The CEO SERIES

Business Leaders: Thought and Action

Technology for the New Millennium

An Original Essay Written for CSAB

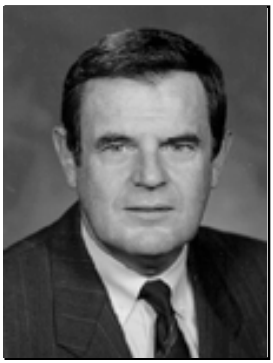
by John F. Smith Jr.
Chairman
General Motors Corporation

CEO Series Issue No. 41
July 2000

Center for the Study of American Business
Washington University in St. Louis

Technology for the New Millennium

by John F. Smith Jr.



John F. Smith Jr.

By now, most of the world recognizes the essential role of advanced technology in responding to concerns about climate change. Yet disagreements over the science, economics, and feasibility of the Kyoto Protocol have prevented us from doing little more than recognizing the need for advanced technologies. We have yet to develop and apply such breakthrough technologies that would reduce or sequester greenhouse gas emissions without imposing serious economic harm on developed and developing nations alike.

A recent report, however, notes encouragingly: "Both environmentalists and industry predict that this year could prove to be a turning point in the debate..."[1] There are fewer debates over the science of climate change, with industry increasingly recognizing that there is cause for concern and a need to take effective actions to address this concern.

There are also fewer debates over the Kyoto Protocol, with governments and non-governmental organizations increasingly recognizing that the Protocol is not an effective instrument of public policy for addressing these concerns. In short, we have a more constructive dialogue focused on the need for alternative responses to the concerns about climate change. This is real progress.

I am optimistic that constructive dialogue will take us beyond recognition of the essential role that technology must play in responding to concerns about climate change. This dialogue needs to take us to an examination of the

---

John F. Smith Jr. is chairman of General Motors Corporation. He retired as chief executive officer on June 1, 2000.

technology development and implementation process; to a better understanding of the roles of the private and public sectors in the development of new technology; and to policies and initiatives that will accelerate the development, commercialization, and global diffusion of the needed technologies.

Technology Development in the Private Sector

Corporate executives are confronting critical technology decisions today that will affect the nation's ability to meet the environmental and economic needs of the new millennium. Conflicting signals from the market and the environment make technology choices unusually difficult. Further compounding these difficulties is the fact that neither set of signals is complete. Market signals do not capture important "externalities," such as the risk of global warming created by rising concentrations of greenhouse gases in the atmosphere. Environmental signals exclude the "opportunity costs" of allocating limited resources to environmental goals, such as slower economic growth.

Conflicting signals from the market and the environment make technology choices unusually difficult.

Corporate decision makers know they must pursue technology strategies that will meet the demands of the market as well as the needs of the environment to succeed—it is not an either-or proposition.

The clearest signal from the market is that traditional fossil fuels will be in abundant supply and cheap for the foreseeable future. Long-term forecasts (15-20 years) of future oil prices are in the $20 per barrel range after adjusting for inflation, not the $100 per barrel range predicted in the 1970s. One observer writes: "In light of this, the gravest prediction yet regarding the future of oil may not be its impending shortfall, but its unimaginable bounty."[2]

The worldwide demand for energy will double by 2030,

driven largely by growth in developing countries. Fossil fuels, which account for 85 percent of today's energy supplies, will account for 87 percent in 2030, with some shifting from coal and oil to natural gas.

The abundance, low cost, and growing demand for traditional energy supplies has critical implications for technology choices in the private sector. First, there is little consumer demand or market pull for alternative technologies that are often more costly, and less functional and reliable than traditional fossil fuels.

With cheap and abundant energy, energy efficiency often ranks low in the factors important to consumers when they purchase a new appliance, home, or motor vehicle. For example, automobiles that ranked in the top ten in fuel economy accounted for only 1.6 percent of the 7.4 million 1998 model-year cars sold in the U.S. Only 0.6 percent of the 6.7 million sport utilities, pickup trucks, and minivans sold in the U.S. ranked in the top ten in fuel economy—35,000 out of the 6.7 million sold.

There has been a decline in private and public expenditures for energy research in most OECD nations, despite rising environmental concerns.

There has been a decline in private and public expenditures for energy research in most OECD nations (Japan being the major exception), despite rising environmental concerns. This also attests to the lack of market pull for alternative energy technologies.

Consumer behavior, lifestyles, investments, and future expectations, especially in the U.S., have all been firmly rooted in traditional, low-cost energy technologies. Any transition to alternative energy technologies would thus create substantial economic and social disruption.

Finally, the world is wired for oil. Any alternative energy technology that requires new infrastructure is at a huge cost, convenience, and reliability disadvantage relative to fossil fuels.

While fossil fuels are the technology choice of the market, concerns about the risk of global warming from the

accumulation of carbon dioxide in the atmosphere from the combustion of fossil fuels sends strong environmental signals for technologies that are more energy efficient and less carbon intensive. These technologies include alternative fuels, hydrogen fuel cells, and renewable energy sources such as solar, wind, and hydropower.

