Power for the

No industry employing IBEW members has experienced such dramatic change in such a relatively short period of time as electric utilities. In the span of nearly eight years since the passage of the National Energy Policy Act of 1992, utilities have undergone massive restructuring, deregulation and downsizing. Yet the biggest changes for utilities may be yet to come.

The legislative, regulatory and political battles over utility deregulation have been well documented on these pages. The fight over reliability—especially the need for companies to retain a skilled, well-trained work force—has become perhaps the key issue for the IBEW. The question of reliability is central to the Brotherhood's ongoing efforts to ensure that the era of transition for utilities does not create the disruption and widespread displacement that has taken place in other deregulated industries (see "DOE Questions Utility Reliability; IBEW Drives Point Home," page 8 of this issue).

No one can say what the structure of the electric utility industry will be in the next decade. Almost certainly, the identity of companies that generate, transmit and distribute electric power will be different, as is already happening. It also seems clear that some form of customer choice for industrial, commercial and residential users will be in place. In Canada, privatization and restructuring will continue. In the United States, many observers also predict that the push for federal legislation will accelerate some of these changes. The scope and ultimate impact of federal action, however, remains unclear.

Even before the smoke clears on the restructuring front, IBEW members associated with the electric utility industry will deal with many other changes brought about by numerous factors. Technology, the engine that is driving change in virtually every industry, will have an impact. The advent of "distributed generation," i.e., self-contained power sources such as fuel cells in homes and businesses, will affect the way utilities do business. The demand for more efficient energy in both industrialized and developing nations will create new challenges and opportunities. The drive to utilize cleaner sources of fuel will also play its part in shaping the future of power. All of these factors will increase the need for expanded research and development that will alter the face of the industry.

In a world increasingly dependent on technology and the energy to power that technology, IBEW members will be in the midst of a blizzard of change that is to come. The challenge for the IBEW in the future, as it was in the early days of the union, will be to make sure that the industry's workers through the collective bargaining process have a voice in shaping the future.

Distributed Generation

Imagine getting the electricity to power your home not through the power company's wires from a pole but from your own home-based fuel cell. Many industry experts say that the drive for customer choice and concerns over reliability will hasten the widespread use of distributed generation. Small residential fuel cells costing about $2,500 could become commonplace. In larger settings, microturbines will be used to power commercial or industrial

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sites or as part of a generation and distribution system more localized than those currently in place. Distributed generation has a distinct advantage in certain geographical locations because it can be sited close to the end user, which proponents claim is good not only for increased conversion efficiency, but also for reduced delivery infrastructure requirements.

Fuel cells, an important part of distributed technology, are currently under development to power electric vehicles or as stationary generators. Stationary generators can be combined with gas turbines for central station generation. These combined fuel cell-gas turbine plants appear to have the highest conversion efficiency of any known fossil fuel generating cycle—70 percent—making it the lowest in carbon emissions of any fossil power system and extremely attractive for keeping carbon emissions to a minimum.

In addition, proton exchange membrane (PEM) fuel cells are being developed for advanced electric vehicles but could also be used for stationary distributed applications for residences or commercial buildings.

The Worldwide Push For Cleaner Power

In the aftermath of World War II, North America and Western Europe constituted the industrialized world. Now, almost all corners of the globe are participating in an economy that knows no boundaries. With the expansion of the global economy comes the demand for clean, safe, reliable electric power that will challenge the worldwide industry's

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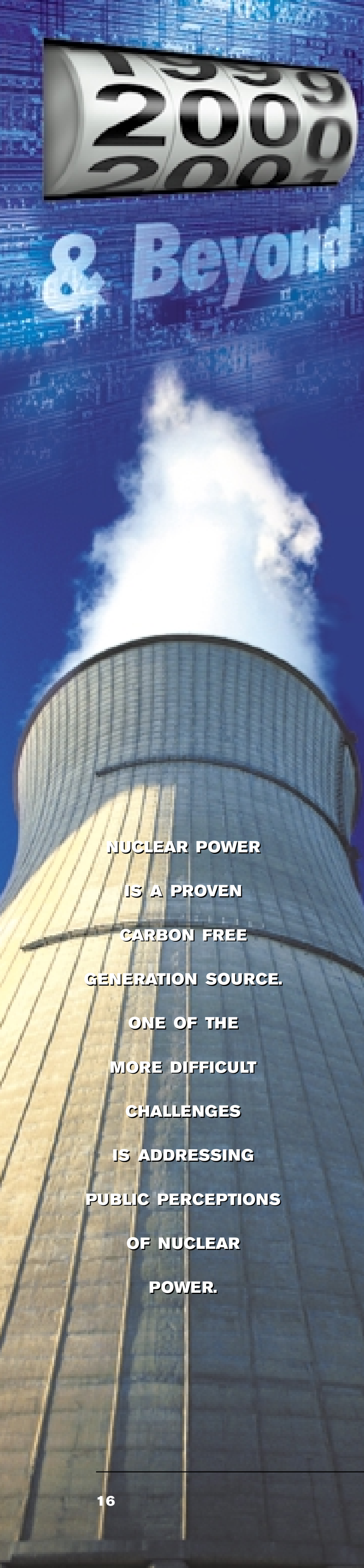

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ability to produce the technology and systems needed to meet that demand.

