/utilities to adjust the power consumption behaviors of their consumers during critical peak time. Currently, demand response technology resides within third party load

aggregators who provide virtual capacity to grid operators / utilities by adjusting participating consumers' thermostats or other smart appliances. Participating consumers have traditionally been commercial and industrial clients; however, future market penetration will include residential consumers.

In addition to making the grid more reliable, demand response management is also seen as a cleaner, cheaper and faster alternative to building new capacity, often new natural gas plants.

- Home Energy Management is perhaps the most interesting piece of the Smart Grid puzzle because it aims to revolutionize the way consumers use energy. All told, home energy management will allow homeowners to control their electric usage through a suite of hardware and software solutions. Consumers will gain cost saving insights by being able to observe their consumption habits while receiving pricing signals from their utilities through online applications or other monitoring tools.

According to PG&E, the home energy management segment is forecasted to grow at a CAGR of 185% – representing a market size of \$3.3 billion by 2012. This is also an area where traditional industries can participate in a meaningful way. Companies in sectors such as IT, consumer electronics, automakers and home builders will begin to weave networking capabilities into their products so that they can communicate with the home's monitoring system.

Main Drivers of the Smart Grid Industry

Policies on Renewable Energy Usage

Regulatory pressure is the major driving force behind Smart Grid investments. More and more states have Renewable Portfolio Standards (RPS is a regulation that requires increased production of energy from renewable sources such as solar, wind, biomass and geothermal) they must achieve, and Smart Grid deployment is essential in incorporating renewable energy into the grid. Last year, the Department of Energy distributed \$3.4 billion to 100 Smart Grid related projects. Within those projects, an estimated 18 million smart meters will be installed nationwide capturing approximately 13% of U.S. homes. The DOE expects another \$4.7 billion of Smart Grid funding to come from the private sector.

Figure 4: Department of Energy's Smart Grid Investment Breakdown

<u>Dollar Allocated</u>	<u>Objective</u>	<u>Project Description</u>
\$2 Billion	Integrating and Crosscutting Across Different "Smart" Components of a Smart Grid	Much like electronic banking, the Smart Grid is not the sum total of its components but how those components work together. The Administration is funding a range of projects that will incorporate these various components into one system or cut across various project areas - including smart meters, smart thermostats and appliances, syncrophasors, automated substations, plug in hybrid electric vehicles, renewable energy sources, etc.

<u>Dollar Allocated</u>	<u>Objective</u>	<u>Project Description</u>
\$1 Billion	Empowering Consumers to Save Energy and Cut Utility Bills	These investments will create the infrastructure and expand access to smart meters and customer systems so that consumers will be able to access dynamic pricing information and have the ability to save money by programming smart appliances and equipment to run when rates are lowest. This will help reduce energy bills for everyone by helping drive down "peak demand" and limiting the need for "stand-by" power plants - the most expensive power generation there is.
\$400 Million	Making Electricity Distribution and Transmission More Efficient	The Administration is funding several grid modernization projects across the country that will significantly reduce the amount of power that is wasted from the time it is produced at a power plant to the time it gets to your house. By deploying digital monitoring devices and increasing grid automation, these awards will increase the efficiency, reliability and security of the system, and will help link up renewable energy resources with the electric grid. This will make it easier for a wind farm in Montana to instantaneously pick up the slack when the wind stops blowing in Missouri or a cloud rolls over a solar array in Arizona.
\$25 Million	Building a Smart Grid Manufacturing Industry	These investments will help expand our manufacturing base of companies that can produce the smart meters, smart appliances, synchrophasors, smart transformers, and other components for smart grid systems in the United States and around the world - representing a significant and growing export opportunity for our country and new jobs for American workers.

Source: Department of Energy (DOE)

The DOE's increased effort in revamping the U.S. grid, especially from an investment perspective, demonstrates the current administration's commitment to clean energy and energy independence. This commitment has encouraged utilities to proceed with Smart Grid demo-projects as many had been awaiting more clarity before making these types of capital expenditures.

