2 Science and Technology in the Bush Administration

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The Bush Administration is committed to changing the way things are done in Washington. Fundamental to this effort is our commitment to be candid with the American people about our national challenges. We have major national challenges in dealing with our economy and our national energy situation, and in protecting our environment. They are interrelated, and success will require creativity as well as a willingness to confront facts and avoid ideologies and preconceptions.

We all know that scientific research lies behind our nation's long-term economic success. Good science is also the key to both defining and addressing many of the great policy challenges facing our country. Ultimately it will belong to the scientists to lay the foundation for new technologies and increase our understanding of the world around us. Their work will enable our nation to address these important policy challenges.

During the campaign, then-Governor Bush spoke of energy as a storm cloud forming over the economy. America's reliance on energy had continued to grow, but its supply had not kept pace. We now know the consequences. A few years ago, many people had never heard the term "rolling blackout." Now everybody in California, and across the country, knows the term all too well. The rest of America is starting to wonder when these rolling blackouts might roll over them.

It is only reasonable for Americans to ask if California is once again foretelling a national trend. Throughout the country, we have seen sharp

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increases in fuel prices, from home heating oil to gasoline. In parts of the Northeast, communities face the possibility of electricity shortages this summer. Energy costs as a share of household expenses have been rising, and families are feeling the pinch.

Similarly, we confront a potentially major challenge in human effects on the global climate. We also face the need to improve the quality of the air we breathe and the water we drink. But without a clear, coherent energy strategy for the nation based on hard data and sound science, all Americans could one day go through what Californians are experiencing now, or even worse.

As the situation in California now makes clear, the absence of such a strategy means we will neither have energy nor a clean environment. We know, for example, that less efficient and more polluting generators will be used to provide needed electricity this summer than would have been the case had adequate planning taken place. We know that fish and wildlife, which depend upon adequate water sources, will have less water because of the California energy crunch.

It is inaction that forces us to choose between energy and the environment. It is careful planning and maximum use of science and technology innovations that allow us both the energy we need and the clean environment we have a responsibility to protect.

Most decisions in government are interdisciplinary in nature, and bringing them together can be a source of enormous frustration for the scientist, the economist, or the businessperson when he or she enters the public sector. I have been privileged to have enjoyed a variety of career paths, having continuously rotated among jobs in academia, the private sector, and government. What is always striking to me when I shift jobs is the change in vocabulary that goes along with it. For example, the meaning of the term "cost-benefit analysis" varies as one shifts from teaching economics to working in business, and changes again when one enters government. The same is true of the term "sound science."

This confusion only begins with language. The fundamental objectives of academic, business, and public sector decision making are different. This means that different questions are asked and different issues are considered important. Someone steeped in one paradigm would naturally be puzzled by the decision-making processes used in a different paradigm. Worse, these differences are magnified when those in positions of influence—the press and public officials for example—fail to understand any of these paradigms, and instead operate under their own paradigm that exploits every possible appearance of controversy.

The result is widespread public confusion and misinformation, which ultimately makes sound decision making in the public sector more difficult.

This situation has been years in the making; it will take years to overcome. In January 2001, President Bush directed the Vice President to form a Cabinet-level task force to recommend a new national energy strategy. In March, he ordered the creation of a Cabinet-level group to work on global climate change. The meetings of both groups are "principals only." This means that the decisions of the group are not going to be part of a bureaucratic process of give-and-take, where the language of the least common denominator prevails. The members of both groups are senior decision-makers of this Administration. They are the ones who are accountable to the President, the Congress, and the public for rendering their best judgment. These issues are not being relegated to some nameless and faceless bureaucrat or to some ill-defined "process." Far from putting difficult decisions on some back burner, the President has put these issues at the top of the menu. To my knowledge, there has never been such a commitment of so many of the top decision-makers in the executive branch to any policy working group.

