

Energy Security, Innovation & Sustainability Initiative
Progressive Dialogue Series

Deploy.

Progressive Dialogue III:
Demand Drivers for Sustainable Energy Solutions



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Council on
Competitiveness

Progressive Dialogue III: Demand Drivers for Sustainable Energy Solutions

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Energy Security, Innovation & Sustainability Initiative
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**Progressive Dialogue III:
Demand Drivers for Sustainable Energy Solutions**

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Chantilly, VA



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Demand Drivers for Sustainable Energy Solutions**

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Letter from the President

It is my pleasure to release the proceeding from the third and final high-level experts dialogue conducted under the auspices of the Council on Competitiveness Energy Security, Innovation & Sustainability (ESIS) Initiative.



The conclusion of the Progressive Dialogue Series marks the end of an important phase for the ESIS Initiative. During the past year and a half, we have been on a journey of thoughtful inquiry into how energy and sustainability are reshaping the global competitiveness land-

scape. We have worked to discover the most important preconditions for a successful transformation to a vibrant, robust and clean U.S. energy system driven by the many small and large businesses, education and research institutions and other organizations that comprise America's private sector.

Dialogue I documented how energy and sustainability have become among the most powerful drivers of competitiveness in the global economy, compelling states, economic regions and leading companies to take measures to succeed in a world being reshaped by a shifting energy supply-demand relationship and global climate change. Dialogue II drew forth a multi-faceted business case for enterprises to adopt energy and carbon

management strategies and identified the key ways in which business and government leaders can support the private sector in moving forward on these fronts.

Dialogue III revealed that while energy suppliers are beginning to make the new investments and implement new approaches to producing and delivering energy, they require a level playing field on subsidies and transparent energy prices, along with well-designed regulations, informed consumers, innovative workforce development partnerships and confidence that responsibility for arresting global climate change will be shared among developed and developing nations alike.

Taken together, the Dialogues reveal a private sector poised to lead an energy revolution through innovation, investment and partnerships across sectoral lines—but in some key areas awaiting government leadership and support in the form of smart policies, regulation and creative financing. Many ideas for constructive government action were generated by the experts we convened and by the ESIS Initiative Steering Committee. These ideas were distilled and prioritized into a select number of recommendations that the Council put forth in *Prioritize: A 100-Day Energy Action Plan for the 44th President of the United States*. We

urge the president to act decisively upon these recommendations to ensure that no time is wasted in reving the country's energy innovation engine.

The Council is convinced that extraordinary opportunities reside within the technological, economic and financial riddles that must be solved in order to create a secure and sustainable energy future. We are excited at the prospect of helping to unleash an unprecedented wave of innovation, investment and economic expansion. We believe that a stalwart and focused energy security, innovation and sustainability agenda can lead the United States out of an economic downturn and to the forefront of discovery, higher levels of economic productivity and a better quality of life for all Americans.

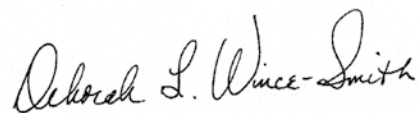
In closing, I would like to express our gratitude to the Department of Energy for their generous support in underwriting the Progressive Dialogue Series, and in particular, Secretary Samuel Bodman; Assistant Secretary for Energy Efficiency and Renewable Energy Andy Karsner; Deputy Assistant Secretary for Energy Efficiency and Renewable Energy John Mizroch; and Industrial Technologies Program Manager Doug Kaempf. We continue to be extremely well served by the guidance of our distinguished CEO Steering Committee and the leadership of co-chairs James W. Owens, Shirley Ann Jackson and D. Michael Langford.

The success of the Progressive Dialogue Series is the result of the insights and thoughtful contributions of the many individuals who have generously contributed

their time and expertise to this process. We offer our sincere appreciation to the experts participating in Dialogue III. Finally, I would like to recognize and commend Susan Rochford, vice president for energy and sustainability initiatives, for her innovation in conceptualizing and skill in executing the Progressive Dialogue Series, and Kara Jones for the excellent organizational and research support she has provided as a member of the ESIS Initiative team.

Having released the *100-Day Energy Action Plan* in September, the Council is now well on its way to achieving the goal of the ESIS Initiative: to enhance U.S. competitiveness and energy security by shaping a public-private action agenda to drive private sector demand for sustainable energy solutions, creating new markets, industries and American jobs. We look forward to releasing our action agenda at the Council's National Energy Summit in Washington, D.C., in the fall.

Sincerely,



Deborah L. Wince-Smith
President

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Executive Summary

In just the past few years, the United States—and the world—has experienced a dramatic awakening to the critical influence that the forces of energy supply and demand have over markets, economic growth and competitiveness, and the prosperity of communities, families and individuals. Recognition and acceptance of the direct linkage between the use of fossil fuels and global climate change has also deepened.

World energy demand is projected to grow by 50 percent during the next two to three decades unless very dramatic energy efficiency gains are realized. Developing countries—home to 80 percent of the world's population—will account for around two-thirds of global energy consumption by 2030 as these economies experience steady increases in their standard of living.¹ As a result, upward pressure on global energy prices and supplies can be expected to continue for decades to come. Even as energy demand continues to grow, scientific experts indicate that global greenhouse gas (GHG) emissions, the majority of which comes from energy, must be slashed by 50 percent to 80 percent from 2000 levels by 2050 to avert the most severe consequences of climate change.²

All nations are therefore confronted with a mandate to produce and consume energy in a sustainable manner. The United States, which currently depends on traditional fossil fuels produced by decades-old technologies to meet the vast majority of its electricity and fuel demands, is no exception.

The United States must transform its energy system to meet increasing demand while also stabilizing and then reducing its carbon emissions. This systemic transformation will not depend upon a single technology or fuel—there will be no silver bullets. All energy sources should be considered in order to meet future energy needs and ensure continued economic growth and prosperity. Everything must be on the table, and all energy sources have a role to play. However, the manner in which these resources are harnessed, converted, delivered and consumed will have to change. Inherent in that change is tremendous opportunity.

For its third and final session in the Progressive Dialogue Series that was conducted under the auspices of the Energy Security, Innovation & Sustainability Initiative, the Council convened 46 senior executives, representing a cross-section of energy suppliers, as well as other experts, to determine the key drivers for the development and deployment of sustainable solutions across the U.S. energy portfolio.

Energy industry experts participating in Dialogue III expressed confidence that they will undertake and ultimately profit from new energy investments and infrastructure development. They expressed a willingness to embrace transformational technologies and rethink approaches to energy production and delivery to meet growing demand in a sustainable manner. But they also indicated that they could not get there from here without government action and support on several fronts.

To accelerate transformation and drive the deployment of sustainable solutions across all segments of the industry, energy suppliers require:

- **A Transparent Market Based on the Real Cost of Energy**—The playing field on energy subsidies must be leveled, and externalities inherent in the production and consumption of energy must be clearly identified and reflected in the market prices, including costs for carbon content.
- **Clear Government Rules to Drive Market Behavior**—Government must craft streamlined, rational and transparent regulations, harmonized across state lines where possible, while preserving the competitive nature of the market and protecting consumers.
- **Technology and Commercialization Policies that are Aligned, Balanced and Executed**—Federal investment priorities must reflect technological time horizons, research and development must be accompanied by an equal emphasis on commercialization, and government must follow through on its policy commitments.
- **A Massive Public Education Effort**—A much higher level of U.S. energy literacy must be achieved, and a new social compact forged based on a clear understanding of the cost and benefits that arise from achieving a sustainable energy framework for the nation.
- **Partnerships to Attract and Develop a World-Class Energy Workforce**—The U.S. energy sector is facing a demographic time crunch that

requires government, industry, labor and higher education to work closely together in order to close the workforce gap.

- **Policy Instruments and Institutions to Foster International Cooperation**—Climate change is a global commons issue that will require innovative, cooperative models beyond those that exists today.

While such broad-based actions are vital to creating a favorable market environment, there are also specific issues that need to be addressed to ensure the viability of the full spectrum of available resources within the national energy portfolio.

