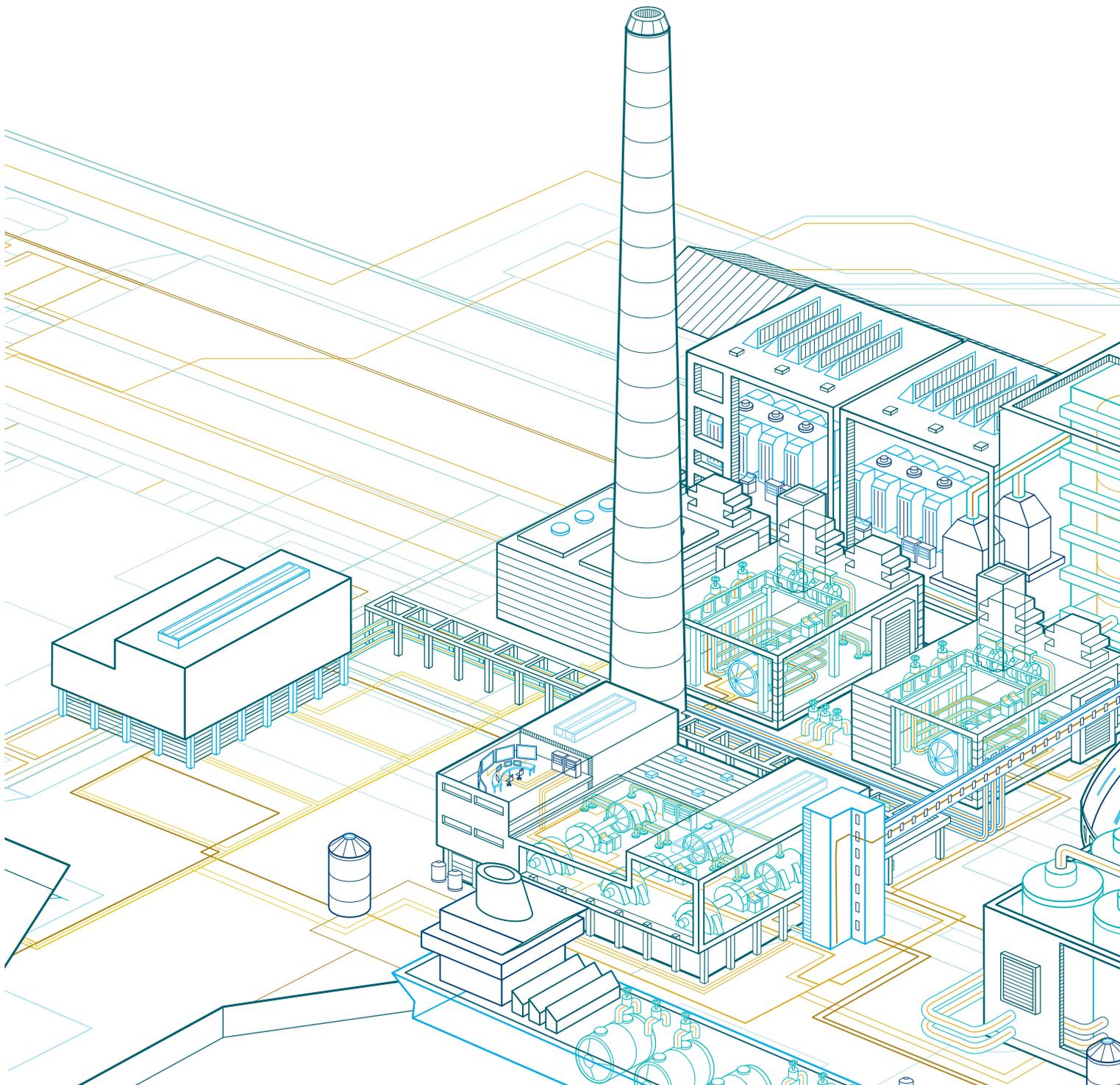


The evolving world of power Opportunities and challenges



Balancing the need for power with minimum environmental impact

Global demand for energy is rising fast, and demand for electricity is rising even faster. Unless changes are made, by 2030, global electricity consumption will be close to 30,000 terawatt hours a year.¹ That's more than twice the amount used in 2000. Meeting this kind of demand would mean building a one gigawatt power plant and its associated grid infrastructure every week for the next 20 years.

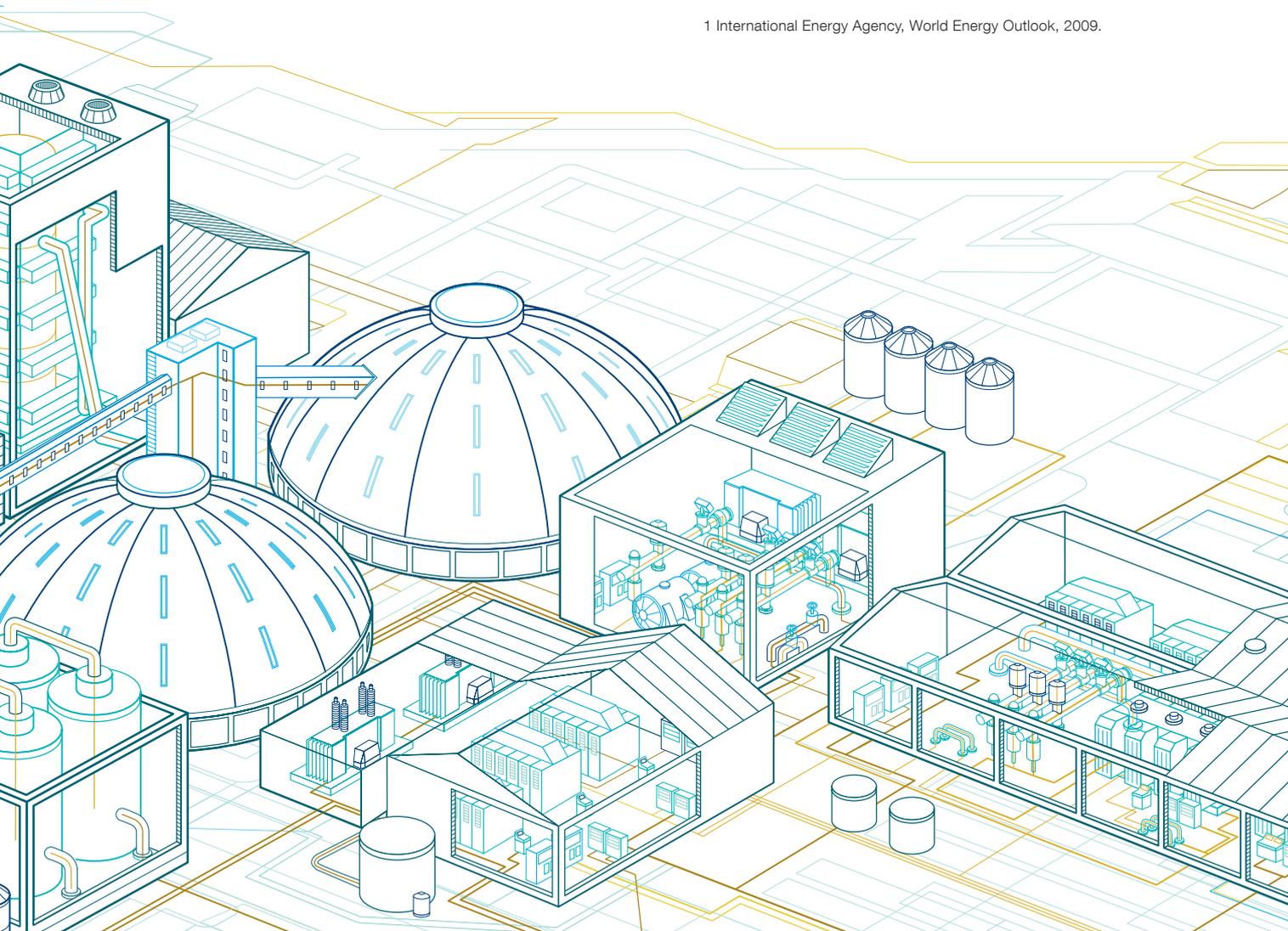
While increasing demand for power is a reality, climate change is also a serious cause for concern. There is mounting evidence that the rise in global temperatures, which began during the industrial revolution, is due in significant part to man's activities.

