



# The power to make power happen

Intelligent, digitally managed  
power transmission and distribution

[siemens.com/energy-management](https://www.siemens.com/energy-management)

Electrical energy  
makes the world go round.

No matter where power comes from  
or where it has to go, we make sure  
it makes it's way – every step of the way.







## From central power and an unidirectional grid ...



### Digitalization

Information technology and its convergence with operational technology are key enablers of a more sustainable energy system. Digital data enable efficient planning, control, and monitoring of all processes.



### Automation

Comprehensive energy automation provides the basis for the quality and security of supply we usually take for granted nowadays.



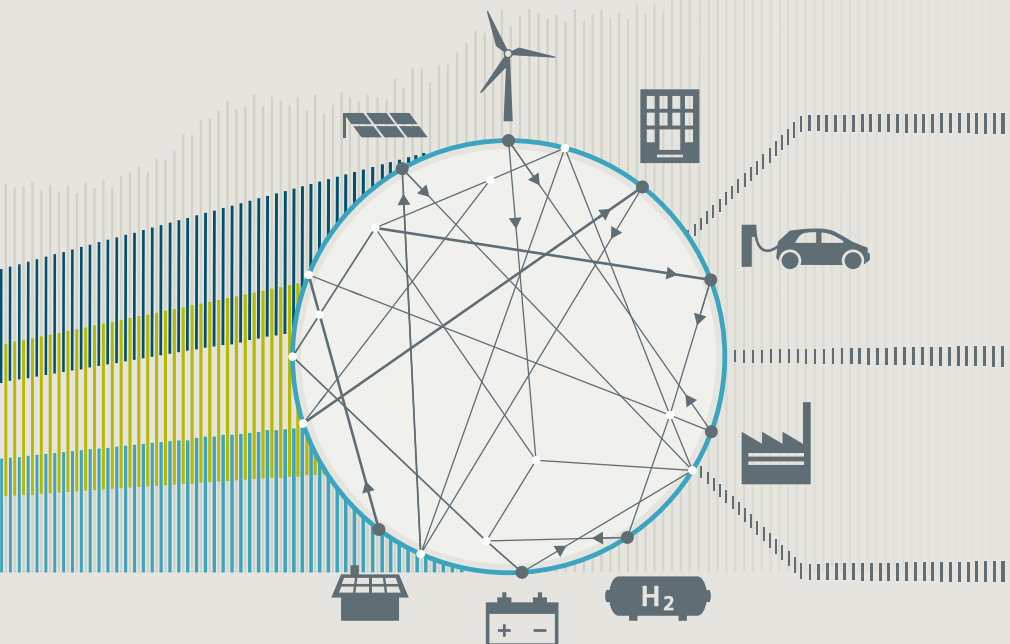
### Electrification

Electricity paved the way to the modern world – its amenities, industries, and infrastructures. Nevertheless, there is room for improvement: about two billion people on our planet still have no sufficient access to electrical power.

# Demanding challenges, promising prospects

The pace of innovation is accelerating

## ... to distributed energy systems and bidirectional balancing



### Services and trusted partnership

From the first planning and design steps to commissioning, operation, and all the way to maintenance, updates, and dismantling, Siemens as a consultant, system integrator, supplier, and partner provides a comprehensive range of customized services, such as training and financing. They ensure the reliable, efficient, value-adding operation of any power transmission and distribution asset.

### Connecting grids

Solutions from Siemens that help master the new challenges emerging from the convergence of grid infrastructures, such as the efficient long-distance transmission of green power, power exchange between grids, and the connection of microgrids to the main grid.

### Agility in energy

An open and flexible architecture of Siemens solutions and services that enable a multitude of customized applications for smarter grids, system stabilization, the development of new business models, and optimized energy trade.

### Totally Integrated Power

A comprehensive range of Siemens high-, medium-, and low-voltage products, systems, solutions, and services for the safe, reliable, and efficient power supply of industrial infrastructure applications and facilities, rounded out by expert support throughout the entire life cycle.

### The future is electric

Electrical power has become one of the most important commodities of our time. Now a more distributed energy infrastructure is evolving. This entails fundamental technical and economic change, and it makes grid operation more complex than ever before. While electrification and automation have provided a reliable basis for today's energy landscape, digitalization holds the key to mastering these new challenges:


- a changing generation mix
- generation capacity additions
- the growing distance between source and load
- public and private decentralization
- the need for refurbishments and upgrades

### Expertise you can rely on

A steady stream of innovation in power technology for more than 160 years has made Siemens a trusted, valued partner of leading energy, industrial, and infrastructure companies worldwide. Continuing this tradition, Siemens addresses the new challenges of the energy system in three areas:

- Connecting grids
- Agility in energy
- Totally Integrated Power

Products, solutions, and services from Siemens cover the entire value chain in these areas of activity. They help actively shape the future of energy and make it a success story for all stakeholders from the point of grid infeed all the way to the customer.