- To achieve much higher levels of **energy efficiency** in the U.S. economy, appropriate standards and regulations, along with transparent energy price signals, must be set or the market for efficiency will remain seriously distorted.
- For **renewables** to achieve substantially higher penetration in the market, all externalities—including carbon—must be reflected in the price of all forms of energy so that their real costs are evident to the consumer.
- Crucial to the viability and reliability of multiple energy sources and related technologies—including the spectrum of renewables, plug-in hybrids and energy efficiency through generation to consumption—is the development of a unified, high-voltage, intelligent and self-healing **grid and transmission system**.
- To reward saving, not just selling, electrons and to incentivize the delivery of innovative new energy

technologies and services, some experts believe that the **electric power industry** may need a regulatory overhaul along the lines of the telecommunications industry in the 1990s.

- To maintain competitiveness and fulfill its vital role in meeting domestic energy demand, the **oil and gas** industry requires ongoing U.S. government support in obtaining access to both domestic and international resources.
- To maintain and expand **nuclear power** capacity in the United States, timely license renewals for existing plants and federal loan guarantees for new plant construction are essential.
- To retain coal—an abundant national resource—as a staple of the U.S. energy portfolio, the United States needs to create incentives and smart policies to accelerate the development and deployment of **carbon capture and storage technologies** that divert emissions to geological repositories or toward other uses.

Taken together, the conclusion is clear: to meet its future energy needs while ensuring environmental sustainability and economic competitiveness, the United States will have to adopt a system-wide view of the challenges and opportunities while acting nimbly and in parallel on many specific fronts.

The Progressive Dialogue Series has sought to understand, from the perspective of both energy users and suppliers, what will drive the private sector to demand more sustainable energy solutions. In other words, what will move the market

toward a desired end: a diverse, secure and low-carbon energy portfolio and a vibrant U.S. energy system. From this investigation, several conclusions can be drawn about the nature of markets.

Markets are not created on their own. They are shaped significantly by government policies and regulations. These policies and regulations must be designed carefully, consistently applied and backed by genuine government commitment and adequate resources. Markets will not function rationally or optimally without transparency, appropriate price signals and a level playing field. Markets consist of consumers, both individual and enterprise-level. Markets function best when consumers are well informed and understand the cost-benefit analysis of the available choices. Markets respond to and sometimes require leadership, and that includes leadership from the ranks of private-sector enterprises and institutions, as well as government. There are some challenges that the market alone cannot solve. Challenges to the global commons, like climate change, require proactive government management. It is equally true that without the full engagement of the market, such grand challenges cannot be met.

The U.S. public and private sectors must move forward together to orchestrate—in careful and balanced harmony—a secure, sustainable and competitive energy future. The new administration has a precious window of opportunity and a tremendous responsibility to wisely and boldly exercise its authority to move the nation forward toward this future.

Setting the Stage: The Business Case for Sustainable Energy

Shirley Ann Jackson

Rensselaer Polytechnic Institute
and ESIS Initiative Co-Chair

When the Council on Competitiveness began the Energy Security, Innovation & Sustainability Initiative more than a year ago, we set a clear goal to enhance U.S. competitiveness and energy security by shaping a public-private action agenda to drive private sector led demand for sustainable energy approaches and to support the creation of new markets, new industries and new jobs. Though politicians may say otherwise, there is no energy independence because energy challenges are interrelated, interdependent and global.

The world needs energy. Energy demand will grow in the United States and globally as our population grows, and especially as other economies rise, and so what we must have is energy security. In this context, security recognizes the interlinked effect that global market competition and worldwide energy supply chains, as well as domestic infrastructure and the vulnerability of all parts of the supply chain to disruption, have on one another. Energy security is also inextricably linked with increasing concerns in multiple sectors about climate change.

Progressive Dialogue III will consider the business case for sustainable energy from the perspective of those who have been involved in supplying energy. As a nation, we have spent a lot of time debating climate change. Strategic thinking has taken place in Europe and elsewhere, and our global competitors



From left: Ralph Izzo, Public Service Enterprise Group Incorporated; Deborah L. Wince-Smith, Council on Competitiveness; and Shirley Ann Jackson, Rensselaer Polytechnic Institute.

are working to address energy security and climate change simultaneously. As we frame our discussion, we must ask, “Can a solid case be made for why applying energy sustainability at the enterprise level makes good business sense?” We will consider the necessary external conditions pertaining to the market, in regulation and legislation and even in the geopolitical arena.

Businesses increasingly think in terms of risk management. One key risk globally is associated with the fact that there are other wealthy nations competing for resources that are either: a) increasingly hard to produce due to technical or geopolitical factors, or b) believed to be in limited supply, if not today then in the near future.

Some nations have deeper pockets than others. Some of those with the energy resources are beginning to keep them for themselves. A number of nations are using a combination of economic and political approaches to secure energy supplies if they do not have them. Producer nations are beginning to demand changes in business contracts, and some nations unilaterally change them. There is also risk involved as the public increasingly demands energy approaches that lessen, or at least do not increase, greenhouse gases.

America's energy infrastructure is vast, complex and vital to virtually every facet of modern life and to the functioning of the U.S. economy. The scale is staggering. Twenty million barrels per day of oil, 17 million barrels per day of refining capacity and 200,000 miles of oil pipelines are all aimed at fueling the more than 250 million registered cars and trucks now on U.S. roadways. The nation's infrastructure for extracting and transporting natural gas encompasses some 1,300 drilling rigs and more than 300,000 miles of pipeline. Thousands of power plants, 200,000 miles of interconnected transmission lines and countless transformer substations operate in sync to power millions of homes and businesses. For example, there are 104 operating nuclear power reactors across 70 sites in 31 states that supply 20 percent of our electricity.

The nation's existing energy infrastructure embodies an enormous capital investment. And simply maintaining and expanding it, much less transforming it, will require financial and institutional resources of comparable scale.

The case has been made that energy efficiency and conservation are the low-hanging fruit, so business can and must encourage and enable consumers to become more efficient in their energy consumption. Does this apply to energy companies as well? To date, most energy companies' profits are based on user consumption rates. A key shift in strategy will be to develop public policy and corporate strategies that can make energy efficiency profitable for these companies as well. At the enterprise level, the choice to invest in energy efficiency has had a lower priority relative to immediate core business needs, but more enterprises are recognizing that energy efficiency investments can bring long-term benefits to the overall health of the enterprise, if properly and thoughtfully done.

During the next day and a half, we will identify where we must go in public policy, legislation and regulation to stimulate the development and deployment of sustainable energy options, be they wind, solar, nuclear or new approaches in the fossil fuel arena.

Dialogue Proceedings

Drivers for Deploying Sustainable Energy Solutions: Key Findings

Experts participating in Progressive Dialogue III identified the following as the key prerequisites for the development and deployment of sustainable solutions across the energy sector.

A Transparent Market Based on the Real Cost of Energy

The playing field for energy sources and technologies must be level; the market must not be biased toward incumbents. Experts observed that subsidies for fossil fuels must be eliminated. Externalities inherent in the production and consumption of energy must be clearly identified and reflected in the market price, particularly the carbon content. After that, how energy comes to market, whether it is central or distributed generation, or fossil-based with carbon capture and storage (CCS), will be decided by market participants. All solutions will come into play. It is only when full costs are factored in that the market and regulators will be able to appropriately weigh the cost of energy alternatives.

The other pricing signal that must be adopted and must be transparent to the consumer is the true price of electricity at the time it is produced. The United States has historically used a system of average cost pricing, which means that energy consumers do not know the actual cost they have paid until months after the fact. Real-time pricing will provide the right signals and will stimulate technologies to enable what is called the smart grid. The smart grid is an assembly of hardware and software that transmits pricing signals to intelligent devices that are programmed to modify their

operation throughout a single day to utilize energy cost-effectively. At the same time, with half of the utility workers retiring within the next five years, it is essential to create immediate training opportunities for workers who may be displaced by real-time pricing and similar technologies.

Clear Government Rules to Drive Market Behavior

Only government can set rules on the level and price of carbon emissions nationally. It needs to set ambitious standards for energy efficiency and investment incentives for high-risk, high-reward technologies that will eliminate or reduce carbon emissions. It must also set goals and timetables for achieving progress.