Concern for the environment is now high on the global agenda and governments around the world are mobilizing resources to fight climate change. It is now widely accepted that global temperatures must be limited to a maximum of 2°C above pre-industrial levels if the effects of climate change are to be held to an acceptable economic, social and environmental cost.

To achieve this goal, greenhouse gas emissions must be dramatically reduced. According to the International Energy Agency (IEA), a combination of energy efficiency measures and renewable power generation could deliver 75 percent of the required emissions reduction over the next two decades.

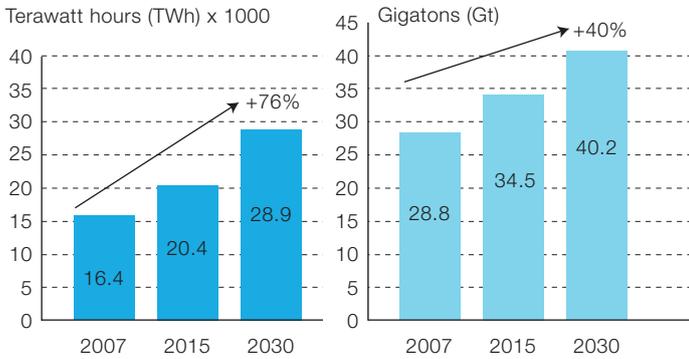
Approximately 80 percent of energy is lost in the chain from primary harvesting of resources such as oil and gas, to end-use in our homes, offices and factories. Improving the efficiency of this energy chain remains the most cost-effective way of lowering consumption and emissions.

1 International Energy Agency, World Energy Outlook, 2009.



World electricity demand

Energy-related CO₂ emissions



Source: International Energy Agency, World Energy Outlook 2009.

ABB solutions, based on existing technologies, can reduce losses at each step in the energy value chain by 20-30 percent.

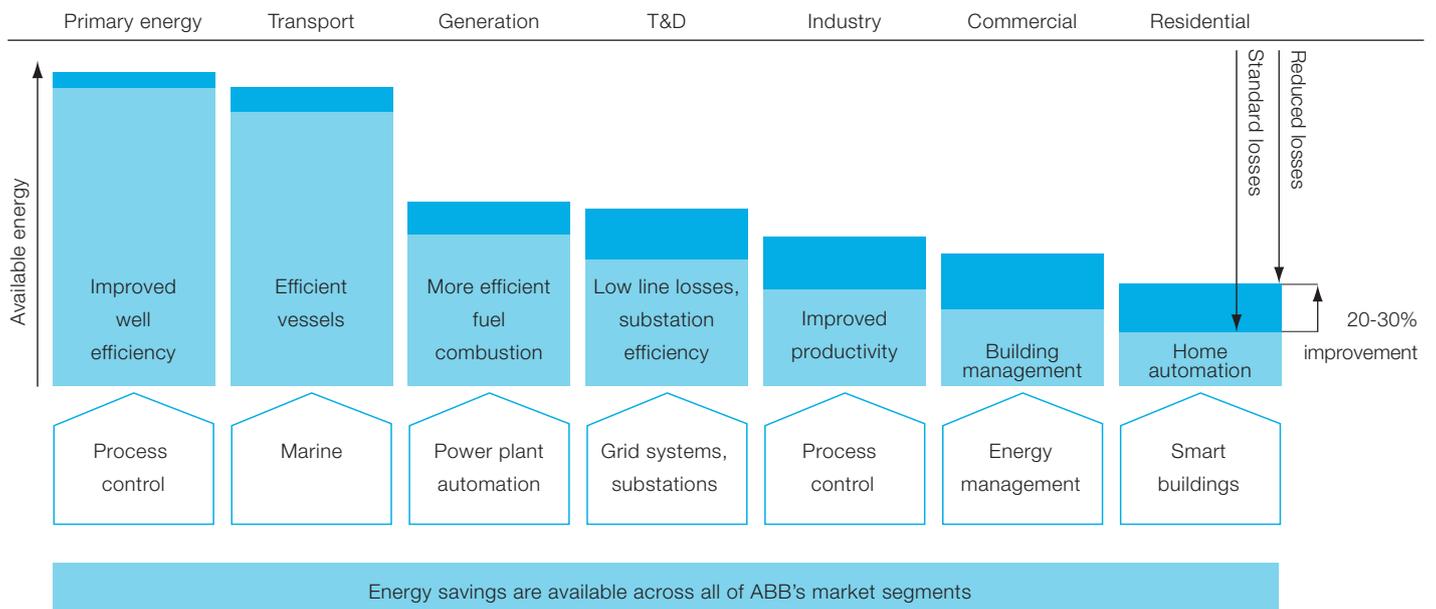
Industry consumes over 40 percent of the world's electricity, and more than 40 percent of global carbon dioxide emissions are produced by fossil-fueled power generation. Clearly, the power sector could play a major role in efforts to reduce greenhouse gas emissions by facilitating improvements in energy efficiency and integrating renewables.

better use of renewable energy sources, we can reduce environmental impact and costs. The same benefits can come from reducing transmission losses, managing distribution networks more intelligently and using electricity more productively.

