Our Progress in Energy Production, Efficiency and Management

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When we graduated in 1965, it was business as usual in energy development. We were a nation dependent on fossil fuels (oil, natural gas, and coal) to meet our substantial energy needs. Nuclear power was in its infancy with its promise of producing electricity that was "too cheap to meter." We were becoming significantly dependent on the importation of oil to meet our voracious appetite for gasoline to operate our fuel-inefficient cars.

Air pollution concerns were beginning to manifest themselves, particularly in those regions where noticeable smog resulted from manufacturing activities or from the operation of great numbers of automobiles in areas with unfavorable climate and topography (such as the Los Angeles basin). When I arrived in Washington in 1968 as a young staff member of the Senate Commerce Committee, my first task was to review some hearings and write a report entitled "The Search for a Low Emission Vehicle." Some of the findings in that report were incorporated in the first meaningful Air Pollution Act in 1970.

The next two decades saw significant developments in every sector of energy production.

1. Fossil fuels: The most important event here was the rise of the Organization of Petroleum Exporting Countries (OPEC), which brought a sharp increase in prices and the memorable "gasoline lines." Meanwhile, after bitter battles with consumer groups, the natural gas industry obtained deregulation. The Strategic Petroleum Reserves were created. Fuel economy standards for automobiles were established by the Corporate Average Fuel Economy (CAFE) legislation. The later was something I personally oversaw as General Counsel to the Senate Commerce Committee. The initial standard established by law was 26.5 miles per gallon; the current proposal under CAFE is above 50 mpg.

2. Nuclear energy: The Three Mile Island accident put a crimp in the expansion of this sector for a time.

3. Energy efficiency: End use efficiency was given a boost in the 1970s through federal legislative initiatives and state regulatory actions. One novel idea was to have utilities pay for the value of energy saved over time and to treat efficiency as a resource. Thus a performance contracting company could finance investments in energy efficiency using payments from the utility based on measured savings. If successful, it would earn enough to retire the debt it had incurred to pay for the improvement and realize a profit. The end user would gain by paying less for energy because of the efficiency provided to him without charge.

Our classmate Bill Bradley, Senator from New Jersey at the time, led the charge for this new approach.

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He introduced and obtained enactment of a bill promoting the Residential Energy Efficiency Program (REEP), which recognized energy efficiency as an important resource that utilities should pay performance contracting companies for based upon its value to them. As a result, more than 100,000 homes, primarily in retirement communities in New Jersey, were weatherized at no cost to the homeowners. In turn, the utility companies were spared what it would have cost them to generate the energy that was saved. Thus it was a win for the end user, a win for the performance contracting company, a win for the ratepayer, and a win for the utility. It is rumored that the Senator may have had some help from a Princeton friend in that undertaking.

4. Cogeneration: In the late 1970s Congress enacted a law that gave a big boost to the production of electricity by burning fuels such as natural gas, sewage, wood, garbage, etc., and capturing the waste heat to use for industrial or other purposes. The law required utilities to purchase power from cogenerators at a price equal to what they would have to pay (i.e., the avoided cost) to get it from other sources. The law was based on the premise that cogenerated power was more efficient and less polluting than traditional generation. An ex-Senate staffer who had been involved in energy on the Hill was asked by the owner of a newly constructed waste-treatment facility to get this provision passed at the federal level. An amendment was attached to an energy bill while the utilities were worrying about another provision. As a result, a whole new industry of cogenerated energy was created that benefited the end-user, the ratepayer, and the environment.

5. Renewables: Prior to the 1980s some areas of the country (such as the Pacific Northwest) had come to depend on hydroelectricity, and large dams had been constructed by the federal government to provide inexpensive hydropower. During the ’80s more facilities for capturing renewable energy were built, such as smaller hydroelectric plants in locations where dams had been constructed in earlier periods to power mills that were later abandoned. Wind machines began to multiply on the ridgelines of mountains in California. And central-station solar plants were constructed in the deserts of California.

6. Clean Air: Efforts to remove pollutants from the atmosphere continued on the regional and national level as the Clean Air Act of 1970 was implemented and then amended in 1980. State Implementation plans (SIPs) were developed throughout the country to reduce pollution. Some States allowed the use of energy efficiency credits to offset pollution from new power plants, thereby monetizing the pollution avoidance value of energy efficiency for the first time. (This approach is once again being advocated in the Clear Air Plan recently proposed by the Obama Administration.)

THE PAST fifteen years have seen both entrenchment in some areas and change of direction in others.