The future economic prosperity of the United States is inextricably linked to its ability to create a sustainable, environmentally prudent and balanced energy system. This is possible only if policymakers produce the right framework to drive the private sector to deploy low-carbon products and services on a much larger scale.

The European Union (EU) recently responded to this urgent challenge by announcing a directive that sets an overall binding target to reduce greenhouse gas (GHG) emissions by 20 percent, ensure 20 percent renewable energy utilization and reduce primary

“Energy security is not a challenge but an opportunity. No states or utility companies have yet asked consumers to pay the real price of the electricity that they currently use. Yet consumers are asked to pay a premium for renewable energy. As a result, renewable energy is at a competitive disadvantage. Germany today has the world's largest solar powered industry in the world. Their policy-driven markets have resulted in training for their employee base and efficient energy use. That decision was an investment in the future, both in technology and human skills. The United States is behind the curve.

The reality of the marketplace is that climate change and declining energy security are driving the cost of energy steadily higher. Only by establishing a reality-based pricing system will we be able to develop a policy-driven market that will cushion the shocks for the consumers. We have never *not* had a policy-driven energy market in the United States.



Low gasoline prices are policy driven. Why then should we not include solar, wind and other renewable energy sources and efficiency policies into this schema? Alternative energy needs to be policy-driven as well in order to compete. It does not need to be given an advantage over coal or gas products, merely equitable policy.”

Joseph A. Stanislaw, Deloitte & Touche USA LLP

energy 20 percent by 2020. Once enacted, this legislative package would be the biggest commitment to reduce emissions from any region of the world.

On the other hand, one expert explained that the lesson learned from when California deregulated its electricity markets in 2001 is that if a market is designed badly, it will work badly. So as government takes measures that affect the design and operation of electricity markets, it must do so intelligently, and it must be done carefully by regulators.

Differing federal, state and local regulations on energy facilities have impeded some critical investments in the energy system. The very simple task of connecting a wind generator to the transmission system is not an easy process. This is a national problem, not a local problem. There is a strong case to be made that the Federal Energy Regulatory Commission should be given sole jurisdiction over siting and permitting for electricity production, distribution and transmission technologies.



“With respect to price and markets, let me say that I have been an academic and I have been in industry, and both have this notion of some mystical market. All my life I have been trying to meet this market to say hello, how are you, and how do you make your decisions? But markets don’t exist in the abstract. Markets are created. And if this market is of one company, it is not a market. It is a monopoly. So, how do we create efficient markets and sustain them? That is a very important objective of policy. Over and over, I hear the comment that the markets will take care of it. And again, I haven’t been able to meet this very efficient intrinsic market that exists all by itself.”

Kenan Sahin, TIAX LLC

Regulators should strive for streamlined, rational, transparent and, where possible, harmonized regulations that preserve the competitive nature of the market and create desired outcomes for the siting of transmission, power plants and CCS projects. Regulations must encourage balanced growth and investment and ensure energy diversity and system reliability while protecting workers and the environment, rewarding consumers and establishing a fair framework for emerging technologies. If states opt for slightly different rules, they should create a single point of contact within their state to minimize industry confusion. Stakeholder education on the need for energy facilities plays an important role in the streamlining of the process. Some Dialogue III experts suggest that jurisdictions could be ranked by the efficacy of their processes in siting key energy facilities, and those rankings could be made highly visible to attract investment to specific regions and create pressure for individual states to become more efficient.

Technology and Commercialization Policies that are Aligned, Balanced and Executed

Policy and Investment Priorities Aligned with Technological Time Horizons

In the near term, marginal improvements to conventional technologies can strengthen the existing energy system and the fossil fuels upon which the nation will depend for some time to come. Greater deployment of existing technologies that can enhance energy security and reduce GHG

“I agree on the comments of the group on the importance of execution. What we really need is to execute very crisply. This country is bogging itself down as a result of our behaviors and our underinvestment over the years. And we have lived off the fat of those investments for quite some time—whether they are production, generation, transmission or distribution—and now it is finally coming home to roost.”

Gary Leidich, FirstEnergy Corp.

emissions must be achieved—particularly energy efficiency technologies and those to produce renewable energy.

Unlike energy efficiency, which offers compelling economic benefits, the principal reason to invest in a technology like CCS is out of concern for climate change. While it is still years away from commercialization at scale, CCS must be pursued for the medium term to ensure that the United States will be able to avail itself of the full range of its energy resources, including coal, natural gas and oil. Carbon dioxide (CO₂) is already being captured and put to use in industrial applications and enhanced oil recovery.

Longer-term investments in the basic research required to develop breakthrough technologies must begin now so that a range of sustainable energy solutions are available in the coming decades as carbon reduction targets grow increasingly aggressive. Moreover, as time goes on, the science and modeling for climate change will continue to improve, and technology investment assessments and allocations will become wiser.

Equal Emphasis on Technology Development and Commercialization

To achieve a vibrant market, with a diversity of energy options providing maximum choice to consumers—be they commercial, industrial, government or residential—requires a range of technology investments. The level of investment need not be analogous to that of the 1970s. It is not a matter of throwing money at the problem. Nor should the government pick the specific technologies for investment. The criteria for technology investments should be outcome-oriented and encompass a broad portfolio of R&D. It must be accepted that not all investment will produce results, but those that do will offer a high return on the original investment.

The United States must make strategic investments in new energy technologies, but R&D alone is not enough. Equal emphasis must be given to ensuring the resulting technologies are actually deployed. If the United States is going to devote funds to develop emerging technologies and invest in research, development and demonstration, but then fall short in the investment and effort to achieve commercial deployment, no value has been added to the country. Any investment in successful technology development should be accompanied by a commercialization plan to take the results to the market. The nation needs a commercialization plan for the U.S. market, and it needs to be driven at a very fast pace.

There is a disconnect between research, development and deployment in the small companies that are bringing forth emerging technologies. They do not have the commercial or market wherewithal to know where to take their technology once it has been proven. Government procurement of new energy technologies could play an important role here. Partnerships of private equity firms, utilities and corporations could allow better sharing of the risk in the demonstration of new technologies and the start-up firms that introduce them to the market.

Government Commitment to Execution

The government must focus on actually implementing policies to achieve energy objectives, one hard step at a time if need be.

If the erratic extension of production tax credits is hampering the renewable industry, then the government should move decisively to extend them for at least 10 years. If investment in new nuclear capacity is stalled because of uncertainty about the cost of building a new facility, then the government should take the initiative to fund and build the first new nuclear facility—at the Tennessee Valley Authority or elsewhere—so that the industry and the financial community have a sound basis upon which to finance new deals. If there is resistance to building new coal-fired electrical generation based on existing technology, then the government needs to move forward aggressively with CCS demonstration projects while also incentivizing efficiency improvements to existing facilities. If plug-in hybrids need to be deployed quickly and at scale to meet carbon reduction goals, then federal and state governments should use their procurement power and turnover their vehicle fleets to this technology.

Oil is a national security, not just an economic security, issue. It affects the ability of the U.S. military to perform. The state of the grid is a national security issue, too. The military can be a mover in solving both challenges and can help the private sector in tackling these issues. The government must show the will to execute precisely and quickly.

Government must innovate in policy approaches, for example, by providing performance-based incentives that reward companies for results actually achieved and feebates* that are provided

*Feebates refer to a market-based system that places a charge on the purchase of a good that is associated with high environmental impacts (e.g., less efficient automobiles) and provides a rebate or credit toward the purchase of a good that is associated with relatively lower impacts (e.g., more efficient automobiles).

“We need massive public education as to the fact that while energy efficiency is generally a win-win opportunity—where people can reduce their energy bills and reduce their environmental impact—it is not quite the same on the renewables front. This is a place where traditional cost-benefit analysis is needed. We need to educate the public. In exchange for paying higher rates for their energy supply, they will be getting enormous benefits not only in the terms of averting climate change, but in reducing SO₂ and SO_x, fine particulate matter in mercury—which is vital to health and quality of life.”