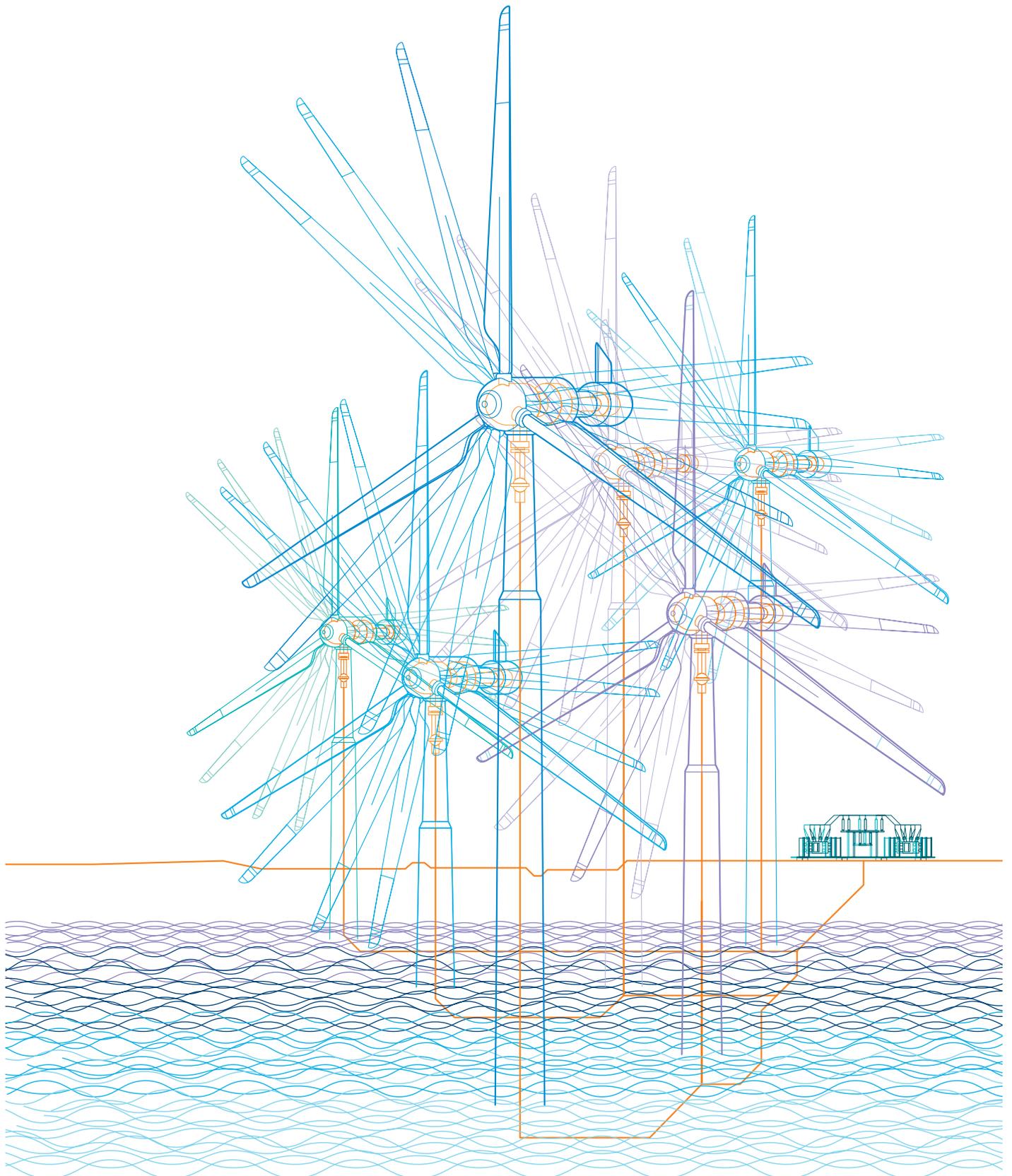
ABB solutions, based on existing technologies, can reduce losses at each step in the energy value chain by 20-30 percent. If we can generate power more efficiently, and make

Major reductions in carbon emissions can come from the development of renewable energy sources such as hydro, wind and solar. These sources will reduce our long-term dependence on fossil fuels, lowering global emissions of greenhouse gases and other pollutants.

Energy losses can be reduced by 20-30% using ABB solutions



The power sector will play a major role in efforts to reduce greenhouse gas emissions by integrating renewables

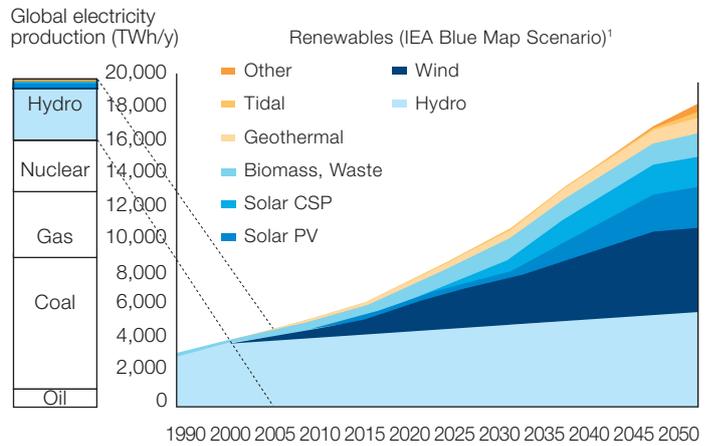


While the cost of renewable energy is generally higher than that of conventional alternatives, economies of scale and advances in technology are bringing prices down and making the environmental benefits ever more attractive.

But renewable power sources, which are often located far from centers of demand and may be subject to the vagaries of the weather, will need to feed into electricity grids. The grids must be able to manage their unpredictable and intermittent nature, and accommodate an increasing share of small-scale and distributed generation sources at the same time.

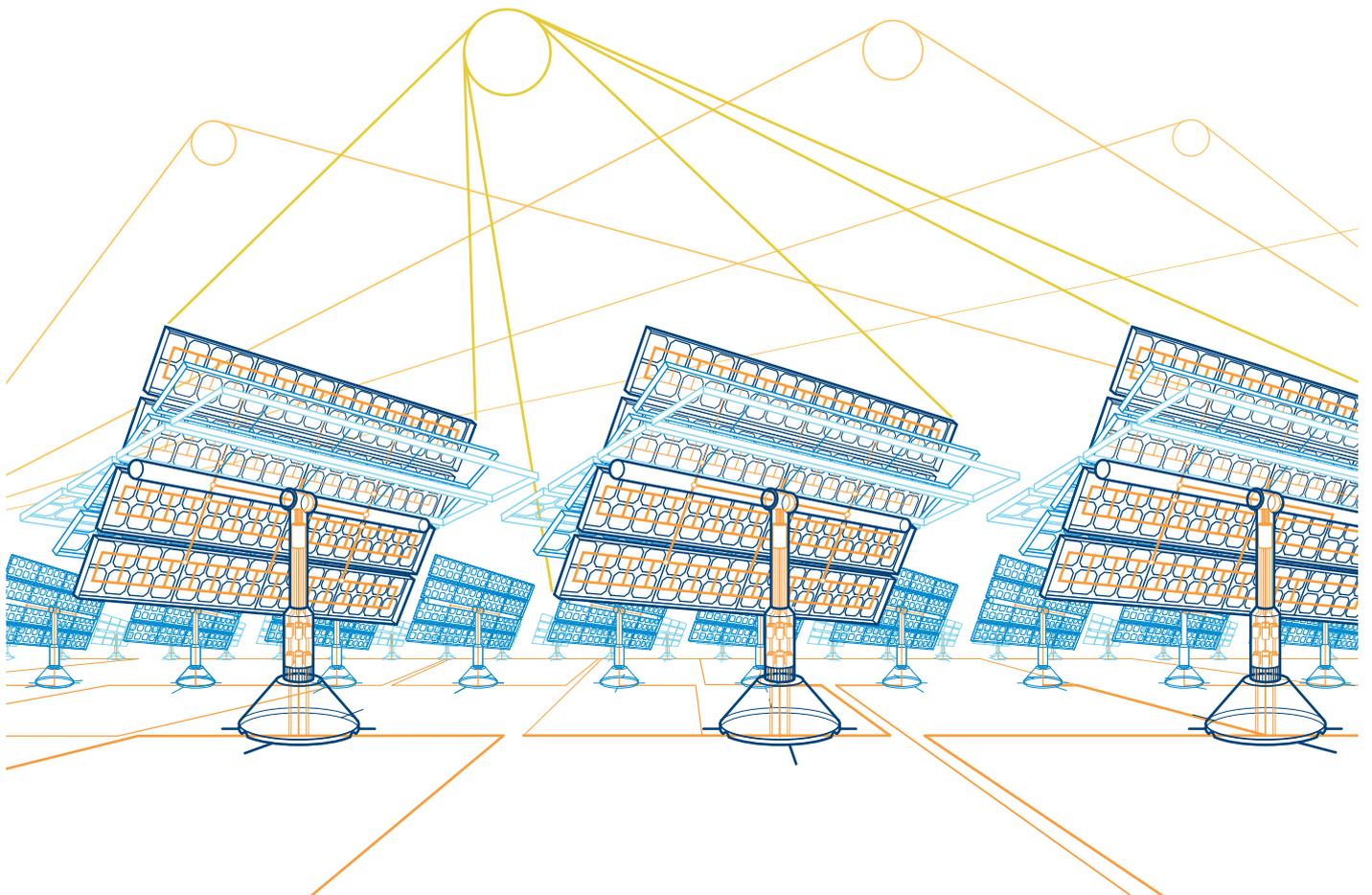
Since electricity networks have evolved over the decades to transport electricity from predictable and controllable generation sources, which are close to centers of demand, the increase of renewables will bring a set of new, though not insurmountable challenges and the grid will need to evolve.