Growing Energy Demand and Rising Electricity Costs

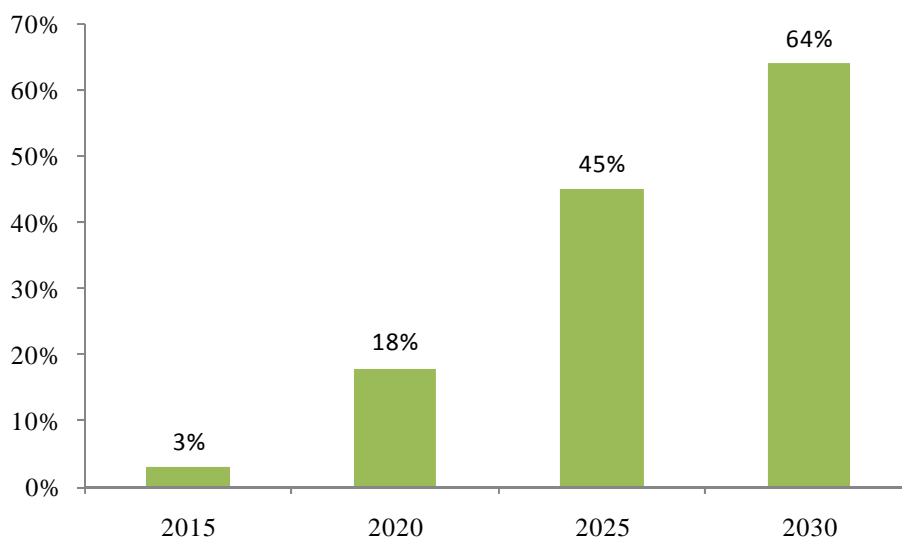
Rising energy demand coupled with volatile energy prices since 2008 have made for front page news stories nationwide, particularly when oil prices reached \$145 per barrel. Since then, both public and private sectors have been investing in alternative energy and the government has been establishing policies to make these resources competitive to traditional energy. However, the most basic answer to solving growing energy demand may be simply to have better control of electricity flow; thereby minimizing transmission losses and increasing efficiency.

Think Equity, LLC estimates that power outages cost the U.S. economy \$135-150 billion per year; which on average also translated into 106 minutes of outage per year. The aforementioned data is comparatively high, as Western European and Japanese customers lose only 15 minutes and 3 minutes per year, respectively. The U.S.'s inefficient power distribution is partially attributable to the grid's aging transmission and distribution infrastructure. By making the grid more efficient through full utilization of Advanced Meter Infrastructure (AMI), consumers are projected to decrease electricity usage by 20% by 2017¹.

Electric Vehicles to Grid

Plug-in Electric Vehicles (PEVs) are poised to become mainstream as future PEVs promise to provide zero emissions and performance at a reasonable price. Industry experts believe that with the government's help through tax credits and loans, the adoption of PEVs will rise significantly and eventually outpace both, gasoline cars and hybrids. In fact, it is projected that more than 60% of the light vehicle fleet in U.S. will consist of electric cars by the year 2030.

Figure 5: Projected Electric Vehicle as a Percentage of U.S. Vehicle Sales



Source: EIA 2009 Annual Energy Outlook, Center for Entrepreneurship & Technology, University of California Berkeley

In order to accommodate these electric vehicles, the grid must be integrated with the vehicles to deliver high quality energy off and on-peak hours. Moreover, charging stations, on and off home premise will need to synch up to the current transmission and distribution centers to ensure efficient load management – both from the consumers' and utilities' perspective.

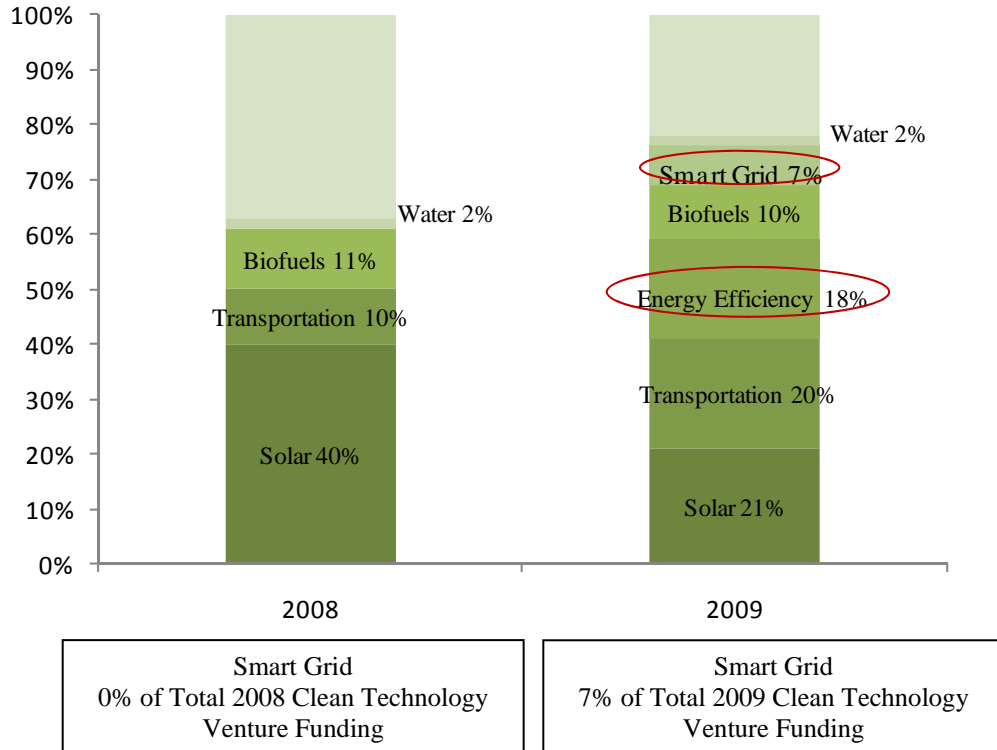
¹ "A National Assessment of Demand Response Potential" by Federal Energy Regulatory Commission on June 18, 2009