Ralph Izzo, Public Service Enterprise Group Incorporated

to consumers in exchange for taking inefficient, polluting vehicles off the road. Government can create multi-disciplinary teams to devise innovative solutions that a singular view of a problem would not generate. Only government can do that in an activist way. It will not happen spontaneously.

There is no lack of energy initiatives, but there is lack of implementation. It is not possible to go to scale overnight in the energy business, and scale is a very important factor for meeting the energy and climate challenges within the timeframe required. The federal government must help drive this process.

A Massive Public Education Effort

Much of the public does not know that electricity has different values across the United States. One expert described how Florida pays about 12 cents a kilowatt-hour at peak times. New England pays 18 cents, and the San Diego peak time-of-use-rate averages 32 cents a kilowatt-hour. When people are paying more for their energy, they generally do something about it. That is why San Diego is doing more on energy efficiency than New England, and New England is doing more than Florida. Similarly,

considerably higher gasoline prices in the rest of the industrialized world have encouraged the use of more fuel-efficient vehicles.

Americans have been trained to read dietary information on the side of cereal boxes and other food items. There is no such information available from the electric utility industry. That information needs to be available so U.S. consumers understand what it is they are buying. As prices go up, consumers will start to care. They really have not cared because energy has been a pretty economical product, at least up until now. Energy Star labeling has been effective, but the United States must go beyond this, such as applying the labeling practices to industrial equipment and new homes and buildings. In the business world, it is no different. Chief financial officers in companies only see the aggregate bill for their energy; they need to see the components of it much the way their telephone bills are itemized.

Americans need to understand the value proposition of the entire energy cycle from supply to transmission and distribution to actual consumption instead of just focusing on what comes out of the outlet. People need to recognize, when they see an electric tower in the air or a power plant, why it is there, why it is needed and what it means for them. The connection must be made with people that the digital revolution for iPods, Blackberries, fax machines and computers is increasing energy demand. At the same time, information technologies drive new social networking tools like Facebook and YouTube. These outlets present an opportunity to drive grassroots action to raise energy awareness and change behaviors. Traditional media and communication channels are increasingly less effective as the younger generation looks less to conventional advertising, instead turning to the Internet for information.

Climate scientists basically agree on the science of climate change. According to a 2004 article in *Science*, in almost a thousand scientific journal



Robert Rosner, Argonne National Laboratory, and D. Michael Langford, Utility Workers Union of America, AFL-CIO

“Unfortunately, the public will to achieve full deployment of clean energy technologies—the social compact, if you will—does not exist. During previous historical moments when it was required to raise taxes and the cost of doing business, there was an agreement that it could be done because it served the national purpose. Classic examples are World War II and the early days of the space race. The current crisis of a changing climate and the need for a clean energy revolution is not part of the current social compact, yet it needs to be.”

Robert Rosner, Argonne National Laboratory

articles reviewed, no papers disagreed that the climate is being affected by human activities.³ Yet, as described by one expert, in a recent review of almost 3,500 articles in the popular press, about half of journalists' reports gave equal credence to the idea that climate change is primarily being caused by natural forces, as did those who attribute it to energy use by humans. The fundamental problem is that most journalists are not trained experts in climate science, and they tend to approach stories by presenting both sides of any issue. Increasing basic energy and environmental literacy for journalists, policymakers and regulators and creating opportunities to see new technologies in action would improve the public atmosphere for constructive change. This would also encourage journalists to give due credit to public officials and politicians who implement far-sighted energy and environmental initiatives.

Partnerships to Attract and Develop a World-Class Energy Workforce

It is no longer a given that the United States can capture the world's best and the brightest. In 2007, approximately 50 percent of America's graduate students in engineering and physical sciences were foreign-born.⁴ For many years, foreign students stayed in America. This is no longer the case; many are returning home or going elsewhere. The United States must seed its economy with human talent. It must create a vision and generate enthusiasm among the U.S. population for the whole range of skills and talent that energy system transformation requires.

The energy industry—from oil and gas to the electric power sectors—is facing a demographic time crunch. Workforce attrition is occurring real-time in these industries and the pipeline of new workers is not there.

There is a range of approaches to be taken. Partnerships with the military are promising—the Helmets to Hardhats program, for example. Worker retraining is essential for those displaced from other industries,

like the automotive industry. National training institutes should be considered for these workers as well as for those who are simply not ready to retire.

The United States graduated two times more engineering, math and science bachelor's degree students 50 years ago than today.⁵ In the last two decades, graduates with these degrees have gone down 18 percent in the United States while they have grown substantially in China and India.⁶ The total number of U.S. power engineers receiving bachelor's degrees per year, as of 2005, was approximately 500.⁷ These numbers are reflective of substantial underinvestment in the very fields where the United States is most lacking expertise.

The U.S. education system has a significant role to play in the transition from oil dependency to energy security. Education needs to incorporate curricula inclusive of comprehensive engineering science, dispersed throughout all grade levels from elementary school to graduate school. And a transformation within the universities is needed to cast science education in a new light. Business, labor and government actions are being highlighted and merged, but the education sector has been excluded from the equation, even though it is an equally crucial actor. The public/private education nexus must be joined here to provide projects and internships for students, endow chairs in universities and fund scholarships. Education is a crucial component to a comprehensive approach to universal energy reform in the United States.

Policy Instruments and Institutions to Foster International Cooperation

Resource competition is going up dramatically around the world. State control of much of the world's oil and gas is not going to change. It is a fact of life. Arguments are going to increase over climate change and who is responsible. This points to the importance of developing policies and approaches that foster local development and deployment of

innovative new and low carbon technologies at scale. The fundamental solutions required may well come from places other than the United States, and it may be possible that America's energy will come in new ways from other countries—like Japan, Korea, India or China.

The United States is the world's largest energy user; China is No. 2.⁸ China will surpass the United States as the largest annual vehicle market in three to four years based on the current rate of growth. No one could have predicted this 15 years ago. For the United States, a relationship with China about energy is probably the most important one to develop. The United States and China have the greatest need and ability to develop and manufacture the necessary technology to deal with energy and climate change challenges.

It is difficult to grasp the scale of China's needs and the timeframe over which their energy system is building out. In a single year, the U.S. electric power industry may weigh adding one power plant, while some experts noted that China has been adding two or three plants a week. The country is working to bring a billion people up to a Western living standard in a relatively short period of time.

The question of who is responsible for emissions is complicated. China produces CO₂ when it manufactures products, but many of these products are consumed in the United States. Canada is the largest exporter of energy to the United States and

“There's a general recognition of the need for a large, commercial-scale demonstration program [for carbon capture and storage], and as yet there is no money set aside to fund this at the EU level. Some individual countries are taking action, but doing it on this scale is the essential challenge.”

Joan MacNaughton, Alstom Power Systems

produces considerable CO₂ while producing it.⁹ International disagreements have and will occur over these responsibility issues. In 2003, the EU put in place a guarantee of origin (GO) system to verify the energy source, date and place of electricity production for renewable energy sources—alongside voluntary targets—for burden sharing among the member states on GHG emission reductions and increased renewable energy production.¹⁰ The Russians have expressed interest in becoming part of the European burden sharing system because Russia has the world's largest untapped renewable energy potential, in forms such as wind, biomass and hydroelectricity. No nation can solve these problems on its own.

Dialogue Proceedings

Workforce Development: The Crucial Role of Partnerships

D. Michael Langford

Utility Workers Union of America, AFL-CIO

Partnerships are vital to the development of America's energy workforce. The experience of the Utility Workers Union of America (UWUA) offers tangible examples of best practices in this regard. We have partnered with utilities around the country to create regional training centers. We have also partnered with communities, community colleges and universities to develop hands-on training programs. Students who obtain a two-year college degree can, in most cases, further that up to a bachelor's, master's and on to a doctorate degree, if they so choose.

We are working hand-in-hand with these communities and the colleges, along with local utilities, to create these training centers for all skilled workers, from nuclear power plant operators to overhead linemen to substation controllers to everybody in between—electricians in the power plants to pipe fitters to welders. Training for these kinds of jobs takes four to five years. You cannot hire people off the street.