Renewable energy sources are expected to make a major contribution



¹ Blue Map Scenario is a combination of high efficiency, biofuels, electric vehicles and hydrogen fuel cells; the result is that CO₂ emissions in 2050 are contained at half the level of 2005.

Source: International Energy Agency.



In many regions, grid expansion and renovation will be required to ensure the reliability, efficiency and security of electricity supplies, and elsewhere, whole new systems will be needed to serve consumers as living standards rise. The advent of electric vehicles will also have an impact on the development of the future grid – key aspects that need to be addressed are the charging and energy storage infrastructure, and billing systems. Across the world, power systems need to become more effective and efficient, through increased automation and greater deployment of energy efficiency technologies to ensure we make the best possible use of our infrastructure and our resources.

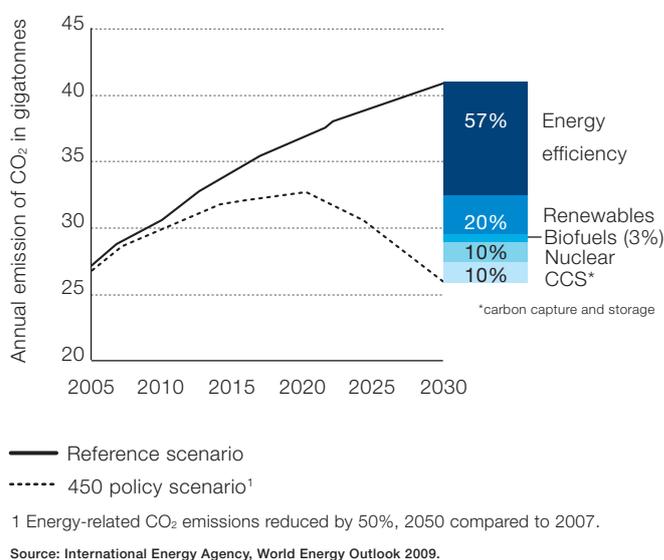
The evolving power system will have more long-distance transmission links and more grid interconnections, which will accommodate remote renewables and facilitate efficient energy trading. Stability will be enhanced by enabling generators to share power during periods of low demand, helping to meet shortfalls in neighboring systems. There will also be more focus on ensuring power quality and reliability to avoid power fluctuations and failures.

The power system of the future will be more flexible and interconnected, leading to the evolution of a stronger and smarter grid, balancing our growing need for power with environmental concerns.

In the past, electricity supplies simply followed demand patterns, but in the future, as more renewable power is incorporated into the system, consumption will also need to be controlled. To ensure a balance between supply and demand, demand management will require the active involvement of power generators, utilities and consumers.

By their nature, the utility management and control systems of the past were inherently difficult to compromise and a “security by obscurity” approach prevailed. But the introduction of information and communications technologies to our grids has increased the need for cyber security. Alongside the benefits these technologies bring, which include faster fault detection and resolution, additional control systems are required to ensure that the grid’s systems will function correctly, without interruption by external influences.

Energy and renewables could deliver bulk of CO₂ savings

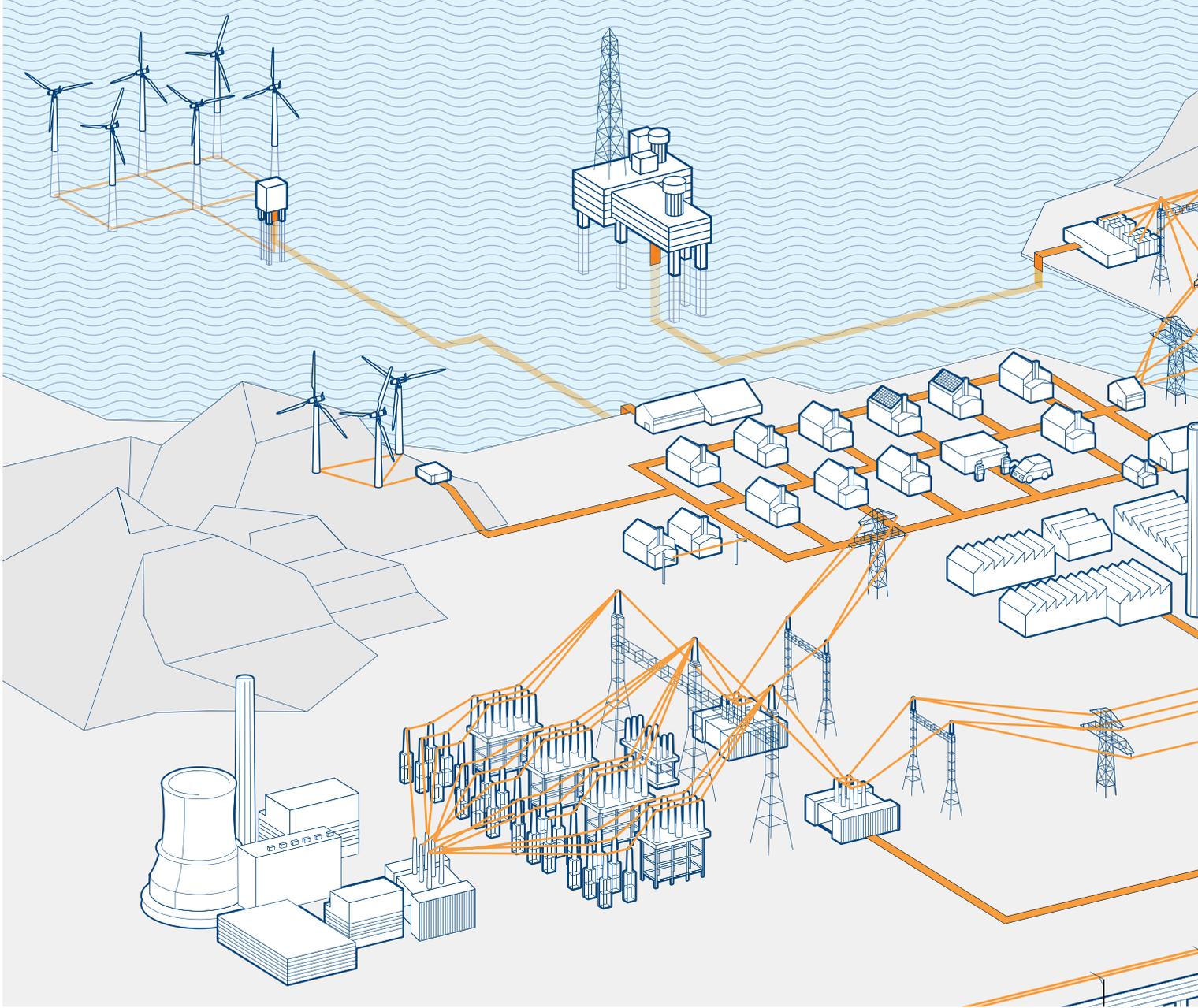


Another key development in the management of the evolving power network is the convergence of information (IT) and operational (OT) technologies, which strengthens the link between software systems used to control the network and the physical infrastructure of the grid. This convergence will deliver the sophisticated automation systems needed to support the many growing complexities, while maintaining the required levels of grid reliability in the coming decades.