1. Fossil Fuels: While coal is our most plentiful domestic energy source, its extraction and use causes many problems. Mining has negative human and environmental impacts. When coal is used to generate electricity, many pollutants—ranging from mercury, to ash, to greenhouse gases—are released. The industry has made strides in developing “clean coal” technologies and pollution control systems. Nonetheless, given the widespread concern about global climate change, it is a fuel whose use as a percentage of our energy budget is projected to diminish. The industry may continue to flourish by improving extraction and transportation techniques and becoming a more significant exporter.

Natural gas has become the fuel of choice to replace coal for generating electricity. It produces significantly less pollution and its cost is stabilizing (at least for now), largely as a result of “fracking” (where fluids are pumped into certain geological formations that hold quantities of natural gas in order to produce cracks through which gas can escape and then be captured). However, there is substantial concern among environmentalists and some residents in communities where fracking is done that their water supply is being tainted and the geological formations underground are being destabilized, causing tremors and the potential for significant earthquakes.

Domestic production of oil is also increasing because of "fracking" and other new techniques, such as extracting oil from tar sands. The issue of offshore oil drilling continues to be controversial, especially since the BP spill in the Gulf of Mexico.

2. Renewables: Central Station Solar was the first type of solar power to make a significant contribution to the U.S. energy budget. Large arrays led the way in the California desert regions and continue to do so there and in other arid regions. These units, for the most part, use mirrors to concentrate the sun's rays on large vessels containing working fluids that produce steam, which flows through generators to produce electricity.

Photovoltaic panels, which convert sunlight directly to electricity, became large contributors to energy budgets in some regions of the country that had the sunlight and regulatory environment to promote small-scale solar arrays on the roofs of buildings. These arrays have moved from roofs to larger plots of land where the sunshine and state regulations work together to make the electricity cost-effective, particularly when the external costs of other methods of generating power are taken into account. The lower cost of natural gas from fracking regions is creating some economic challenges for photovoltaic energy in those regions.

While windmills have been used for centuries to pump water, wind machines for the generation of electricity are of more recent vintage and design. Today they are making a significant contribution to the renewable industry. Noise and bird kills remain issues, but they are being addressed. Locating wind machines offshore is still being debated in the United States but has been widely accepted in Europe. Despite controversies over siting and other issues, the wind machines are here to stay.

Many other renewable sources of energy are emerging, such as tidal and wave motion, as well as the burning of wood, sludge, and municipal waste, to mention a few. The list goes on, but space does not permit detailed discussion of them here.

3. Energy Efficiency: As recounted above, this was first recognized in Senator Bradley's REEP legislation as a resource that utilities should not only promote through advertising but actually support financially by purchasing saved units at a price equal to the cost of generating them. Since that time, a number of pay-for-performance programs have been implemented at the state and federal levels. The U.S. Department of Energy manages the Energy Savings Performance Contracting Programs (ESPCs) and state utility commissions manage ESPC-type programs at the state level. Recently, however, some states such as Ohio have

rejected these savings programs for reasons that are unfathomable to me and most other people who follow energy issues.

Energy efficiency standards for devices ranging from light bulbs to refrigerators and freezers have been established and are conserving large amounts of energy, saving consumers money, and lessening greenhouse gas emissions. Both the U.S. Department of Energy and the Environmental Protection Agency are involved. EPA's Energy Star labels help consumers identify efficient products, and DOE's standards-setting efforts ensure that progress is being made by manufacturers to develop them.

The "smart grid" refers to a broad spectrum of technologies that are designed to enhance the reliability of the electrical system by making it less vulnerable to interruptions from physical storms and cyber attacks, as well as smarter from the standpoint of providing better information to operators and end users about how the system is performing or how to use the information to reduce costs.

"Demand response" is a smart-grid technology that enables the operator to request that a customer curtail use when the grid needs power for emergency situations or when the cost of operating the grid exceeds what the customer is paying (for example, when the operator has to purchase power at a higher than normal price during a heat wave). It is designed to provide a meaningful economic incentive for users to curtail their use while lowering the cost to a lesser degree for the grid operator and its non-curtailing customers. The use of the Internet and information technology to trigger curtailments and to effect and measure them has substantially increased the use of demand response as a strategy for the smart grid.

Smart meters are being employed to retrieve real-time data about the energy use of utility customers. This information can be used by the utility to request curtailments or by customers to govern their own use based on the cost signals provided to them.