We have created a pipeline approach for high school juniors and seniors that allows them to get acclimated and educated on what these jobs are like while they also begin taking credited courses toward their college degree in math or science. Schools such as Bismarck College are cooperating with us by offering the opportunity to obtain degrees online.

There are many other examples of initiatives. For example, the Taft-Hartley Training Fund involves



D. Michael Langford and George Manoogian, Utility Workers Union of America, AFL-CIO

multiple employers' participation. These funds can be leveraged along with grant dollars, which are helpful in getting programs going. The Carpenters Union, for example, has created its own state-of-the-art training center in Las Vegas, which is one of the top training centers in the world.

Even as we try to attract new workers, we must consider those that are leaving. Half the electric utility workers will be leaving the workforce during the next five years. Many do not want to retire but are leaving so as not to lose the health insurance they are currently guaranteed. We are working to recruit and train these experienced and retired workers to serve as mentors.

Do we wish we had begun these initiatives 10 years ago before the situation became so acute? Of course, but 10 years ago the focus wasn't there among the utilities and other companies. It is now, so we must take advantage of it.

Dialogue III Photos



Deborah L. Wince-Smith, Council on Competitiveness; Shirley Ann Jackson, Rensselaer Polytechnic Institute; and Susan Rochford, Council on Competitiveness.



Andris Silins, United Brotherhood of Carpenters & Joiners of America, and Debbie van Opstal, Council on Competitiveness.



Branko Terzic, Deloitte Services LP, and Ric Abel, Prudential Capital Group.



Paul Hunt, Michigan State University; George Manoogian, Utility Workers Union of America, AFL-CIO; and Anne Hoskins, Public Service Enterprise Group Incorporated.



Richard Brent, Solar Turbines Incorporated, and Cynthia McIntyre, Council on Competitiveness.



Experts convened in small groups for more in-depth discussions.



Dialogue III experts engaged in roundtable plenary discussions and presentations for the day and a half event.



Scott Pace, NASA Headquarters; Sharon Finley and James Finley, U.S. Department of Defense; Roy Ferguson, Embassy of New Zealand; Deborah L. Wince-Smith, Council on Competitiveness; Starnes E. Walker III, U.S. Department of Homeland Security; Shirley Ann Jackson, Rensselaer Polytechnic Institute; and Arden L. Bement, Jr., National Science Foundation.



Ben Erulkar, U.S. Department of Commerce, and Deborah L. Wince-Smith, Council on Competitiveness.



Peter Evans, GE Energy, and Susan Rochford, Council on Competitiveness.



Shirley Ann Jackson, Rensselaer Polytechnic Institute; John Holdren, Harvard University; James Finley, U.S. Department of Defense; and Deborah L. Wince-Smith, Council on Competitiveness.

Dialogue Proceedings

Meeting the Energy Challenge: Innovation for Competitiveness, Security and Sustainability

A KEYNOTE PRESENTATION

John Holdren

John F. Kennedy School of Government
Harvard University

Energy strategy is complicated by the multiple objectives it has to meet, including economic and environmental goals and a set of national security and other international aims. The most fundamental of energy-related security problems is avoiding energy blunders that perpetuate or create deprivation.

Energy strategy is difficult in part because these aims are often in tension with one another. It also is difficult because it is an initial-value problem—not an equilibrium problem—with initial values and rates of change that are unfavorable for desired outcomes, especially in relation to the problems of oil dependence and global climate disruption from fossil fuel use. And there is no technological silver bullet, no panacea, no one thing that we can do to meet all of our energy strategy aims.

In this situation, energy policy has two primary tasks. One is to find and implement the best compromises available among the most important economic, environmental and security objectives—given the resources and the technologies currently available. The second task is to promote technological advances that, over time, reduce the limitations of existing energy options and thereby alleviate the tensions among the various objectives.



Soaring Energy Demand But Plenty of Resources and Money

In the 150 years from 1850 to 2000, world energy use increased twentyfold. The growth rate in the last 50 years of this period was more than 3 percent per year, twice the rate in the preceding 100 years. That growth was driven above all by expansion of oil and natural gas consumption. The United States is still the largest energy-consuming country in the world, but China is closing the gap. China's energy use is expected to double between now and 2030.

The problem is not that the world is running out of energy. It is running out of cheap and easy oil and gas, but other fossil, nuclear and renewable energy resources are large in relation to current and

foreseeable demand. Nor is the problem that the world is running out of money. The projected capital investment in energy-supply technology from 2005 to 2030 is in the range of \$15-30 trillion. This is real money, but it is only 5 percent to 10 percent of total investment projected for this period.

Tensions Among Multiple Energy Objectives

The real problems with our energy aims are the tensions that lie among them: cost minimization versus energy system modernization, increased robustness and reliability and environmental improvements; increased domestic fossil-fuel production versus protection of fragile ecosystems; and increased nuclear-energy production for greenhouse gas abatement versus reduced risks of accidents and terrorism.

Another set of problems accompany the world's dependence on fossil fuels and its increasing dependence on imported oil and gas. These mean economic vulnerability as well as international tensions and potential for conflict over access and terms. Emissions of carbon dioxide from fossil fuel burning are also the largest driver of global climate disruption, with harm to human well-being rapidly becoming more severe.

The two biggest challenges the world faces in the energy domain are: 1) reducing urban and regional air pollution and the dangers of overdependence on oil, despite growing demand worldwide for personal transportation, and 2) providing the affordable energy that is needed to create and sustain prosperity everywhere without wrecking the global climate with carbon dioxide emitted by burning fossil fuel.

Worldwide Growth for Personal Transportation

In 2006, the United States was using about 21 million barrels of oil a day and importing almost two-thirds of it. Forecasts show oil use in the country going up

to 28 million barrels a day by 2030, with all of the increase expected to come from imports. There is no expectation that the United States can do anything more than maintain domestic production during that time span.

Transportation uses most of the world's oil, has done so in the past and is expected to do so in the future. The number of vehicles registered in Beijing has been growing at an absolutely extraordinary 50 percent per year. China's oil imports by 2030 are expected to be about as big as those in the United States are today. The fact that imports of oil from the Persian Gulf going to all of developing Asia are already bigger than imports from the Persian Gulf going to North America is a great surprise to many people.

The Largest Climate Change Driver

Global climate is changing rapidly, and humans are responsible for most of the change. Carbon dioxide (CO₂) emissions are the largest driver, with 75 percent to 85 percent of the CO₂ coming from the combustion of fossil fuels. These emissions are immense in total magnitude—about 30 billion tons per year in 2006 from fossil fuels. The remaining human-caused CO₂ emissions come mainly from deforestation, almost entirely in the tropics.

The World Health Organization has estimated that in 2000, more than 150,000 premature deaths worldwide were attributable to climate change—heat waves, floods, droughts, expanded range of malaria and dengue fever and other climate-related factors. And continuation of business-as-usual greenhouse gas emissions will mean increasing severity and frequency of heat waves and droughts, accelerating ice-sheet loss and sea-level rise and much more.

The world's 80 percent fossil fuel-dependent energy system represents approximately \$15 trillion in capital investment and turns over in a 30- to 40-year time-frame. These numbers show that the world cannot

change its energy system overnight. Yet avoiding the biggest risks from climate change requires that the world sharply reduce the ratio of carbon dioxide produced from energy delivered, starting immediately.

The World's Three Options

Climate change presents the world with three options: mitigation, adaptation and suffering. Mitigation means measures to reduce the pace and the magnitude with which the climate changes. Adaptation entails measures to reduce the adverse impacts of climate change not by mitigation. And climate change that is neither avoided nor adapted to means suffering. What remains to be determined is the future mix of mitigation, adaptation and suffering.

Options for adaptation include changing cropping patterns and agricultural practices, increasing defenses against tropical diseases and building new water projects for flood control and drought management.

The cheapest, fastest and most reliable means of mitigation is to increase the efficiency of energy use in buildings, industry and transport. Such actions are win-win; they save money, reduce conventional pollution and reduce oil imports. Unfortunately, such win-win approaches are not going to be enough by themselves. Adequate mitigation will also require using more costly options (such as nuclear and solar energy and CO₂ capture and sequestration from fossil-fuel power plants) to reduce greenhouse gas emissions from energy supply.