Venture Capital Funding

Shifts in Clean Technology Funding

The clean technology venture funding landscape remains dynamic since the industry is young relative to other clean technology sectors. We believe the most interesting shift in clean technology venture funding is the change in industry mix. From 2008 to 2009, venture investment in solar and wind subsided substantially, making room for other clean technology sectors such as transportation (20%), smart grid (7%) and energy efficiency (18%). We believe this shift is driven by lower solar company valuations and also venture fund managers' desire to lessen their exposure to capital intensive projects.

Figure 6: Comparison of Top Venture Clean Technology Sectors



Source: Cleantech Group, LLC

Clean Technology Funding Update:

According to Cleantech Group data, global clean technology venture investment increased by 65% in 1H2010 versus the same period in 2009. This data suggests that despite the global financial slowdown and concerns regarding the strength and sustainability of the globally recovery, investors continue to believe in the future of clean technology.

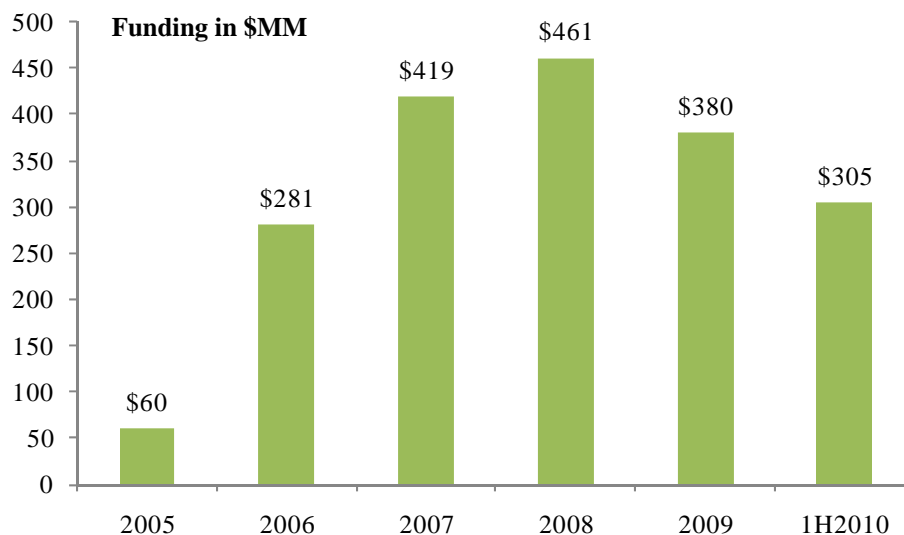
Moreover, over the past two years, corporations have continued to play an important role in clean technology innovation. In fact, global corporate investment in clean technology reached a new high of \$5.1 billion in 1H2010 – a 325% increase from the same period last year. With the support of the large corporations and utilities, many venture backed companies will have the opportunity to scale up and commercialize their products beyond what venture financing can provide.

U.S. Smart Grid Venture Funding

Prior to 2004, the term Smart Grid was not conventionally used. However, the U.S. government's Smart Grid initiatives, coupled with state mandates to meet ambitious Renewable Portfolio Standards, powered the sector's profile.