The power system of the future will be more flexible and interconnected, more automated and intelligent, to address the challenges and opportunities of balancing our growing need for power with environmental concerns.

At ABB, we remain committed to the development and deployment of technologies to help our customers to be more competitive by increasing efficiency, enhancing capacity and improving reliability, while lowering environmental impact.

ABB technologies enable the flow and control to be more flexible, reliable, efficient, intelligent



Energizing and controlling power plants

Power plant operators aim to run their installations at the highest possible level of efficiency, regardless of the energy source. With more than 125 years of experience and a vast installed base, ABB offers technologies for complete electrical and automation solutions as well as controls and instrumentation products for power generation plants of all kinds.

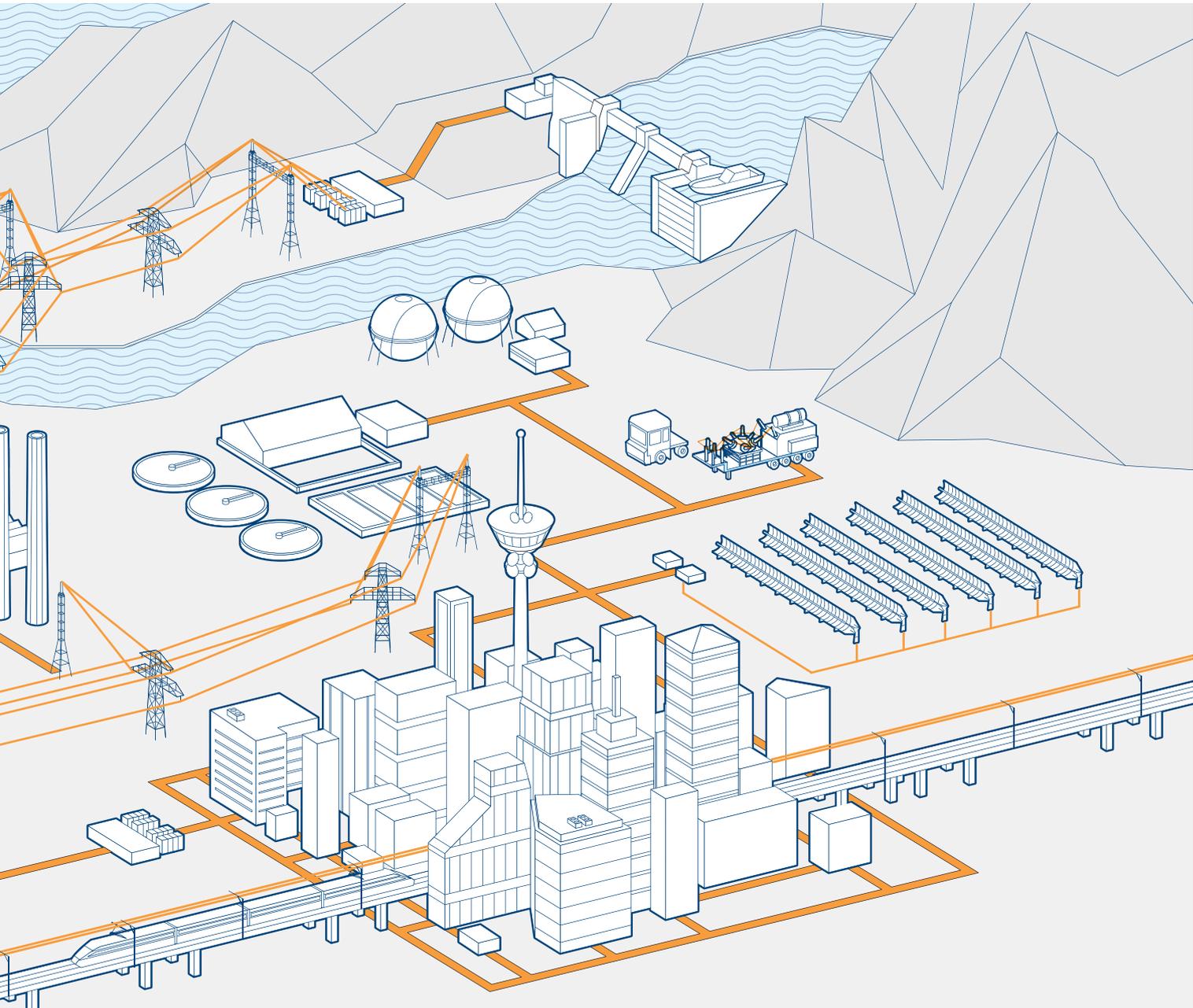
Power transmission

ABB is a pioneer and market leader in technologies for efficient and reliable transmission of power over long distances with minimal losses. Our ultrahigh and high-voltage solutions up to 1000 kV, including technologies like HVDC, HVDC Light, FACTS and cable systems, help transport power and connect transmission grids over land, underground and even underwater.

Substations

Transmission and distribution substations use a range of high- and medium-voltage products that ensure reliability and efficiency in the power system. These include surge arrestors, protection equipment, switchgear, circuit breakers, and transformers. Specialist automation systems protect and optimize the flow of power within a substation.

of electricity for power networks to and environmentally friendly



Managing the network

Network management software products and systems collect, store and analyze data from thousands of points in a network. Systems like network solutions, SCADA (supervisory control and data acquisition) and utility communications enable real-time monitoring and control of power generation, transmission and distribution systems, as well as industry and rail networks.

Products

ABB's product offering across voltage levels includes circuit breakers, switchgear, capacitors, instrument transformers, power, distribution and traction transformers as well as a complete range of medium voltage products - enhancing reliability, improving energy efficiency and lowering environmental impact.

Services

With unparalleled domain expertise, ABB's offering encompasses the entire range of services, from consulting, repair and refurbishment to complete maintenance and asset management solutions. ABB's global installed base coupled with its vast portfolio facilitates life cycle support across the power value chain.

ABB's offering across the power value chain

Energizing and controlling power plants

More than 50 percent of the total investment in power infrastructure goes to the generation sector as we continue to add capacity, especially in the emerging economies. Although power generation around the world will continue to depend heavily on coal and other fossil fuels for the foreseeable future, the renewables sector is growing and will play an important role in the global transition to a low-carbon economy.