The bottom line is that there is a large gulf between the market signals that drive individual consumer choices for traditional, low-cost energy technologies and the technologies needed to address society's collective concerns for the environment. This schism places corporate decision makers between the proverbial rock and a hard place. They know success requires them to meet both the individual needs of consumers and the collective needs of society.

I believe the only realistic technology strategy is to continue to improve traditional fossil-fuel technologies to meet current consumer demands while simultaneously investing heavily in more environmentally-friendly technologies for which there is little market demand or economic incentive, but that ultimately will prove competitive with fossil fuels.

For example, automobile producers must meet today's consumer demands for larger, safer, more powerful, functional, and affordable vehicles to remain viable in an intensely competitive global industry. At the same time, they are investing billions in advanced vehicle technologies to build vehicles that will meet future consumer and societal needs.

Automakers are actually pursuing a three-prong technology strategy to meet both individual needs for personal mobility and society's collective needs for environmental preservation.

Improvements in fuel economy will continue with the implementation of *conventional technologies* such as reductions in vehicle mass through greater use of lightweight materials, improved aerodynamic drag, and further reductions in tire rolling resistance and engine friction.

Further improvements will come from promising *advanced-conventional technologies*, including direct injection; stratified charge gasoline and compression ignition engines; continuously variable transmissions; and vehicle struc-

tures incorporating greater use of aluminum and polymer composites.

Research on *advanced vehicle technologies* includes alternative-fuel vehicles; electric vehicles; hybrid vehicles that operate with small gasoline or diesel engines and electric batteries; and fuel-cell vehicles powered by hydrogen stored on board or reformed on board from methanol or gasoline. Alternative fuel, electric, and hybrid vehicles are on the market today in limited volumes. Concept vehicles operating on fuel cells have been developed and demonstration vehicles are on the road. Production-readiness should be achieved within this decade.

The auto industry is investing billions of dollars because of the great potential of these advanced technology vehicles. Many complex problems must be overcome, however, to bring these vehicles to market in large volumes. For example, while fuel-cell vehicles have great potential, and substantial technical progress is being made (e.g., starting at sub-zero temperatures), huge challenges of cost, technology, and infrastructure remain. Costs are still high relative to conventional gasoline-powered vehicles, and serious safety issues in the production, distribution, and use of hydrogen must be resolved. Storing hydrogen in solid form is another daunting technical challenge for the industry. A hydrogen-based transportation system would also require an investment of one trillion dollars or more to bring fuel to the consumer safely, economically, and reliably.

The auto industry is investing billions of dollars because of the great potential of these advanced technology vehicles.

A substantial transition to a hydrogen or other technology base could thus occur only over decades. Advanced technology vehicles will coexist with gasoline-powered vehicles for many years. With over 200 million conventional vehicles on the road today in the U.S., and the average life of a new vehicle approaching 15 years, the fleet does not turn over rapidly even with high-volume sales of advanced technology vehicles.

Automakers must invest in this full spectrum of advanced vehicle technologies because it is just as impossible today to predict which technologies will prove successful as it was at the turn of the century, when gasoline-powered vehicles competed with steam and electric vehicles and the much-maligned horse. Substantial international differences in motor vehicle demand, driving conditions, and government transportation and environmental policies also create opportunities for different technologies in different markets, and for multiple technologies for specific niche markets.

This multiple technology strategy exposes corporate decision makers to both great business and political risks. Implementation requires a delicate balancing act that gives rise to more than a little corporate schizophrenia. The consequences of failing to meet both environmental and market needs can be severe, as illustrated by the auto industry's experience with electric vehicle technology. These zero-emissions vehicles represent impressive technological achievements, and their high cost is subsidized by the manufacturers and by government tax incentives. Nevertheless, fewer than 2,000 have been sold or leased in the past three years because the vehicles do not meet all consumer expectations.

It is just as impossible today to predict which technologies will prove successful as it was at the turn of the century.

Public Policies to Promote Technology

Because of the limited market pull for alternative energy technologies in a world of abundant fossil fuels; the great business and political risks companies face in pursuing multiple technologies to meet the individual needs of the consumer and the collective needs of society; and the infrastructure challenges in a world wired for oil, it is essential that public policies support technology development in the private sector.

A number of public policies are aimed at promoting the new technologies needed to respond to concerns about global climate change. The Partnership for a New Generation of Vehicles was created in 1993 as a joint public-private collaboration of the federal government and General Motors, Ford, and DaimlerChrysler. The goal of the collaboration is to develop vehicles that achieve fuel economies up to three times (80 mpg) those of comparable 1994 family sedans without sacrificing performance, size, utility, or affordability.

The administration's climate change budget for 2001 includes over $4 billion, most of which is for technological and scientific research. The Murkowski-Hagel Bill (S.882) proposes spending $2 billion over 10 years to accelerate the development of new technology that would reduce or sequester greenhouse gas emissions. The primary instrument of public policy for addressing concerns about global climate change, however, is the Kyoto Protocol adopted in December 1997.