One of the best attributes of these high-level groups is the diversity of backgrounds in their membership. As a result, these groups are a natural for discussing the interdisciplinary nature of the challenges of formulating a national energy strategy and studying the issue of global climate change. The first step in our process has been to go back to school. We have been meeting with some of the leading experts in the country on these subjects, listening to their analyses, reading what they have written, and questioning them. This is a process that speaks of seriousness and concern about the need to craft the right long-term solution.

One cannot stress enough the interdisciplinary nature of determining appropriate public policy regarding energy and the environment. Obviously, economics and engineering are involved in the process. But so too are physics, biology, chemistry, and environmental science, and since we are talking about public policy, both law and political science are invaluable.

To some the task of providing energy and economic growth is incompatible with preserving a clean environment. But the data suggest that science, technology, and sound economic and public policy do make both possible. Since 1973, the U.S. economy has grown four times faster than our energy use. If we had continued to use energy as intensively as we did in 1970, last year we would have consumed over 168 quadrillion BTUs (British thermal units), compared to the 94 quadrillion actually

consumed. That 74 quadrillion BTUs difference is the equivalent of 1,350 (1,000 megawatts) power plants.

Historically, U.S. carbon dioxide emissions have grown at less than half the rate of the Gross Domestic Product (GDP). In recent years, however, very robust growth in the nation's GDP has been accompanied by a slowdown in the growth of greenhouse gas emissions. In both 1998 and 1999, U.S. GDP grew by more than four percent each year while carbon dioxide emissions grew by less than 0.15 percent per year and was 1.3 percent in 1999. In addition, the overall carbon dioxide intensity of the U.S. economy (that is, the amount of carbon dioxide emitted per unit of GDP) declined by 15 percent over the course of the 1990s.

Our success in reducing other, more immediately health-threatening emissions has been even greater. Since 1970, for example, the economy has grown nearly 125 percent. But our emission of sulfur oxides is down 36 percent, and we have 98 percent less lead in our air. We have cut nitrous oxide emissions almost in half per unit of GDP.

These successes are due to major improvements in technology. For example, technology has already led to significant reductions in pollution from coal-fired plants. Today, emission scrubbers can reduce the amount of sulfur dioxide emitted by over 90 percent. Coal currently provides half of all the fuel for electricity generation in this country and will, of necessity, play an important role for decades to come.

But, further progress is still possible. Two-thirds of the energy used in a conventional coal-fired power plant is wasted in the production of electricity. These losses can be minimized through a number of innovations, including installing high-efficiency steam turbines, reducing steam leaks, and using software to optimize combustion efficiency. New coal-burning power plants can achieve efficiencies of over 40 percent using existing technology. And companies are investing in the search for even more efficient technologies. In addition, wasted energy can be recycled for use in industrial processes or for heating buildings. A family of technologies known as "combined heat and power" can achieve efficiencies of 80 percent or more.

Technology also allows us to make efficient improvements in our use of energy on the demand side. For example, advanced sensors and controls enable buildings and factories to be operated more efficiently, allowing equipment and lights to be turned off or dimmed when not in use. These technologies are already being offered in the marketplace. Energy management companies now offer their services to reduce de-

mand for energy by final users, and tie their profits to the energy fees being charged.

New technologies are allowing the market to work even better. One clear example is time-of-day pricing. For any locality, optimal electricity generation is a diversified affair. High capital, low fuel-intense plants provide the base of production while low capital, high fuel-intense technologies provide peak generating capacity. The former are less polluting, but inefficient to operate on a peak-power only basis. Time-of-day pricing provides consumers an incentive to smooth out their electricity use, thereby minimizing the need for peak power production. Improvements in metering technologies allow a greater use of time-of-day pricing.

We can obtain the same type of improvements in energy efficiency by a more interconnected electric grid and more efficient electricity markets to fill those grids. These changes will require both technological and regulatory improvements to succeed. Furthermore, the lack of interconnection standards or guidelines for electricity supply impede the use of distributed energy technologies and load management techniques. As a result, developers of small, renewable energy projects must negotiate interconnection agreements on a site-by-site basis with local distribution companies, which are often opposed to distributed generation projects because of increased competition.