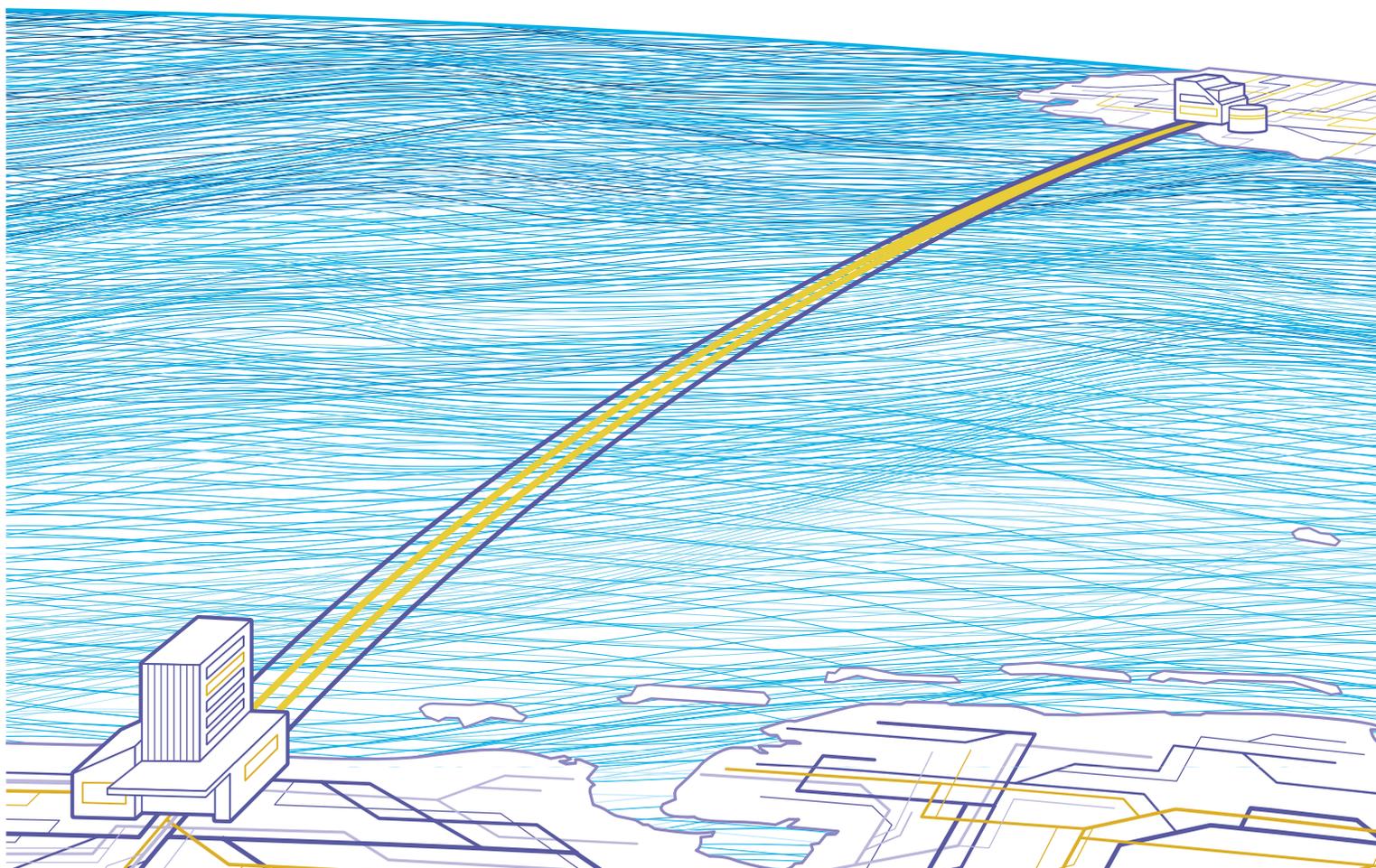
ABB is a leading provider of integrated power and automation solutions for all types of power generation plants. With an extensive offering portfolio that includes electrical balance of plant, automation, instrumentation and control systems we offer products, systems and service solutions that help optimize performance, improve reliability, enhance efficiency and minimize environmental impact through the entire lifecycle of the plant.

Power transmission

ABB has a comprehensive offering of alternating and direct current transmission systems, which help customers to reduce transmission losses, maximize efficiency and improve grid reliability.

ABB pioneered HVDC (high-voltage direct current) technology more than 50 years ago and has supplied more than half of the world's installed HVDC capacity.

HVDC technology is designed for high-efficiency power transmission via overhead transmission lines and underground or submarine cables. It has lower losses and a smaller footprint than traditional high-voltage alternating current (HVAC) transmission systems, and is able to stabilize intermittent power supplies that might otherwise disrupt the grid. For these reasons, it is the technology of choice for long-distance transmission projects, which can deliver electricity from remote generation sources to consumption centers. HVDC is also widely used for grid interconnections.



HVDC Light®, a system based on ABB's classic HVDC technology, is ideal for linking offshore installations, such as wind farms or oil and gas platforms, to mainland grids. It is used to overcome limitations of distance and grid incompatibility, while ensuring robust performance and minimal electrical losses. The environmental benefits of HVDC Light®, include neutral electromagnetic fields, oil-free cables and compact converter stations.

FACTS (flexible alternating current systems) technologies improve power quality and can significantly increase the capacity of alternating current transmission lines - by as much as 50 percent - while maintaining or improving the system's reliability. FACTS technologies also boost transmission efficiency, relieve bottlenecks and can be used for the safe integration of unpredictable power sources such as wind and solar into the grid.

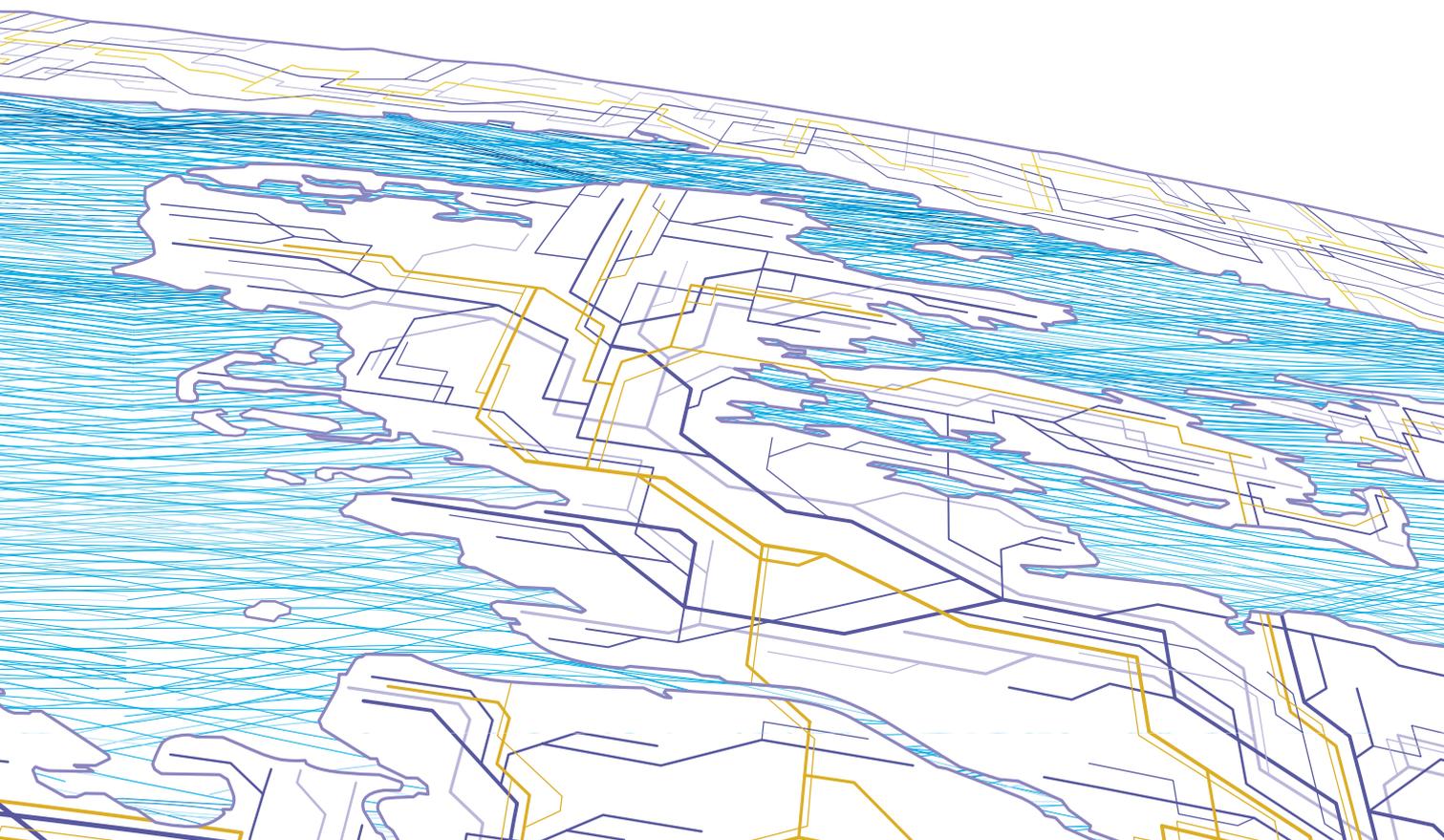
By enhancing the capacity of existing transmission infrastructure, FACTS solutions can alleviate the need for capital investment, reducing the time, cost and environmental