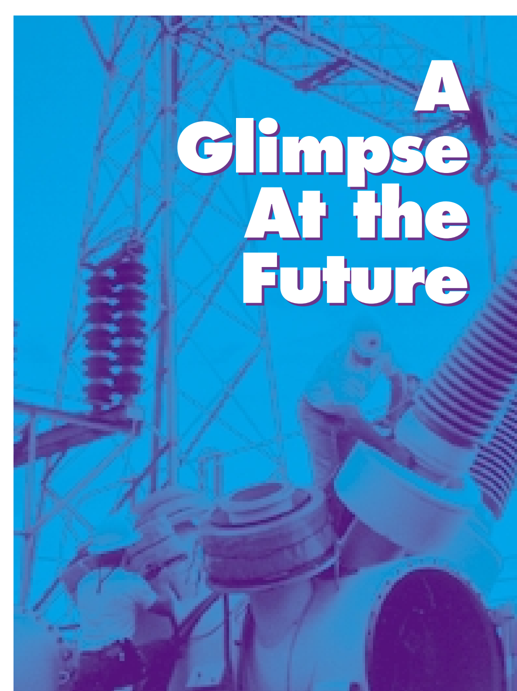
Energizing all the countries around the world will be affected by other factors: population growth, urbanization, expanding global commerce and responsibilities for human welfare. To take these factors into consideration and succeed in universal electrification, the industry will need to open up a balanced portfolio of energy resources and advanced generating technologies, including low carbon emissions and noncarbon technologies, according to the Electric Power Research Institute (EPRI).

A balanced portfolio of energy resources includes at least seven sources of fuel, none of which would have more than a 30 percent share of the market. Over the past 200 years, the world's energy has been dominated by fuels like wood, then coal, oil and natural gas, each with progressively less carbon per unit of energy. More efficient and environmentally advanced technologies will be required to convert fossil fuels to electricity and to capture and sequester carbon. Sequestering carbon is the process of removing carbon dioxide from the atmosphere and converting it into stored compounds. It will be a key component in future energy use.

With this scenario of universal electrification, says the EPRI, a balanced portfolio would include an anticipated use of natural gas for power generation at 20 percent, coal from 10 to 30 percent, oil at 10 percent, nuclear at 15 to 20 percent and renewables (solar, wind, biomass) at 15 to 20 percent. Nuclear power and renewable energy are expected to be an important part of the portfolio, assuming that necessary breakthroughs are achieved in safety, reliability and public acceptance of nuclear plants and the performance and cost of renewables.

Another area of development is advanced coal-refining technology. The U.S. Department of Energy is developing a coal-based technology road map called Vision 21. It includes a coal refinery combining electricity generation, hydrogen separation, chemical production and carbon dioxide sequestration. The approach allows efficient and complete use of coal's total resource value. However, Vision 21 will not be commercially viable before 2020 without major funding for continued research and development.

Among renewables, wind turbines, biomass fuels and solar photovoltaics are becoming more common around the world. Biomass, which includes wood, agricultural, and food processing residues like nut shells, is another renewable resource used in power plants. Wind turbines, biomass and solar photovoltaics are advantageous in rural regions remote from where power can be delivered from a central station rather than being deployed through a power grid.



But again, further resources are needed to pursue breakthroughs in renewables-based technologies.

Nuclear power is a proven carbon free generation source. One of the more difficult challenges is addressing *public perceptions* of nuclear power. But engineering advances are being made in cost, waste handling and against noncommercial use. One potential breakthrough applies nuclear power in a modular high-temperature helium-cooled reactor that combines heat and power. This technology could power the high-efficiency electrolysis of water during off-peak periods, producing hydrogen as a peak generating fuel in advanced gas turbines or as a transportation fuel in fuel cell vehicles. Nuclear power is significantly important for global energy because of our dependency on carbon-based fuels.