The list of potential gains from technology goes on and on. No doubt, some yet-to-be-developed technology will provide us with an even cleaner environment. The key point is not the individual technologies involved, but the fact that science and technology play a key role in making our lives better and our environment cleaner.

Let me add to that an economic fact of life: Science and technology, as well as the environment, prosper in a growing economy. Prosperity allows us to commit ever-increasing resources to cleaning up our environment and to developing the science and technology that will lead to future economic growth and environmental improvements. This is not principally the case for making larger commitments of public sector resources that are made possible by larger tax collections from a bigger economy. In fact, the great majority of scientific and technological advances and their applications take place in the private sector.

We can look at a bit of financial math. Currently, the average annual real rate of return on corporate investment in America is about nine percent. That includes both plant and equipment investment as well as investment in research and development. A stream of research that yields

a nine percent return over a long period of time literally makes dreams come true. Stated simply, a nine percent return over a century in a new technology will lower the cost of doing something by a factor of 5,000. For example, Dennis Tito paid the Russians $20 million to be the first tourist in space. Given nine percent returns, the cost of a similar vacation in space in the year 2100 will be around $4,000 (in current dollars), a bit less than the current round-trip business class airfare from New York to London.

Similar investments over the previous century have brought down the cost of many products—from light bulbs to space flight. In 1900, a light bulb cost roughly $20 in today's money; today it costs 40 cents, lasts at least ten times longer, and uses a fraction of the electricity to generate the same amount of candlepower.

The benefits of actual technological change are even greater. One modern 100-watt incandescent bulb burning for three hours each night would produce 1.5 million lumen-hours of light per year. Today, it costs a worker making $30,000 per year about 40 minutes of labor to pay for the needed energy and light bulbs for the year. In the last century—before electricity—obtaining this amount of light would have required burning 17,000 candles, and the average worker would have had to toil almost 1,000 hours to earn the dollars to buy the candles.

Or consider space flight. Of course, this technology was impossible a century ago, but even 40 years ago, when President Kennedy assigned us the task of "sending a man to the moon and returning him safely to Earth," such a task was enormously expensive. The budget of the National Aeronautics and Space Administration (NASA) during much of the 1960s consumed nearly one percent of GDP, the equivalent of almost $80 billion per year today, and it took almost a decade of such spending to accomplish that task. Today, the entire NASA budget is just $13 billion.

This financial math is important when considering some of the biggest environmental challenges we face today. When confronting long-term challenges—and the environment is certainly one of these—investing in the research and development of new technologies, with actual applications decades in the future, is far more cost-effective than trying to continue with existing technologies.

The Kyoto Protocol

It is for precisely this reason that the Administration opposes the Kyoto Protocol to the United Nations Framework Convention on Climate Change. We believe the Kyoto Protocol could damage our collective prosperity and, in so doing, actually put our long-term environmental health at risk. Fundamentally, we believe that the Protocol will fail to significantly reduce the long-term risks posed by climate change and, in the short run, will seriously impede our ability to meet our energy needs and economic growth. Further, by imposing high regulatory and economic costs, it may actually reduce our capacity to find innovative ways out of the environmental consequences of global warming and to achieve the necessary increases in energy production.

First, consider the supposed benefits of the Protocol. Under the terms of the agreement, the estimated level of greenhouse gases expected in the year 2010 will instead be put off by a little over a decade. Few of the developed nations who say they support the treaty have, in fact, undertaken domestic policies to lend credibility to the assertion that they will meet the Protocol's targets. The two leading exceptions are Britain and Germany. In Britain's case, abandoning the intensive use of coal and switching to the use of new natural gas discoveries made the conversion fairly easy. In Germany's case, including the industrial base of the former East Germany in the treaty's 1990 base year made attainment easy. It would have been cost-effective to shut down much of East Germany's highly polluting electricity generation even without the treaty. Looking at the other nations, attaining the treaty's goals is not realistic. A further 27 percent reduction by Japan and a 22 percent reduction by Canada are as unlikely as the 30 percent reduction by the United States from its projected 2010 levels.