impact associated with the construction of new generating facilities and transmission lines. By improving efficiency, FACTS technologies help to deliver more power to consumers, reducing waste, improving services and revenues.

ABB is a global leader in FACTS technologies and has more than 700 installations in operation or under construction around the world.

ABB also offers a comprehensive range of land and submarine cables, accessories and services for a range of applications from medium- to high-voltage AC and DC systems. The portfolio includes high-performance XLPE (cross-linked polyethylene) insulated cables for high efficiency transmission systems at voltages up to 500 kV. ABB has delivered more than 7,000 km of XLPE cables for voltages in excess of 100 kV for projects around the world.

When it comes to transmission grid solutions, ABB has a unique in-house manufacturing capability that includes semiconductors, cables and complete converter stations.



Substations

Substations are key installations in the power grid that facilitate the efficient transmission and distribution of electricity. They perform the vital function of monitoring and controlling power flows, feeding power from generating stations into the grid and providing the link between transmission and distribution networks as well as end consumers.

As the world's leading supplier of air-, gas- and hybrid insulated substations, ABB has successfully delivered projects in all kinds of environments, from deserts and mountains to offshore rigs and crowded city centers.

ABB's offering is compliant with IEC 61850, the open communication standard, which provides a common framework for substation automation and facilitates interoperability across devices and systems. This provides real-time control and monitoring functions and helps to maximize the availability, efficiency, reliability and safety of ABB's substations. The standard also facilitates multi-vendor integration and substation extensions, as well as enterprise-wide data integration for efficient power system management.

ABB's substation offering covers a range of voltage levels, up to 1,100 kV.

Managing the network

ABB's network management and utility communications solutions monitor, control, operate and protect power systems. They ensure the reliability of electricity supplies and enable real-time management of power plants, transmission grids, distribution networks, and energy trading markets.

ABB's offering includes control and protection systems for power generation, transmission and distribution, as well as software solutions for central electricity markets and mixed utilities (electricity, district heating, gas and water).

Network management systems are a key smart-grid component enabling highly automated power systems to incorporate and manage centralized and distributed power generation, intermittent sources of renewable energy, real-time pricing and load-management data.

With the recent addition of Ventyx, ABB has a unique portfolio comprising an end-to-end software offering in addition to a comprehensive range of operational technologies - a valuable combination for the development of smart grids.

ABB products, systems and service solutions facilitate the generation, transmission, distribution and utilization of electricity – enabling efficiency, reliability and power quality.

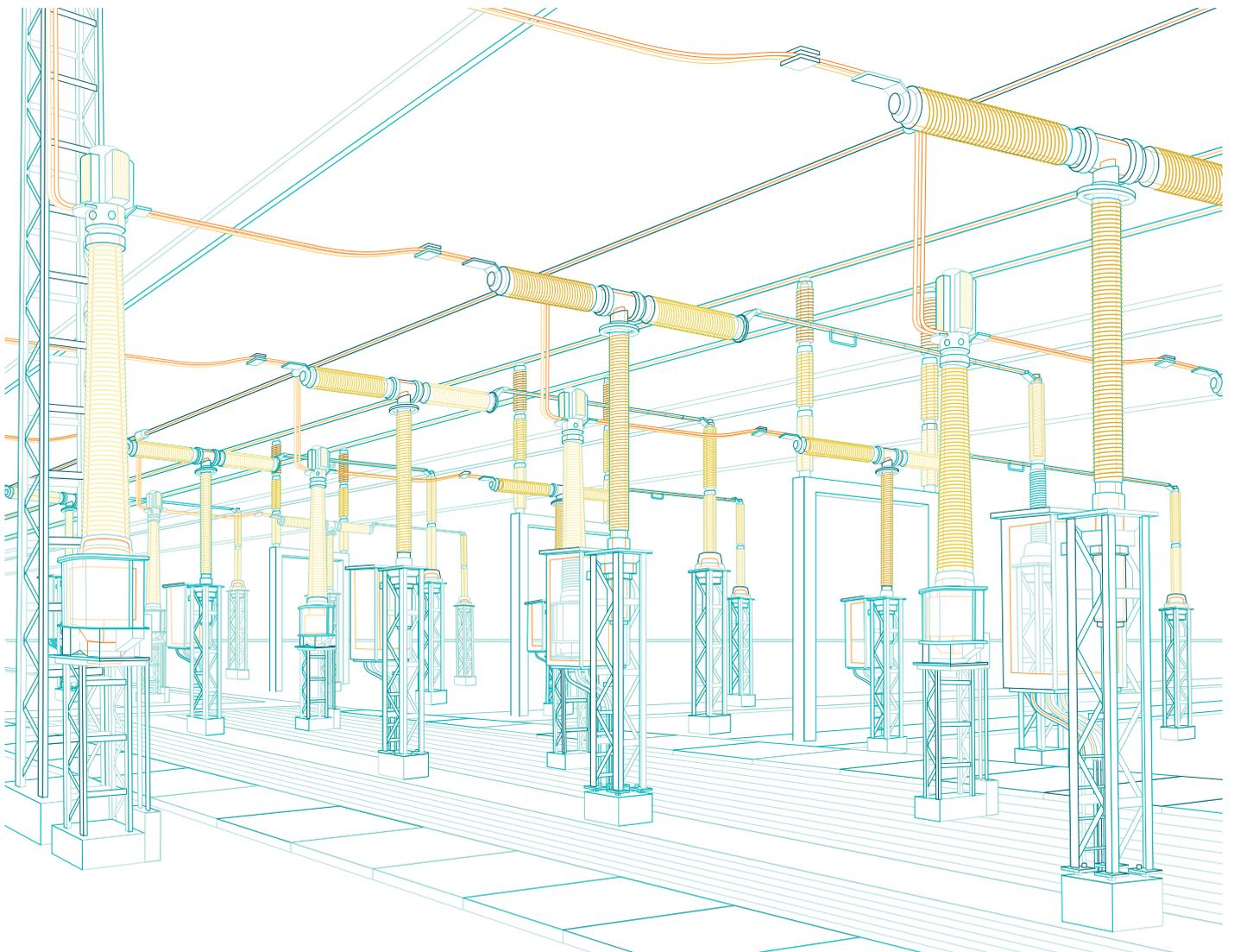
Products

ABB offers a spectrum of high-voltage products at ratings up to 1,100 kV. This includes air-, gas- and hybrid-insulated switchgear solutions, live- and dead-tank circuit breakers, instrument transformers, power capacitors and surge arresters.

