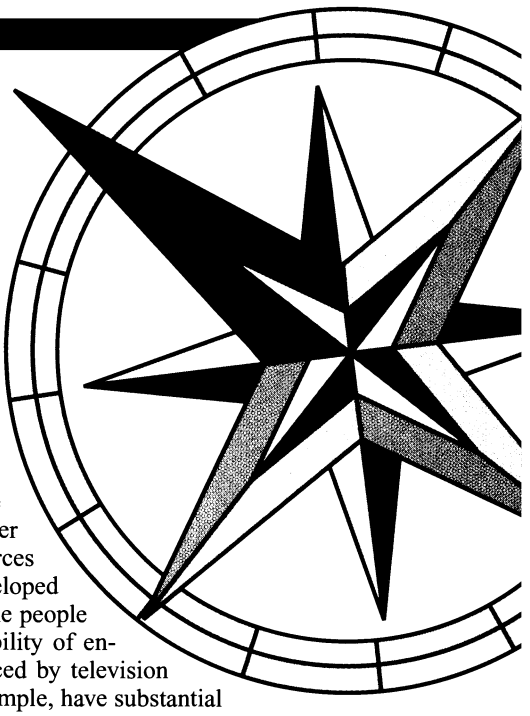

Future Supplies of Electricity

Philip H. Abelson

Electricity has become an essential ingredient of business, industry, and everyday living in the developed countries, and the future trend is toward greater dependence on it.* During this decade, most of the world's electricity will be generated by the combustion of fossil fuels. In the United States (the biggest single consumer of electricity worldwide), the cheapest fuel is coal, from which 57% of power was generated in 1997. Other contributors to the supply were natural gas (9%) and oil (2%). Nonfossil sources included nuclear power (20%) and hydroelectric power (11%).† Other developed countries are also heavily dependent on fossil fuels for power generation. The people of less developed countries have become increasingly aware of the desirability of enhanced availability of reliable electricity. Their opinions have been reinforced by television images, advertisements, and other communications. China and India, for example, have substantial reserves of coal, and have been burning them at an increasing rate to generate more electricity.

It seems more and more likely that higher atmospheric concentrations of greenhouse gases will ultimately lead to the need to drastically curtail releases of CO_2. One strategy would be to embark on greatly expanded generation of electricity from renewable resources and from nuclear reactors. Another strategy would be to develop further techniques for capturing CO_2 and injecting it into long-term sinks, such as permeable formations on the continents or into the deep seas. Even if methods of reducing CO_2 emissions from power plants are economically practical, many years would be required to achieve a substantial result. The complex equipment used to create electricity is costly, and historically 30 to 50 years have passed between major introductions of new equipment. One impediment to change is a lack of U.S. federal support for necessary R&D. Public expenditures on energy R&D have declined by one-third during the past 20 years.

"Electricity has become an essential ingredient..."

Renewable energy has had some support. One of the handicaps of wind power and solar power is intermittent generation. This factor can be minimized through the use of energy storage devices, but the net effect is to increase the true cost of wind and solar power. These sources of electricity are also facing strong economic competition from very efficient equipment powered by natural gas. Those power generators can be located close to major customers, avoiding power transmittal losses. Air pollution is minimal, and emissions of CO_2 per kilowatt hour are less than those from coal-fired equipment.

The potential availability of cheaper power has led to the deregulation of electric utilities. Entrepreneurs are able to use existing transmission lines to deliver electricity to the highest bidder. About half of all U.S. electricity generation is now sold on the wholesale market before it reaches customers. Much of this power travels long distances between source and user. Growth in these activities comes at a time when many parts of the North American transmission system are already operating close to their limits.‡ If the United States and the rest of the world are to have a sustainable and prosperous future, numerous steps must be taken. Many of them will involve changes in the means of generating and distributing electricity. The Electric Power Research Institute (EPRI) in the United States has been a key agent in organizing a continuing exploration of goals and the means of achieving them. It has sought the advice and assistance of more than 150 major U.S. stakeholder organizations, who have identified future-oriented policies and have detailed research opportunities and the costs of exploiting them.§ In total, the proposals call for a rapid increase in annual U.S. R&D expenditures from $3.1 billion to $7.7 billion. In comparison to the nation's gross domestic product, this sum is tiny.

The suggestions of these stakeholders are many and constructive. They include R&D to decrease the cost of renewable power; the development of hydrogen fuel cells that generate competitive electricity; safe and cheaper nuclear power; and electronic control of the supply, transmission, and delivery of reliable electricity. As a means of preparing for a drastically different future, the proposed program is worthy of serious consideration.

Electricity Technology Roadmap: 1999 Summary and Synthesis* (EPRI, Palo Alto, CA, 1999), p. 1. †*Electricity Technology Roadmap: Electricity Supply* (EPRI, Palo Alto, CA, 1999), fig. 2-1. ‡*Interim Report of the U.S. Department of Energy's Outage Study Team: Findings from the Summer of 1999* (U.S Department of Energy, Washington, DC, 1999). §*EPRI J.* **Fall 1999, 17 (1999).