Our high-quality products, solutions, and services, backed by the capabilities of a global energy technology powerhouse,

help connecting grids in order to meet the complex requirements the future holds for power transmission,

create the agility in energy that is key to coping with today's and tomorrow's power distribution challenges,

and enable the reliable, safe, and efficient power supply of industries, buildings, and facilities with Totally Integrated Power.





# Connecting grids

## Cross borders, exceed limits

### New links to complement established structures

Power generation, especially from renewable sources, often takes place far from the centers of load, where resources such as water and wind are abundant and can be exploited efficiently. In addition, there is a tendency to interconnect existing transmission grids. The power transmission infrastructure needs to be prepared for this coalescence as well as for the new challenges that arise from the establishment of increasingly multilayered structures and processes: Aging grid infrastructures need to be replaced and updated. In addition, new solutions that help increase transmission capacity, power quality, and system stability need to be applied.

### Innovative solutions on a reliable basis

One example is the full bridge converter, a technology for high-voltage direct current (HVDC) power transmission. The full-bridge topology with HVDC PLUS (multilevel voltage-sourced converter technology) provides significant benefits and excellent performance, allowing selective fault clearing on overhead lines in radial multiterminal systems.



Siemens FACTS (flexible AC transmission) systems – such as SVC PLUS – supply reactive power to AC grids to improve transmission quality and efficiency. A new grid-access solution for offshore wind power plants helps significantly reduce the levelized cost of offshore wind power.

Customized, state-of-the-art high-voltage turnkey substations are the one-stop solution for the node points of the increasingly complex power transmission infrastructure. Air and gas-insulated switchgear, transformers for various applications, and high-voltage products – such as circuit breakers, surge arresters, disconnectors, and bushings – provide the technically sound and reliable basis for mastering the challenges posed by increasing demands and growing complexity. Transformer Lifecycle Management™ and continuous condition monitoring are among the expert services that cover the entire lifecycle of products and applications, ensuring minimum total cost of ownership and creating added value.





## An efficient highway for clean power



### The world's first UHV DC transmission system

Virtually endless hydropower resources are available in the mountains of China's Yunnan province. China's most energy-hungry areas, however, are situated in the Guangdong province in the Pearl River Delta, more than a thousand kilometers southeast. This is one of the world's most densely urbanized regions and one of the main hubs of China's economic growth.

In 2009, the transmission system operator China Southern Power Grid put the world's first ultra-high-voltage direct current (UHV DC) transmission system into operation. It connects the two provinces and transmits five gigawatts of eco-friendly power over a distance of 1,418 kilometers from the Chuxiong substation in Yunnan to Zengcheng in Guangdong. The UHV DC system, based on Siemens technology and awarded the silver Asian Power Award 2011 as one of the best fast-track power projects in Asia, operates on a voltage level of 800 kV. Commercial operation of the first 800 kV pole started in December 2009, and the complete bipole has been in operation since June 2010. The system uses two series-connected 12-valve pulse groups per pole.

In comparison with local power generation based on fossil sources, which would have been the alternative, the transmission of hydropower from the Yunnan province to the Pearl River Delta reduces emissions by more than 30 million tons of CO<sub>2</sub> per year.

# Agility in energy

Ahead of the challenge, ahead of the change





## Agility – a new core capability in the energy business

Change has become a constant for utilities over the past years. Trends such as distributed energy systems, renewables, changing customer behavior, and new forms of competition must be taken into account and managed. Smart automation and digitalization technologies are proving to be extremely valuable in this regard. But as the pace of change continues to accelerate, we're also witnessing the increasing importance of one specific ingredient for success: agility.

### Optimal use of all resources and technologies – optimum results

Agility in energy translates into more open, transparent, adaptable, manageable, and lean systems, structures, and strategies that enable utilities to stay ahead of the challenges and out in front of change. As such, agility is the key to keeping any power supply system efficient, reliable, and sustainable in a world that is spinning ever faster. What's more, it turns the evolution of the energy system into a clear opportunity rather than a threat. It contributes to the streamlining and reorganization of workflows, value chains, and revenue streams. It enhances existing operations and helps create new business models and markets.

### Siemens' comprehensive expertise is the basis for unique value added

Our customers benefit from our unique ability to support and enable the digital convergence of information technology and operation technology in a manner and to a degree

that is unique. We enable the seamless integration of renewable energy and distributed power generation, a high degree of adaptability, unprecedented sustainability, and optimal asset protection – in short: agility in energy.