Coal-burning power plants projected to be built between now and 2030 will emit in their lifetime about as much carbon dioxide as all previous coal burning in human history. If these emissions actually occur, there will be no possibility of stabilizing the atmospheric concentration of CO₂ at a level that would provide a reasonable chance of avoiding intolerable impacts from climate change.

Innovation Does Not Happen By Itself

We need accelerated innovation in energy technology if the challenges described here are to be successfully addressed. Only with better technologies are we going to be able to limit oil imports and oil dependence without incurring excessive economic or environmental costs and to provide the energy needed for economic development and sustainable prosperity without wrecking the global climate.

Increased research, development and demonstration (RD&D) should be the easiest part of getting the needed innovation done, because it is relatively inexpensive. But even this is not happening at the needed scale. In 2005, world economic product was \$60 trillion, annual retail expenditures on energy were about \$5 trillion, all R&D worldwide was a trillion, investments in the energy supply system were \$800 billion, but world energy R&D expenditures were under \$30 billion.

Clearly, new policies to encourage and deploy innovation are going to be essential. We need both increased government investments in energy RD&D and increased incentives for private-sector investment in this domain. Those incentives need to be predictable over the long term in order to be effective. And they need to include a substantial price on carbon emissions, either through a carbon tax or a cap and trade system.

Dialogue Proceedings

Drivers for Deploying Sustainable Solutions: Energy System Snapshots

During the course of Progressive Dialogue III, experts brought forth a range of insights about the U.S. energy system. Taken together, these perspectives offer a series of incisive “snapshots” of the key trends and influencing factors that are—or will—shape major aspects of the nation’s energy future.

Energy Efficiency

The U.S. economy has doubled since the 1970s, but energy use has only increased by about 50 percent.¹¹ Still, there is much more the United States can do in this area with great economic benefits. For example, the McKinsey Global Institute reports that the United States can cap its energy consumption and related GHG emissions to 2007 levels by only utilizing existing energy efficient technologies with an internal rate of return of 10 percent or more.¹² There is much other low-hanging fruit, such as waste heat recovery and the design of new buildings. In the electric power sector, for example, investing in efficiency can relieve the need for new plant construction and can secure electricity at half the rate per kilowatt-hour it would otherwise have cost. Another study by McKinsey indicates that half of the global CO₂ emissions reductions necessary to cap emissions at 450 parts per million can be achieved through energy efficiency improvements with existing technologies.¹³

The trajectory for energy demand and timeline for emissions reductions makes it abundantly clear that much more needs to be done to exploit the energy efficiency opportunity. The U.S. Department of Energy and many states have instituted a number of good energy efficiency programs, but the market for energy efficiency remains severely flawed in sev-

eral ways. Utilities have little incentive to work with customers on promoting efficiency. In the buildings sector, which consumes approximately 40 percent of U.S. energy, those that develop and own the buildings do not typically pay the energy bills and are therefore not motivated to build or renovate for energy efficiency—known as the “agency problem.”¹⁴ Across the economy, there is much emphasis on pay-back periods for efficiency investments in spite of the fact that they represent negative-cost, carbon free alternatives to energy production.

Setting national standards for efficiency can overcome the agency problem in the building sector. Fannie Mae and others can offer energy efficiency mortgages. Dialogue III experts recommended that the United States take a cue from the EU and Australia by banning incandescent light bulbs. The United States only recently passed legislation to gradually phase them out by 2014. In the energy sector, federal fiscal policy can be changed in a way to accelerate the turnover of old, inefficient capital equipment. For transportation, fuel efficiency standards for vehicles are being set for a number of years out, although the automotive industry could actually meet these standards with current technology today.

“The technology exists to make energy efficiency a reality—what is lacking is the political will to drive widespread use. In this regard, the United States is significantly behind Australia and the European Union. Stable, reliable, long-term incentives from government at the federal, state and local levels are essential, such as renewable energy tax credits. There already exists an almost universal belief that such incentives are good public policy, but the path for the private sector to amass capital, expand manufacturing and respond must be established.

One potential driver of efficiency is through transparency. Providing information to the general public will empower the consumer to make choices driven by efficiency. Mandatory labeling on appliances, informing the customer of the kilowatts of electricity needed to operate the appliance and the associated cost per year, will compel efficient purchasing practices. The same model can be employed in homes and buildings, and with manufacturing equipment in the industrial sectors. Such information can be a tremendous asset value, and must be measured and reported. Blending the



energy costs with the capital cost is a critical step in educating the marketplace. Once the customer—whether commercial, industrial, government or the residential consumer—has choices at their disposal, and the necessary information to make those choices, they will be able to respond more quickly to the realities of our energy supply.”

Scott Sklar, The Stella Group, Ltd.

Renewables

Some Dialogue III experts expressed concern that renewable energy technologies continue to face a degree of doubt in the marketplace. But they work, and the United States will need to deploy them at much greater scale to meet future energy needs in a sustainable manner. Contrary to what some may believe, production of renewable energy presents the biggest future growth opportunity in the energy industry, not conventional oil and gas. Renewables are perceived as lacking cost-competitiveness, but if all externalities were incorporated into the price of various forms of energy, the cost equation for renewables would look more favorable. The cost curve is coming down steeply.

Utilities accustomed to the state regulatory environment should take the lead investment role for renewables. This would reduce the perception of risk associated with the investments and thereby the cost of capital. On the consumer side, individuals or enterprises selling power back to the grid should receive close to market price.

Other nations are pursuing more aggressive and consistent policies on renewable energy. For example, the EU has set a target to have 20 percent of final energy consumption from renewables by 2020. EU members have utilized feed-in tariffs to drive deployment of renewable energy by paying producers a premium rate for their output over a long period of time—20 years in Germany. In the United States, the production tax credit (PTC) for renewables has been a very successful policy. For example, it has enabled technological advances in wind turbines that have improved their reliability and capacity, which in turn increases the value of the product to the customer. But the PTC has been on-again, off-again in Congress, and this has inhibited investments.

Renewables represent a tremendous growth opportunity. The conventional oil and gas system that has driven economic development for a century will not

“If you are going to love renewables, and if you really want to make energy efficiency happen, and if you really want to ensure reliable supply from central power stations, whether the technology is clean coal, nuclear or otherwise, then you must understand that the grid is going to have to be an important element of each.”

Gregory Ioanidis, ITC Holdings Corp.

be able to match these growth rates. Renewables will have to play a substantial role in meeting future global energy needs—and as the developed world is largely flattening on energy demand, this growth will be in the developing economies.

The Electric Grid and Transmission System

The U.S. electricity system was built out in the 1940s and 1950s. It is now failing and falling apart, particularly in the northern half of the United States. The system that transports electricity—the transmission system—was originally designed in the 1950s and 1960s to back up regional power authorities in the event of difficulty. Today, it is being used as a highway for the flow of electrons and is essentially full. It is at capacity in two-thirds of the United States.

Today, the integrating element to achieving core U.S. energy systems goals—greater deployment of renewables, plug-in hybrids, energy efficiency and reliable power from central stations—has become the grid and transmission system. That system must become smart, self-healing and resilient. It must allow for interaction with devices that allow consumers to see the real-time price of the power they consume.



Deborah L. Wince-Smith, Council on Competitiveness; John F. Mizroch, U.S. Department of Energy; and Chad Evans, Council on Competitiveness.

“Utilities have tremendous opportunities in the short and long term. They will play a critical role in developing the infrastructure to support plug-in hybrid vehicles. Additionally, net zero energy buildings and homes—and advances in distributed energy—could help utilities manage future electricity loads. If these investments are made today, they could significantly impact projected energy needs and the need for additional generating capacity in the future.”

John F. Mizroch, U.S. Department of Energy

The transmission system is an often overlooked issue. Distribution of renewable generated power can improve the stability of the grid. Deployment of a higher-voltage backbone (e.g., 756 kV) would reduce transmission losses dramatically—a major efficiency gain. Transmission investment is a critical aspect, whether it is to allow direct current (DC) ties

from renewable resource rich areas or just making sure that the alternating current (AC) system is more robust in terms of moving conventional supply to where demand requires it.