IN THE LAST fifteen years several systems have been developed to manage utility bills. Entities using programs and large databases contract with customers to receive their utility bills from vendors. They scan the bills, enter the billing information into a database, check for errors (e.g., usage errors, mathematical errors, beginning and ending date errors, and consumption anomalies resulting from billing errors or malfunction of end-use equipment). Once the bills have been screened and exception handlers have resolved the errors with the utility companies, the billing company sends an electronic billing file to the customer and makes the payment to the utility from the customer's account electronically. The transactions are recorded in that portion of the database accessible only to the customer. Drawing from the customer's electronic payment, the billing company pays the utility and notifies the customer that the bill has been paid. Recent studies have shown that every bill paid electronically reduces the customer's costs by more than $16. The detection of billing errors and consumption variances saves as much as 1-2 percent of the customer's total utility expenditures.

With the information in the database, customers can use the system's report generators to produce useful data to help them manage their utility expenditures. For example, a customer can run reports on the energy cost per square foot for a building or on greenhouse gas emissions for an entire company or for an individual facility or group of facilities.

In addition, customers can use the system to obtain EPA ratings showing how their buildings rank against other similar types of buildings by sending data to EPA's Energy Star Portfolio Manager. (Note: my company uses this system to pay all its bills for the State of New Jersey and New Jersey Transit as well as many counties, municipalities, school districts, and housing authorities in the state. It also pays the utility bills and helps manage utility expenditures for many private companies elsewhere in the country.)

4. Global Climate Change: I believe that one day this will be recognized as the most important issue that faced the world in 2015, the fiftieth anniversary of our graduation from Princeton, and will drive many developments in the areas discussed above. It is probably already the most important issue, even though unrecognized as such by many people. While it may be too late for most of us in the Princeton Class of 1965

to do anything significant about solving this problem, we may be able to contribute to finding paths towards solutions or measures that at least delay or moderate the inevitable. Below I set forth two of those paths based upon my experience that I believe would make a significant and affordable contribution to forestalling and mitigating damage from global climate change.

The first path is described in a new paper published by the American Council for an Energy Efficient Economy entitled "Government Works: Federal Actions on Energy Efficiency." The paper examines "four sets of agency actions on energy efficiency: appliance standards, vehicle standards, power plant emissions standards and select housing polices. Among the limited set of measures, we estimate the policies already issued . . . will save consumers $1.9 trillion . . . on a net present value of savings after needed investments for the lifetime of the measures taken . . . and will reduce carbon dioxide emissions by 18 billion metric tons, roughly equal to the total emissions from fossil fuels in this country over three years. Additional actions, including a new standard for existing power plants, could save consumers another $0.7 trillion and reduce emissions by an additional 16 billion tons."

This paper points out, once again, that increasing energy efficiency substantially reduces carbon dioxide *at negative cost* to society. In other words, our country (and other countries) can afford to pursue an aggressive EE path to mitigate climate change. To put it another way, our country and the world cannot afford not to pursue an aggressive EE path that has negative costs and avoids significant amounts of greenhouse gas emissions.

This path would work better if the federal government tracked its use of energy by applying a system of energy management such as the one employed by the State of New Jersey. This system not only tracks the energy use and the pollution resulting therefrom, it also produces savings for governments by efficiently processing the bills. These additional savings for the government can be used, at least in part, to increase energy efficiency and reduce pollution.

THE SECOND path creates a mechanism for substantially increasing energy efficiency in both the public and the private sectors. A recent McKinsey study projected that the U.S. could realize $1.2 trillion in energy savings by pursuing cost-effective efficiencies that are already technologically available. The study estimated that it would cost approximately $520 billion to obtain these efficiencies, resulting in a net of savings of approximately $690 million The problem is that we currently have no legal structure for delivering this technology and reaping the dollar and pollution savings.

I advocate the following solution: Congress should enact legislation providing utilities with economic incentives to deliver cost-effective energy efficiencies whose financing, installation, measurement/verification, and utility incentive costs would be paid for out of the savings.

Suppose the following:

Installation: $520 billion

Incentives: $150 billion

Financing: $60 billion

Measurement/verification: $30 billion

The total cost of $760 billion would exceed the McKinsey projection by $240 billion—reducing the savings from $1.2 trillion to $960 billion—still a significant savings in dollars as well as emissions

Because utilities are regulated by the states, Congress might feel some reluctance to enact legislation telling the states what to do. Therefore, I would include a provision allowing any state to opt out. (If the incentives for the utilities are set high enough, however, the utilities might well encourage their representatives in the states where they operate to support the legislation and not opt out.)

To date I have been met with ho-hums by energy-efficiency advocates in Washington who are pursuing their own narrower administrative and legislative efforts. I would be happy to talk with any classmates who are interested in working with me on this proposal.