Agility may be the main quality our customers will require to stand their ground in the marketplace. Our meaningful, workable automation and digitalization technology, processes, and financing options enable agile energy management and the successful convergence of information and operational technologies. Siemens combines proficiency in the transmission, distribution, and application of electrical energy with market leadership in automation, communication, and control. Nobody else can provide this kind of comprehensive expertise that translates into a comparable extensive range of products, solutions, and services. These enable the safe and reliable operation of any grid topology, utilization optimization for all assets, and the efficient and profitable planning of conventional grid extensions. Furthermore, they yield optimal results when used together. Transformers, storage solutions, monitoring, control, and protection equipment, and data collection and analysis tools work hand in hand in the comprehensive solutions from Siemens.

In short: We provide our customers with what they need to ensure their company's success: outstanding flexibility, consistency, and the response speed needed to answer today's as well as tomorrow's challenges.

## Agility in demand management



### A unique vision of an efficient utility

NB Power, the utility that delivers electricity to more than 345,000 customers in the Canadian province of New Brunswick, turned to Siemens and its comprehensive COMPASS methodology for a transformative smart grid solution.

The farsighted decision by NB Power to bring Siemens in as a partner resulted in a ten-year agreement that is the first of its kind in Canada.

Intensive work is currently underway on building NB Power's smart grid, which is leading to a fundamental transformation of the utility. Among the major initiatives being rolled out is special software that will enable NB Power to control the amount and timing of electricity used by specific devices, such as electrical thermal storage units and baseboard heaters. In addition, billing and customer service programs are being overhauled. And in the coming years, powerful new tools will be added, such as outage automation to make service disruptions shorter and less impactful. The final aim is to boost NB Power's efficiency to the higher levels that will serve as a global model for where the industry is headed: agility in energy.



# Totally Integrated Power

## Power for challenging environments

### Tailored solutions for industry-specific requirements

Totally Integrated Power (TIP) provides customized answers to the most diverse power supply demands in any industrial or infrastructure context. The consistent TIP product range enables comprehensive, integrated one-stop solutions that cover all aspects of reliable, safe, and efficient power distribution – from planning and design to operation, monitoring, and control, from software to hardware, from intelligent distribution substations to uninterruptible power supply systems and all the way to reliable, cost-efficient components, such as the new 3VA molded case circuit breaker.

TIP is seamlessly integrated into digital environments through Totally Integrated Automation (TIA) and Total Building Solutions (TBS). It supports automated engineering processes with an extensive range of software and

data, interacts with industrial automation through communications-enabled devices and open interfaces, and provides the basis for universal energy-efficiency concepts through systems, components, and software for energy data collection.

A comprehensive range of value-added services covers the entire life cycle of products and solutions and helps make even more of an investment while ensuring full compliance with the strictest technical as well as environment, health, and safety (EHS) standards. Tailored one-stop solutions for many different industries and facility applications ensure that industry-specific requirements are met precisely and that the power-supply system of an industrial or infrastructure facility integrates seamlessly with the automation environment and its operational IT.





## Outstanding performance, efficiency, and sustainability



### Totally Integrated Power for the world's most energy-efficient data center

The Italian company Eni S.p.A recently opened its green data center, the world's most energy-efficient facility of its type. It houses Eni's central computer processing systems for information management and for seismic simulation processing. With its TIER IV classification compliance, the data center in the Lombardian municipality of Ferrera


Erbognone is also considered to be one of the most reliable data centers in the world. Its maximum downtime of 48 minutes per year translates into an availability rate of 99.995 percent – a performance rate that is directly comparable to that of the world's largest IT providers, such as Google and Facebook.

To ensure that the high cooling requirements of the data center do not adversely affect energy consumption, the green data center uses an integrated combination of highly efficient TIP electrical equipment, air conditioning technology, and building automation solutions from Siemens. In addition to its impressive and energy-saving cooling system, the data center benefits from significant energy efficiency improvements in the uninterruptible power supply and in power distribution: While losses can amount to approximately 13 percent of the total energy demand in conventional data centers, they may not exceed 0.6 percent in a green data center.







The background of the slide is a composite image. The top half shows a sunset or sunrise sky with a gradient from blue to orange. The bottom half shows a city at night with lights and a highway with light trails. A semi-transparent network diagram with nodes and lines is overlaid on the left side.

Our unique engineering and solution expertise makes us a trusted partner who ensures our customers' lasting success. Together we shape power infrastructures in a sustainable, profitable, and socially responsible way.

Energy Management all the way.

# One stop for power

## Trendsetting ways of getting power to where it is needed

Exceptionally broad, long-standing expertise and experience in the fields of electrification, automation, and digitalization is what makes Siemens stand out. This unique position translates into a comprehensive range of products, solutions, and services that provide the basis for lasting success in the new energy landscape.