Moving forward, Dialogue III experts believe there are many aspects of grid and transmission infrastructure investment to consider. Some aspects of the current system’s design may now be obsolete, while certain other aspects can be redeployed, such as the wire line structure. Other requirements for the grid and transmission system must also be considered. For example, the damage that nature can inflict far exceeds the damage that any terrorist can even imagine. Storms are bigger. Hot is hotter. Cold is colder. The United States must prepare its infrastructure for the kinds of man-made and natural violence that can occur.

Global competition for materials has become a serious issue in revamping U.S. energy infrastructure as other developing countries rapidly bring new power production on line at a dizzying rate. One expert recounted that the Cliffside unit of Duke Power announced in 2006 it would build two 800 megawatt coal-fired plants. The starting point for construction was \$2 billion dollars for 1,600 megawatts of installed capacity. By February of 2008, Duke changed their estimate for the fourth time in less than two years. Now they are going to build one 800-megawatt unit at \$2.4 billion dollars. That comes to \$3,000 per megawatt for a new coal-fired power plant.

The United States ability to compete for these resources has been weakened as its industrial base has shrunk. There is no foundry, a factory which produces metal castings, in the United States that can support the needs of the electric utility industry. Instead, steam generators and major turbine rotors are being purchased from Japan Steelworks and other outfits in China and India. These are great manufacturers, but they are not here in the United

States. The United States must now rely on global markets, subject to currency fluctuations and other whims, to rebuild its infrastructure. That has changed the competitive picture dramatically for U.S. energy companies.

Electric Power Sector

The electric power industry and its regulation have evolved during the past 100 years, resulting in many different layers of both jurisdictional boundaries as well as regulatory structures. The current regulatory process is a real patchwork quilt. There are state-by-state regulations forming the national network. Some states are fully regulated, some are still evaluating deregulation, and there are a few that are deregulated. There are federal energy regulatory policies and state regulations.

Utilities are only motivated to invest where regulators allow, and that motivation is sometimes skewed toward investments that are not the best for the long term. Provision of least-cost power has been the driver of regulatory decision-making, but some public utility commissions are waking up to the need to incorporate externalities into power costs. Current regulation does not allow most utilities to profit by promoting energy efficiency among consumers, nor are utility investments in improving efficiency rewarded. The public sector needs to straighten out the regulatory process, and not just state-by-state but the entire picture, to be more conducive to clean energy investments. Some experts suggested that the electric power sector may need a regulatory overhaul along the lines of the telecommunications industry in the 1990s.

Growing pressures to increase supply and manage load will be lessened as the nation trends toward distributed generation, zero-net energy buildings/homes and smart appliances. U.S. electric power companies have a huge opportunity to differentiate their products by eliminating power quality problems such as sags, surges and transients that interfere with the operation

“In order to reduce our dependence on fossil fuels, the United States must begin two crucial processes: the electrification of our transportation system and the decarbonization of our electric supply services. Three means of achieving such decarbonization are: increased investment in energy efficiency, renewable energy sources and central power station power that does not produce carbon—meaning nuclear power—or that captures and stores it—meaning investment in carbon capture and sequestration technologies.

The first priority for the United States in attaining these goals is to set a price associated with externalities that are inherent in the consumption of electricity, particularly the production of carbon. The second, to the extent the market is flawed, is to initiate regulatory reform that addresses those flaws. And third, the United States must undertake a massive public education effort as to what all this will mean for consumers. After the federal government has set a price for carbon, the market can be allowed to operate without excessive regulation.”

Ralph Izzo, Public Service Enterprise Group Incorporated

of sophisticated information technologies. If utilities transparently measured and reported their power quality, they could offer consumers various grades of power for different functions. A smart grid interacting with smart devices will also be able to provide consumers with information on the real-time price of power, enabling more informed decisions.

Deployment of existing technologies could help the power sector improve capacity utilization and improve power quality. Development of innovative IT-based technologies will revolutionize energy management

across sectors. Electrification of the transportation system also poses a major new market opportunity for utilities, and plug-in hybrids offer immense benefits in efficiency and carbon reduction, while also holding potential for energy storage functionality.

For many years, Wall Street rewarded the electric power industry for keeping capital expenditures low, resulting in a serious underinvestment in electric infrastructure in the United States. The pendulum has now swung to the other side, and the industry has begun to reinvest but struggles with finding the right balance in today's current regulatory environment. On the generation side, for example, there are a lot of new plants coming and going off-line. There is also great uncertainty about investing in coal-fired power, and climate change legislation is going to be a big factor in determining what happens next.

Oil and Gas Industry

Energy security, not energy independence, is the operational approach for the oil and natural gas industry. Diversity of supply is essential as oil and natural gas assets and resources are distributed across the globe. World energy markets are interconnected. Developing countries are now driving global economic growth, and therefore energy demand, not the United States and Europe. Energy "nationalism" is on the rise among states with state-owned resources. Sovereign wealth funds have amassed in oil exporting nations, increasing the influence of these countries. The United States still has abundant resources but the majority, on federal lands or off coastal waters, has been off-limits to development.

To maintain its competitiveness and fulfill its vital role in meeting domestic energy demand, the oil and gas industry will need U.S. government support in obtaining access to both domestic and international resources. The United States is the third largest oil producer and second largest gas producer in the

"There is a big difference between resources and reserves. While it is true that the large majority of conventional oil and gas reserves are held in other countries, the situation is reversed when we consider unconventional resources. For example, tar sands, oil shale deposits and unconventional oil and gas reservoirs put North America in a world-class position. Converting these multi-trillion barrel resources to recoverable reserves requires overcoming significant technical, economic and environmental challenges. Advanced technology and capital, applied at scale, is what converts energy resources to reserves. If the industry can meet this challenge and significantly reduce the carbon intensity of these vast unconventional resources, we can create a major new production base for the future."

Donald Paul, Formerly with Chevron Corporation

world. If the U.S. oil and gas production base is not sustained, even more imports will be flooding the market to compensate. Over the years, technology has evolved to broaden the range of resources that can be accessed, including those in deep water, oil sands and shale, and the industry is continuing to invest in new technologies. The U.S. industry has learned how to recover these resources in an environmentally responsible way, but these measures add to energy production costs. Some Dialogue III experts are concerned about the competitiveness

implications of differing costs of energy production around the world. Increased efficiency in the oil and natural gas industries will be essential to addressing the escalating costs of production and accessing physical resources.

While there are significant national oil and gas resources in the United States, conventional and unconventional, they do not present a long-term solution for meeting energy needs. The United States must think about the best purpose for the hydrocarbons it does produce and consider alternative and cleaner energy options for other needs. For example, oil and natural gas are industrial feedstocks for manufacturing of goods such as chemicals and pharmaceuticals. Oil and gas can also be utilized as feedstocks for a number of advanced transportation technologies, such as fuel cells.

Nuclear

Nuclear power provides 20 percent of U.S. electricity today and does not emit CO₂ when produced. To even maintain this proportion of power production, the industry will need to bring dozens of new nuclear power plants on line. It has been 31 years since a new nuclear plant has been built in the United States. Because it has been so long, no one knows for sure how much it will cost. One expert detailed how it has been estimated that a new nuclear power plant would cost about \$3,200-\$6,000 a megawatt, which would cost \$10-\$18 billion in today's dollars for a 3,000-megawatt power plant. Companies cannot carry that kind of debt on their balance sheets without loan guarantees. So while nuclear power is a readily available, carbon free and reliable energy source, the business case for building new power plants is very weak. Federal loan guarantees and timely license renewals for existing plants are crucial to maintaining the U.S. nuclear power capacity.



Ric Abel, Prudential Capital Group; Robert E. Estill, Marathon Oil Corporation; and John Tombari, Schlumberger Carbon Services.