A large problem of the Kyoto Protocol is its lack of inclusiveness. Much of the projected growth in greenhouse gas emissions is likely to come from the developing world. How one deals with this issue is crucial to increasing the quality of life for the great majority of people on this planet and for controlling global warming.

It should also be noted that the Protocol does little to promote investment in new technologies even though these advances offer the greatest long-term potential reward in terms of both reducing the effects of global warming and raising the quality of life on the planet. Recall that technological solutions are most likely to succeed if investment and research are allowed to take place over a long period of time. The Kyoto

Protocol, by requiring dramatic up-front reductions in greenhouse gas emissions by those countries with the greatest ability to do such research, turns this on its head. The Protocol makes innovation largely irrelevant by imposing onerous restrictions before technological solutions can be developed. It compounds this problem by making no requirements for reducing greenhouse gas emissions over a much longer term or for mitigating the environmental effects of global warming.

Indeed, while the degree of uncertainty now associated with the science of global warming suggests some modesty about the degree of certainty attached to any action, the treaty requires that the United States and other advanced nations commit enormous amounts of resources to the project. These resources must be expended today, when uncertainty is high, while little is required in the distant future, when uncertainty might be significantly lower.

A Clinton Administration study estimated that the Kyoto Protocol would involve costs of between 0.6 percent and four percent of GDP. Electricity prices would run anywhere between 20 and 86 percent higher than current levels. Gas prices would increase between 14 and 66 cents per gallon. In light of the very limited environmental benefits, a commitment as structured as this is not prudent.

Worse, the Protocol goes out of its way to raise these costs. This anti-economic reasoning involves treaty-imposed inflexibility in allowing the use of a number of creative options. As a practical matter, proponents of the Protocol have worked against such promising solutions as reforestation and more sensible agricultural land use that would likely provide enormous quality of life externalities for people on all parts of the planet. We should not exclude these options from consideration.

It is natural that the United States government would object to a treaty that requires twice as much reduction in emissions from the United States as from Europe and Japan combined. This is not a judgment of the Bush Administration, but reflects a long-standing view of the political process. In 1997, the Senate approved a resolution by a vote of 95-0 to not ratify the Kyoto agreement in its present form. In last year's presidential election, neither party platform supported ratification of the Kyoto Protocol.

We oppose this failed attempt at negotiating a solution to the problem of excessive emissions of greenhouse gases. Sound public policy should encourage efficiency, not dictate austerity by telling families and businesspeople to restrict the efficient use of energy. While our plan

reduces wasteful use of energy, it does not seek to shrink our economy or lower our living standards. People work very hard to get where they are. And the hardest working are the least likely to go around squandering energy, or anything else that costs them money. Our strategy will recognize that the present crisis does not represent a failing of the American people.

Conclusion

To speak exclusively of conservation, environmental protection, or increased energy production, is to duck responsibility for all the consequences of what one proposes. Sound, comprehensive energy, economic, and climate change policies require that we focus on multiple objectives. Happily, if we make the right decisions today and establish an environment where innovation can flourish, these objectives are achievable and mutually reinforcing. America's energy and environmental challenges are serious, but not insurmountable. Most importantly, it is impossible to understate the role that science and technology will play in solving these problems.

The bad news is that our short-term energy problems are likely to get worse before they get better. The good news is that America has a new leader who is strongly committed to long-term, responsible, and effective reforms that will improve both the environment and our supply of energy. Combined with the American people's unsurpassed ability to mobilize, innovate, and resolve problems, I am confident that our nation will be able to enjoy an ever-greater quality of life in the decades to come.