Customers benefit from Siemens' unique ability to support and make possible the digitally enabled convergence of information technology and operation technology. Meaningful, workable technology, processes, and financing options enable outstanding flexibility, consistency, and response speed, which are the essentials in shaping efficient power infrastructures that will stand the test of time.

### Changing generation mix

The growing share of renewable power in the energy mix also means increasingly volatile generation. New technical approaches are required to ensure stability and availability.

### Generation capacity additions

The demand for electrical power keeps rising, and so does the need for adequate grid capacity to ensure a reliable, safe, and efficient power supply.

### Growing distance between source and load

Large-scale resources of renewable energy are often located far away from the centers of load. It takes powerful technology to get the power to where it is needed.

### Public and private decentralization

Today's increasingly complex, more and more distributed energy systems need to be managed with intelligent technology and backed by storage facilities.

### Need for refurbishments and upgrades

The prevention of bottlenecks, overload, and overstress requires cutting-edge equipment as well as solutions for cyber security and improved resilience.

### Reliable, safe, efficient power supply

The basis for today's industrial processes, infrastructure solutions, buildings, and even private life is dependable and affordable power in all circumstances.

- DC interconnectors
- Flexible AC transmission systems (FACTS)
- Energy storage
- Network control systems
- Generation and demand management systems



- High-voltage AC transmission technology
- Intelligent distribution grid technology
- Consulting services



- High-voltage direct current (HVDC) systems
- Flexible AC transmission systems (FACTS)



- Distribution grid automation technology
- Technology for microgrids
- Energy storage and electrolyzers
- Consulting services



- Refurbishment, retrofit, and overhaul products and services
- Cyber security solutions
- Integrated grid management systems
- Smart grid solutions



- High-, medium-, and low-voltage power supply solutions, switchgear, and devices
- Low-voltage switchboards and busbar trunking systems
- Power quality, measurement, and monitoring devices
- Integration into industrial and building automation through TIA and TBS





# Setting the pace

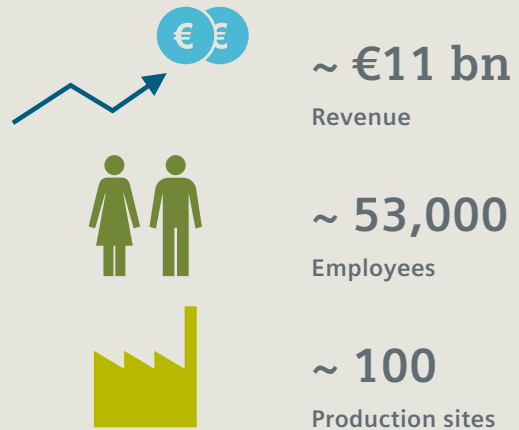
## Expertise that creates value added

### A tradition of excellence

Bringing to the table unique experience in the area of energy and electrification plus comprehensive expertise on all voltage levels – not to forget world market leadership in industry automation and a leading role in digitalization – Siemens is in a unique position to keep the lead in addressing the energy challenge and to drive innovation. And innovation has always been the lifeblood of Siemens.

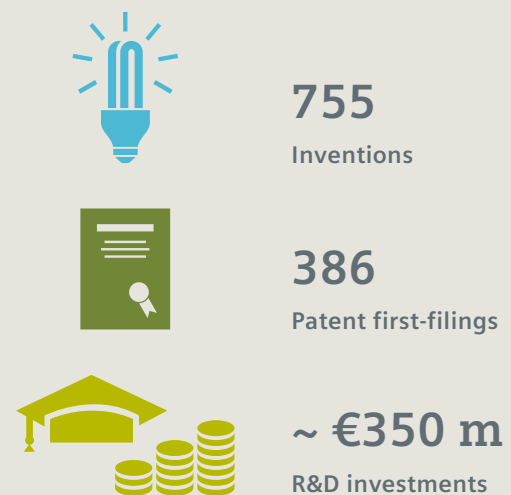
Developing the best answers for the customers' toughest questions made the company the global powerhouse it is today. And the story continues: Products, solutions, and services from Siemens support the development and delivery of viable business approaches and reliable, efficient power supply infrastructures. A comprehensive end-to-end approach that addresses all relevant verticals with a unique one-stop portfolio helps ensure lasting commercial success against the backdrop of an evolving energy system.

## The Siemens Energy Management Division: Core figures



## Research and development

Siemens is a company that lives research and development. It means securing our technological basis, helping shape the future with innovative solutions, and strengthening our position in the market. The following figures provide some evidence.



All figures worldwide as of financial year 2014



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