A number of public policies are aimed at promoting the new technologies needed to respond to concerns about global climate change.

If ratified and entered into force, the Protocol would mandate the 38 developed countries, in aggregate, to reduce greenhouse gas emissions 5 percent below 1990 levels by 2008-12. The U.S. target is 7 percent below 1990 emissions levels. With expected economic growth, the U.S. would be required to cut its emissions more than 30 percent below the business-as-usual forecast for 2008-12 to meet its target.

The Protocol is mired in international controversy. Many elements of the Protocol are unsettled and hotly debated, including the Clean Development Mechanism, Joint Implementation, emissions trading, supplementarity, compensation, global participation, national sovereignty, leakage, monitoring, enforcement, liability, penalties, credits, and sequestration. I'll not attempt to address these issues here. My fundamental concern is that the Kyoto Protocol does not promote the development, commercial-

ization, or global diffusion of the advanced technologies universally recognized as essential to addressing concerns about climate change. Indeed, the Protocol is more likely to impede the development of the very technologies that are needed.

A recent study by The Business Roundtable, *The Role of Technology in Responding to Concerns About Global Climate Change*, concluded: "The Kyoto Protocol provides neither the time nor the appropriate policy environment to develop, commercialize on a large scale and disseminate worldwide the innovative energy technologies that would be needed to make such large reductions in greenhouse-gas emissions without serious harm to the world's economy."

The study also concluded, "Technology and innovation simply cannot be mandated." Scheduling next month's auto production is one thing; attempting to schedule invention and innovation is quite another. Mandating technology and imposing arbitrary targets and timetables on its development only ensures a myopic search for short-term fixes that come at the expense of real innovation. Most importantly, short-term fixes do not advance the technological foundations needed to address long-term environmental concerns.

The Kyoto Protocol is more likely to impede the development of the very technologies that are needed.

Effective public policies for addressing concerns about global climate change must be focused squarely on accelerating the development, commercialization, and global diffusion of advanced technology. A broad outline of public policies that would accelerate technology development includes:

- Building a strong national consensus behind public policies that promote long-term research, innovative technology, and sustained capital investment.

- Providing incentives for basic research on technologies that contribute to climate change and other environmental goals.
- Creating public-private partnerships and global collaborations to stimulate technology development and implementation.
- Eliminating impediments to innovation and accelerating the flow of technology from the National Labs to the private sector.
- Facilitating the commercialization of new technologies through demonstration initiatives, purchase incentives, consumer education, and investments in infrastructure.
- Accelerating global technology transfer by orienting international assistance programs toward advanced technology projects; eliminating trade restrictions that impede technology flows; and building the physical, technical, and managerial capacity in developing nations that would enable them to assess, implement, and maintain advanced technology systems.

The technological potential of the private and public research laboratories across this country and around the globe has never been greater.

The business community also has a responsibility to undertake initiatives to promote advanced technology. In this spirit, General Motors is participating with The Business Roundtable on two promising initiatives. The first is an effort to identify opportunities for accelerating technology development by improving regulatory, tax, trade, market, and other policies that, as an unintended consequence, impede the development, introduction, or global diffusion of new technology. Working closely with government, it is hoped that many unintended impediments to the development and implementation of new technology can be eliminated.

The Business Roundtable will also convene this year a National Summit on Technology that will bring together technology experts from industry, the National Laboratories and leading research universities to discuss effective technology policy for the twenty-first century, and to explore improved mechanisms, systems, structures, and innovative partnerships for accelerating the development and transfer of new technology from the public sector to the private marketplace.

Summary and Conclusions

Technological innovation is at the core of both the success of the twentieth century and the promise of the twenty-first. It is easy to exaggerate its importance in the short run, but difficult to overestimate it in the long run.

The technological potential of the private and public research laboratories across this country and around the globe has never been greater. Exciting technologies are on the horizon in virtually every sector of the economy—from smart machines to smart buildings to smart ships to smart automobiles to drive and smart highways to drive them on. Thus, there is every reason for optimism.

Public policy should be inspired by this enormous technological potential, and motivated by the pressing human needs of a growing world population. But, realizing this potential requires supportive public policies that are long-term and global; that unify the nation; and that marshal the resources to accelerate the development, commercialization, and global diffusion of the advanced technologies that are needed to meet the environmental, energy, and economic challenges of the new millennium.

Notes

1 "Paving the Way for Common Ground," *Inside EPA Weekly*, vol. 21, no. 10 (March 10, 2000).

2 "Why We'll Never Run Out of Oil," *Discover,* June 1999, p. 86.

The Center for the Study of American Business is a nonprofit, nonpartisan organization, funded entirely by grants from foundations, business firms, and private citizens. It is an integral unit of Washington University. The opinions expressed herein are those of the author and do not necessarily reflect the position of the Center or Washington University. Address inquiries to: Center for the Study of American Business, Washington University, Campus Box 1027, One Brookings Dr., St. Louis, MO 63130-4899, (314) 935-5630, http://csab.wustl.edu.