

# smart grid infrastructure

The definition of Smart Grid is broad and encompasses grid infrastructure as well as communication and metering technologies – the brawn as well as the brains. AMSC provides a host of Smart Grid infrastructure solutions that reliably connect distributed renewable generation sources and enhance the reliability, efficiency and capacity of the overall grid.

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## WHAT IS THE SMART GRID?

The Department of Energy has identified key characteristics and technology areas that define and drive the Smart Grid.

### The Seven Characteristics

- Enables and motivates active participation by consumers
- Accommodates all generation and energy storage options
- Enables new products, services and markets
- Provides the quality of power required for the digital, computer and communication based economy
- Operates efficiently and optimizes the utilization of existing and new assets
- Anticipates and responds to system disturbances in a self-healing manner
- Operates resiliently against attack and natural disaster

### The Five Key Technology Areas

- Integrated communications to allow every part of the grid to both 'talk' and 'listen'
- Sensing and measurement technologies, to support faster and more accurate response
- Advanced components, to apply the latest research in superconductivity, power electronics, storage and diagnostics
- Advanced control methods for monitoring, diagnosing, and addressing any event
- Improved interfaces and decision support enhance human decision-making

The DOE further identifies the need for the Smart Grid to be green by "slowing the advance of global climate change and offering a genuine path towards significant environmental improvement."

# AMSC Smart Grid Infrastructure Solutions

## Superconductor Cables

The DOE has explicitly called out superconductors as one of the fundamental technologies needed for the Smart Grid. Cables powered by AMSC's superconductor wire have very low power losses and very high power handling capacity. These cables can be used to both increase transmission efficiency and significantly enhance the flow of power under our city streets to enable, for instance, widespread adoption of plug-in hybrid vehicles (PHEVs). These same cables also can automatically suppress power surges and enable resilient power grids that can survive attacks and disasters. Superconductor cables are environmentally responsible and have no external electrical or magnetic fields, simplifying placement within limited right-of-ways and minimizing the impact above ground.



Superconductor Transmission Cable System on Long Island.

## FACTS DEVICES

### D-VAR® Systems

Based on AMSC's advanced power electronics technology, AMSC's D-VAR product is one of the company's scalable, flexible alternating current transmission systems (FACTS). The DOE's Electricity Advisory Committee recently identified FACTS devices as a key Smart Grid technology. The D-VAR product interacts with the grid on a real-time basis to regulate voltage and relieve congestion on existing transmission lines. The most widely deployed device of its kind, the product also can ensure that wind farms around the world effectively connect to the power grid, buffering the variable output of wind turbines, while insulating the same turbines from disturbances on the grid.

AMSC's D-VAR solutions are applied together with other Smart Grid technologies such as composite conductors and real-time monitoring systems to increase the capacity of existing high voltage transmission lines and prevent blackouts.



D-VAR® System Installation at Hallett Wind Farm in Australia.

### AMSC SVC Solutions

Another FACTS device, AMSC's scalable static VAR compensator (SVC) system can be used on the transmission grid as well the distribution system. One of the most important power electronic systems deployed on electric power grids, high-voltage SVCs continuously enhance the performance of transmission lines improve efficiency, and prevent blackouts. Lower voltage SVC solutions improve the quality of electric power and increase the operational efficiency of large industrial operations.



AMSC Transmission SVC Deployment in Western United States.

# AMSC Smart Grid Infrastructure Solutions

## PowerModule® Power Converters

AMSC PowerModule power converters are high-power AC/DC inverter systems based on advanced power electronic technology. These systems serve as the foundation for AMSC's D-VAR solution and wind turbine electrical systems. PowerModule power converters are used to connect a variety of Smart Grid components to the grid, including distributed storage systems such as batteries and distributed generation sources such as wind turbines and wind and solar farms.



## Smart Grid Infrastructure Solutions by AMSC

Smart Grid Characteristics and Properties	Superconductor Cable	D-VAR® System	AMSC SVC
<b>Characteristics</b>			
1. Enable active participation by consumers			
2. Accommodate all generation and storage options	✓	✓	✓
3. Enable new products, services, and markets			
4. Provide power quality for the digital economy	✓	✓	✓
5. Optimize assets and operate efficiently	✓		
6. Anticipates and responds to system disturbances	✓	✓	✓
7. Operate resiliently against attack and natural disasters	✓	✓	✓
<b>Key Technologies</b>			
1. Integrated Communications			
2. Sensing and Measurement			
3. Advanced Components	✓	✓	✓
4. Advanced Control Methods		✓	
5. Improved Decision Support			
Provides significant environmental improvement	✓		
Replaces RMR generators	✓	✓	✓

# About American Superconductor

AMSC offers an array of proprietary technologies and solutions spanning the electric power infrastructure – from generation to delivery to end use. The company is a leader in alternative energy, providing proven, megawatt-scale wind turbine designs and electrical control systems. The company also offers a host of Smart Grid technologies for power grid operators that enhance the reliability, efficiency and capacity of the grid, and seamlessly integrate renewable energy sources into the power infrastructure. These include superconductor power cable systems, grid-level surge protectors and power electronics-based voltage stabilization systems. AMSC's technologies are protected by a broad and deep intellectual property portfolio consisting of hundreds of patents and licenses worldwide.

The demand for clean and renewable sources of electricity, such as wind energy, and the demand for modernized power grid infrastructure are being driven globally by a variety of factors. These factors include increasing electricity usage, power grid capacity constraints, fossil fuel price volatility, and harmful levels of pollution and greenhouse gases. In addition, our growing digital-based economy demands better power reliability and quality. Concerns about these factors have led to increased spending by corporations and supportive government regulations and initiatives on local, state, national and global levels, including renewable portfolio standards, tax incentives and international treaties.



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