Hundreds of millions of venture dollars have been invested in a wide range of Smart Grid startups. As a percentage of total U.S. venture investment – Smart Grid funding has averaged approximately 2% of total U.S. venture investment since 2008. Moreover, between 2005 and 2009, Smart Grid venture funding grew at a CAGR of 45%.

Figure 7: U.S. Venture Funding in Smart Grid



Source: GTM Research and MERCOM Capital

Venture funding for Smart Grid companies, in dollar terms, appears relatively small compared to other industries. However, certain Smart Grid subsectors, especially within the application component layer, require far less investments than the more capital intensive projects in solar, wind, biofuels or infrastructure. With large utilities and information technology/communications companies taking the lead to explore and build out the necessary Smart Grid infrastructure, venture capitalists are more focused on funding companies to develop applications for the grid.

Notable Venture Backed Smart Grid Companies



Venture Funding to Date: Approximately \$200 million

Private Equity Investors: Advantage Capital, Altira Group, NEA, Susquehanna Growth Equity and Standard Renewable Energy Group

GridPoint is in the Smart Grid software industry. The company delivers a suite of Smart Grid software applications that aggregates and manages distributed sources of loads, generation and storage for utilities. GridPoint's software also addresses the integration of renewable and electric vehicles.



Venture Funding to Date: \$282 million

Private Equity Investors: Foundation Capital, Google Ventures, Kleiner Perkins, JVB Properties and Northgate Capital

SilverSpring operates in the wireless communications layer of the Smart Grid industry. The company provides AMI networking solutions and competes with other AMI players such as Cisco and Trilliant. SilverSpring's Smart Energy Network is based on open, internet protocol standards – this allows for two way communication between the utility and the grid. The company has won some of the largest contracts to date, including a multi-billion contract with PG&E, and is positioned for an IPO.



Venture Funding to Date: \$146 million

Private Equity Investors: Zouk Ventures, MissionPoint, General Electric Hercules Technology, VantagePoint Venture Partners and Investor

Trilliant operates in the wireless communications layer of the Smart Grid industry. The company utilizes mesh networking equipment to allow smart meters to communicate wirelessly with utilities. Trilliant's secure mesh network can alternate between radio frequencies to adjust transmission distances, while keeping data secure.



Venture Funding to Date: \$41 million

Private Equity Investors: Access Venture Partners, Appian Ventures, In-Q-Tel, Good Energies, RRE, VantagePoint Venture Partners and Vista

Tendril develops hardware and software applications for demand response, energy monitoring and energy management / load control. The company offers a variety of products for consumers as well as utilities. Tendril's suite of products includes its residential end to end energy management system. The Tendril Residential Energy Ecosystem (TREE) allows consumers to better understand their energy usage.

Smart Grid Investment Merits / Risks

Venture opportunities are inherent in the push to modernize the grid. We believe this is an investment area where technology investing skills are directly transferable to clean energy venture investing, and that innovative technology applications and services will positively impact the grid and advance it into the 21st century. Investment merits include:

- **Less Capital Intensive:** Venture funded Smart Grid companies are more likely to operate in the technology space (versus Smart Grid infrastructure). This means that start-ups can leverage a growing number of software solutions for free or at a relatively low cost.
- **Relevant Skill Sets:** Venture capitalists have the relevant technology skill set in turning Smart Grid into a reality. Investments are mainly focused on areas such as advanced energy data analytics and customer engaging applications; these investments are very similar to traditional venture IT investments.

Grid modernization is an attractive market for venture investors; however, we believe some “macro” issues need to be resolved before the Smart Grid can be truly deemed a success.

- **Alignment of Interest:** Regulators have different objectives from those of utilities. Policy makers will have to find ways to incentivize and help utilities monetize the environmental and societal benefits of the Smart Grid. The Obama administration has shown consistent support for Smart Grid by pledging \$3.4 billion for the implementation of Smart Grid technologies.
- **Altering Consumer Behavior:** Today's residential consumers do not monitor their electricity usage. Smart Grid companies will have to allocate a large portion of their marketing dollars to consumer education. With that said innovative companies, such as OPOWER, can learn to leverage customer behavioral science, customer data analytics and even social networking platforms to engage residential consumers in monitoring their electricity usage.
- **Interoperability:** All companies competing within the layers of the grid will need to design an "open" grid where technologies are interoperable, open and collaborative. Currently, there may be too many companies advocating their own operating standards, however, government agencies and industry associates are promoting policies and standards for grid.