These products enhance the reliability, efficiency and quality of power supplies with minimum environmental impact and enable the safe transmission of power at high voltage levels. ABB high-voltage products are supported with a full-range service portfolio.

ABB's medium voltage portfolio includes switchgear, modular systems and equipment for distribution automation, all supported by a global service network. The products serve new project installations and retrofit or upgrades, to extend the life of existing equipment and improve performance. Products are also available for OEMs (original equipment manufacturers) to incorporate into their own installations.

ABB's medium-voltage technologies play an important role in maintaining stability, power quality and efficiency in the distribution network. The products are built to withstand the rigors of the most demanding environments, from offshore and industrial facilities to urban and rural locations.



Transformers are an integral component of the power value chain, from power plants, through transmission and distribution systems and substations, to end-user applications. As the world's leading manufacturer of transformers, ABB produces over 2,000 power transformers and 500,000 distribution transformers every year. With 30 service centers, ABB is also the world's leading transformer service provider.

ABB pioneered the development of commercial transformers in the late 19th century and has continuously improved its transformer technology in terms of efficiency, reliability and durability.

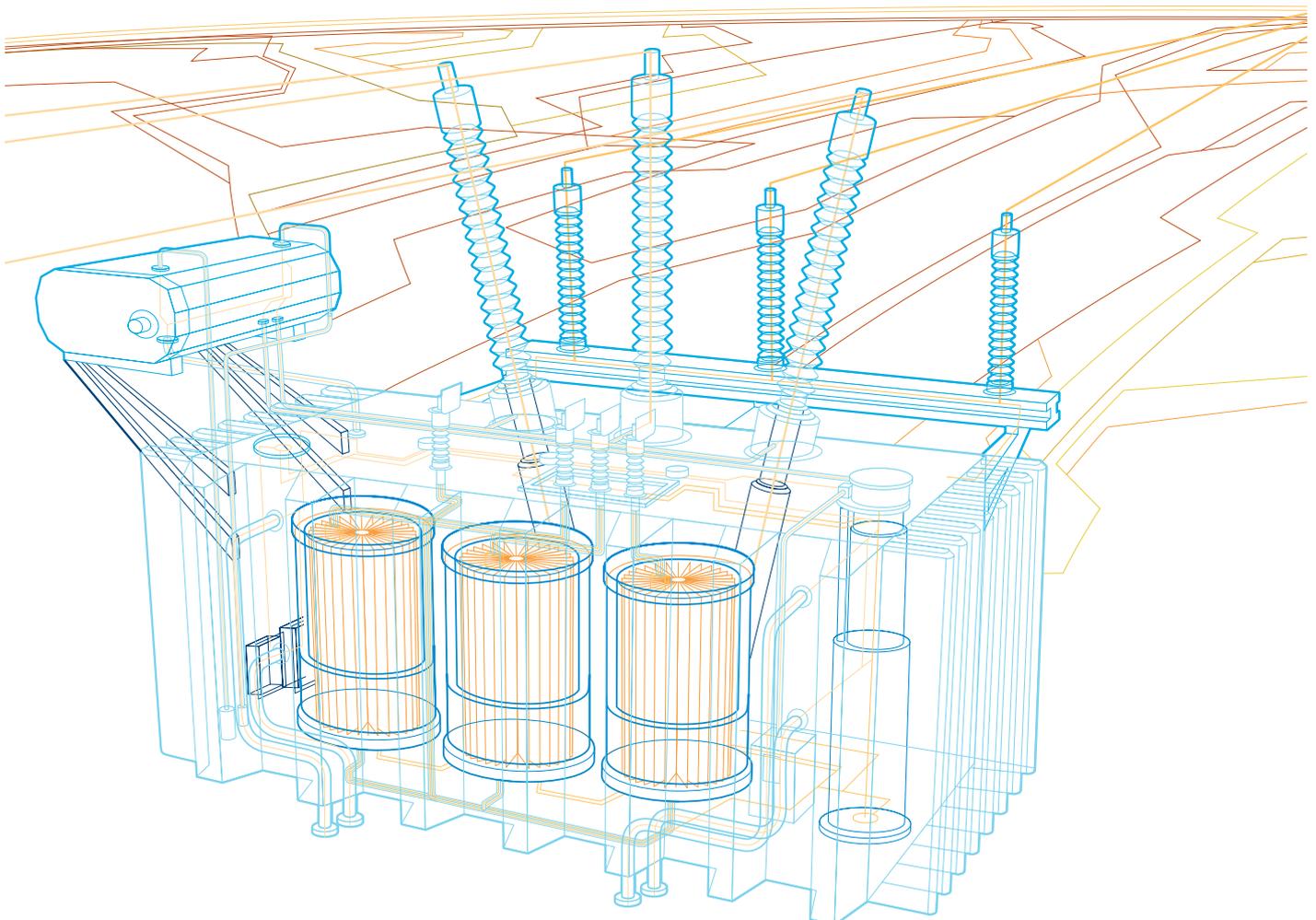
In addition to setting new records in terms of power ratings, ABB's transformer technology achievements include

the world's first 800 kV DC bushings, the world's most efficient subsea transformer (which can operate at depths of up to 3,000 meters); and ultra low-sound transformers for noise-sensitive environments.

ABB has also developed high-efficiency distribution transformers that can reduce energy losses up to 70 percent, and a range of environmentally friendly products including high-efficiency amorphous core transformers and transformers using biodegradable vegetable oil.

Services

ABB's service portfolio includes design and consulting, installation and commissioning, performance optimization and routine maintenance, as well as refurbishments and upgrades.



The evolving world of power

Delivering power and productivity for a better world

ABB constantly strives to enhance efficiency by optimizing power generation and providing reliable power transmission and distribution. In order to maintain our industry-focused expertise and understanding of customer needs, we have corporate research centers in different parts of the world; in Europe, the United States, India and China.

Our engineers and developers are working to maintain a constant flow of ideas and improvements that will enable us to meet the needs of today and tomorrow, through sustainable business practices and environmentally sensitive products.

The power sector is currently witnessing the most significant changes in recent history. We are moving from a centralized, mainly carbon-based and controllable power generation to more distributed, less predictable and less controllable elements that include a larger portion of low-carbon energy sources. This transition brings challenges in terms of renewable integration, reliability, efficiency, and power quality.

Conversely, the ability to manage demand patterns and balance supply with demand is improving as the power system adapts to a multi-directional energy and communication flow. Monitoring systems are becoming more

sophisticated and able to handle complex functions. This evolution will bring flexibility, reliability, more intelligence and the ability to manage power networks effectively.

ABB technologies are addressing the challenge of balancing rising demand for power with increasing concern for the environment. ABB products, systems and service solutions cover the entire value chain from generation, transmission and distribution through to end use, delivering power more efficiently and with lower environmental impact. ABB technologies are playing a central role in the optimization of electricity generation and the evolution of more flexible, reliable and smarter grids.

The use of information technology to improve the intelligence of power systems is increasing. From harnessing and integrating renewables, to software solutions for energy forecasting, planning and enabling demand management to preparing the grid for electric vehicles, ABB offers a vast portfolio of power and automation technologies and remains committed to helping customers to do more with less.

With a 125 year heritage of technology and innovation and a presence in over 100 countries, ABB continues to shape the grid of the future, delivering power and productivity for a better world.

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