Nevertheless, the portfolio of fuels is

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In a survey conducted by the Washington International Energy Group, an energy consulting firm, utility industry senior decision makers gave their views on the future. The report, *2000 Energy Industry Outlook,* predicts future trends for the next five years:

- Customers will choose electricity providers based on new services offering higher quality services like bundled billing and electronic bill paying.
- Increased demand will drive gas prices higher, but competitive pressures could mean little or no change in the delivery price of electricity. This is a view with which the IBEW disagrees.
- Telecom-energy services will be emerging, including automated meter reading, home and business automation, wireless communications and the Internet. People will be able to watch their homes on video, turn on the oven and control energy from their offices. These systems will integrate distributed generating units. Smart cards will be widely used for everything, including buying gas and electricity.
- Since transmission constraints will remain a problem, all transmission owners will belong to a regional transmission operator. Gas transmission will be easier to build, putting generation closer to demand.
- Environmental requirements will be tighter, making it more expensive to burn coal and making nuclear look more attractive.
- Consolidation and convergence will continue unabated. The continuing trend toward fewer and larger generators will accelerate, and distribution service areas will be consolidated. Municipals will contract out their operations and rural cooperatives will be under growing pressure from competition.
- It will be tougher to site new electric and gas lines in urban areas, as downtowns become more attractive places to live, so these areas will rely more on centralized generation.
- Public-private partnerships will become more prolific, as public power plants move to become more competitive through partnering and outsourcing.

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heavily weighted with those that are carbon-based. Even though research into advanced low- and noncarbon energy technologies is being conducted, it may not be sufficient to produce the reductions in carbon dioxide needed to reduce the risk of climate change. The challenge to advance universal electrification through the balanced fuel portfolio, research and development must be funded and expanded. Carbon sequestration technologies need to either capture the carbon dioxide at the point of energy conversion, or remove it from the atmosphere, where it could be stored in carbon sinks such as geological formations, forests and plants or the ocean. Breakthroughs in the basic science and engineering of carbon storage are needed before large-scale, economical sequestration can become a reality.

Mind-Boggling Technology

Computer-driven technology has given us the "smart" home that turns its appliances on and off automatically and "smart" cards that enable us to zip through toll booths while paying electronically. Highly advanced smart materials and systems (SMS) are being developed for several industries, principally aerospace and defense, but emerging SMS could have a major impact on the electricity industry.

Nanotechnology makes SMS that can sense and respond to environmental changes in an automatic, intrinsic way. (See "Nanotechnology: Building Machines from Atoms," *IBEW Journal,* October 1995, p.18.) SMS applications have the potential to reduce maintenance costs and improve plant operations.

Smart materials include conductive polymers, electrorheological fluids that become highly viscous when exposed to an electric field, magnetostrictive materials that change dimension when exposed to magnetic fields and piezoelectric ceramics and polymers that are altered when they come in contact with electric current or that generate current when placed under strain. Other materials like polypeptids, which are biomaterials, contract and expand in response to temperature. There are also chemicals and shape-memory alloys and polymers that revert to an original, undeformed state at a certain temperature. These smart structures are made up of three parts: a sensor, an actuator and a processor. The sensor signals an actuator that modifies the characteristics of the structure.

SMS have potential use in practically every area of power generation and delivery. For instance, fiber optic networks could monitor and assess the condition of rotating equipment and transmission lines 24 hours-a-day, warning of components or locations needing inspection or even triggering self-repair mechanisms. Hydroelectric dams with embedded sensors could sound the alert for internal corrosion and take corrective action.

From sounding an early warning, to applying a temporary fix, to repairing the problem, SMS can exist at several levels. Even though many of these technologies are well-advanced, routine applications for utilities are still many years into the future. Their development, however, will be a major boost toward universal electrification.

SMS can provide early warning of structural deterioration to avoid outages, improve maintenance planning due to real-time condition assessment, control vibration in rotating machinery, noise abatement and provide rapid, automatic response to problems in the system. One application which appears to be feasible is the use of fiber optics on transmission lines for real-time temperature monitoring.

Still, SMS has drawbacks. Each system must be designed for a very specific function. These structures would not be available off-the-shelf and must be designed for specific systems, but all have the potential to improve power delivery efficiency and electric system reliability.

What Does It All Mean?

What are the implications of these factors for the IBEW and its members? Universal electrification will provide tremendous organizing opportunities and produce jobs for electrical workers all around the globe. Since the IBEW greatly influences the industry standard for wages, benefits and working conditions through collective bargaining, organizing drives become crucial to keep and enhance those standards. The potential also exists for the IBEW to set the standards for wages and working conditions beyond the shores of North America.

Industry competition places tremendous pressure on employers to return profits to shareholders. Companies will be forced to respond to public policy changes with structural changes to keep up with the intense competition that results. Employers, as they have already begun to do, will target unions and collective bargaining agreements in order to gain flexibility, efficiency and shareholder value. This will mean more attempts to institute pay-for-performance, outsourcing operations to lowest cost providers, a contingent work force and least-cost strategies as companies jockey for dominant positions in the market. Employers need to be reminded and convinced that IBEW utility workers are as important an asset to industry success as investor and stockholder contributions.

For well-trained and reliable IBEW members, the benefits of new technology bring exciting job opportunities enhancing job security and providing challenges that can turn some low-tech jobs into challenging, precision technical tasks. New job descriptions and virtually new crafts will emerge—a challenge to the IBEW in both bargaining and organizing in order to maintain quality of life for their families and the accustomed high standards for the industry.