“World energy demand will only increase. It is going to be driven by global population growth—from approximately six and a half billion people today to about eight billion by 2030. Developing countries are pursuing the same goals as the United States: growing economies and domestic prosperity. These universal goals are going to drive the need for a secure energy supply. The composition of energy use today is comprised of 55 percent oil and gas, 25 percent coal and 20 percent alternative resources. Dramatic growth in non-fossil fuel energy sources is essential. If the United States were to reduce energy use by 8 percent to 9 percent, and all of that was petroleum, our oil imports would decrease by one third.”

Robert E. Estill, Marathon Oil Corporation

Carbon Capture and Sequestration

Coal is an abundant energy resource for the United States and a key factor in maintaining the country's international competitiveness. Because global carbon emission reduction goals cannot be met without addressing those resulting from coal combustion, the United States needs to create incentives and smart policies to accelerate the development and deployment of CCS technologies. Without these it will be decades until CCS is commercially available on a wide basis.

Low carbon technologies are in need of deployment on a massive scale. CCS is a critical technology—for lowering the carbon content of coal-fired electricity generation—in need of a large, commercial-scale demonstration program. Some estimate that each year of delay in bringing CCS on stream equates to a percentage point increase in the atmospheric concentration of CO₂. Deployment of this technology requires a balance between urgency and long-term strategic vision. The ideal policy approach will be technology-neutral and meant to encourage a broad portfolio of low-carbon solutions.

Cost escalations resulting from a fundamentally different commodities market must be factored into this strategy. Global competition for steel, copper and other materials had driven up prices for the energy industry by 25 percent to 75 percent or more by the middle of 2008. Experts discussed how ultimately, the cost of CCS must be brought way down to at least \$15 a megawatt to have an impact in the marketplace.

Progress must be made now on developing the terms for CCS. Though the technology is not ready for market yet, there is no place in the world yet that has passed a law that regulates CCS. In the United States, there is neither a federal nor a state law. A regulatory framework must be set that will facilitate the placement of piping and storage of the CO₂.

“Coal is a fundamental resource in the United States; it remains essential and in plentiful supply. If the United States is going to remain competitive in the global economy, coal will continue to be utilized. An effective U.S. carbon policy regime is therefore likely if it is constructed around a ‘Grand Bargain’ that reduces coal’s carbon footprint. One element of such a bargain is to establish a robust technology transformation program. This program will need to include federal support to promote early demonstration and deployment of carbon capture and storage technologies, which will be slow to achieve broad market acceptance unless the high costs associated with ‘first-mover’ adoption and implementation can be offset.”

Peter Evans, GE Energy



Dialogue Proceedings

Water: A Critical Business Driver for the Energy Industry

A FEATURED PRESENTATION

James E. McMahon

Lawrence Berkeley National Laboratory

Water security and energy security have been jointly examined by national laboratories during the last five years. The purpose of dual consideration is to determine if energy planners are considering the water constraints on their future plans, and if water planners are considering a similar set of energy constraints. Thus far, the two arenas have not been adequately connected.

They should be. Water and energy are interdependent. Maintaining a sustainable water supply in the future without greatly increasing energy use is a significant challenge facing this country. The complimentary challenge is supplying sufficient energy, particularly electricity and biofuels, with limited water supplies. New practices are needed to manage these resources jointly. The United States withdraws approximately 350 billion gallons of fresh water each day—260 billion gallons from surface water and about 90 billion gallons from ground water. Thirty-nine percent is for irrigation (mostly consumed), and another 39 percent is for cooling thermoelectric power plants (predominantly returned to the source).

Options for a Sustainable, Future Water Supply

Alternative storage, local treatment and water reuse and reclamation on a larger scale are some of the new water management techniques being employed. The reallocation of water through water markets is an option that has received a great deal



James Kim, CMEA Ventures, and James E. McMahon, Lawrence Berkeley National Laboratory.

of consideration. However, most water is controlled by contracts and it is therefore very difficult to trade among entities. Integrated management should be a prominent component of water planning tools, as well as the use of recycled water and recharging of ground water.







Energy costs will help determine the next sources of fresh water. Unfortunately, the energy requirements for desalination are three to five times the energy requirements currently in the public water supply. Similarly, water costs will affect the location of new power plants. Water is used for cooling and heat recovery at electricity generation sites and in cogeneration to accrue efficiency opportunities. The power plant industry knows this to be a serious consideration and constraint in siting new facilities.

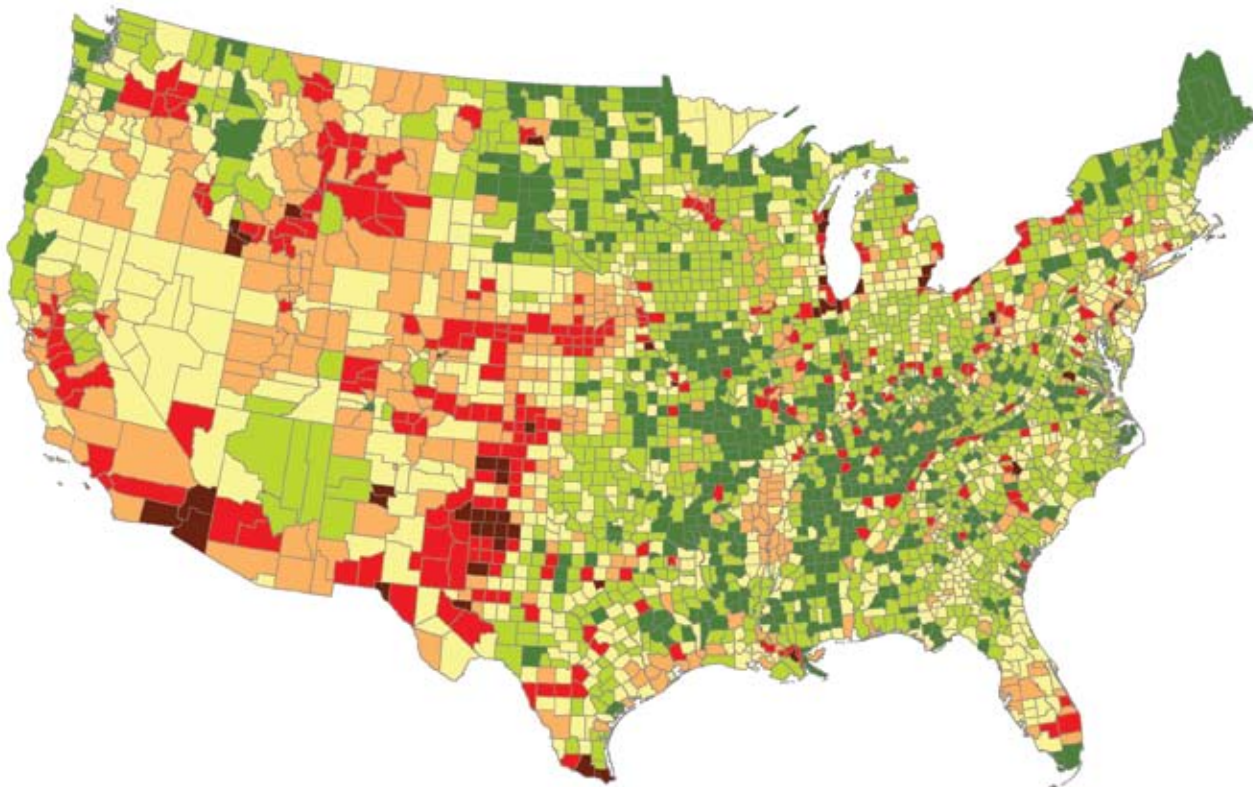
Current Withdrawals of Freshwater May Not be Sustainable

Source: Electric Power Research Institute, 2003

In the red counties, more water is withdrawn for human use than is supplied annually by precipitation.

TOTAL FRESHWATER WITHDRAWAL, 1995 VS. AVAILABLE PRECIPITATION NUMBER OF COUNTIES NOTED IN PARENTHESES

 ≥ 500% (49)	 30-100% (363)	 1-5% (1,078)
 100-500% (267)	 5-30% (740)	 0-1% (614)



The Cost of Water is Rising

The cost of our water supply, historically, has been subsidized by large government projects. Therefore, future water prices are likely to increase, especially if a market for water is created. Agricultural interests have had very inexpensive water up to the present, and cities are now willing to pay a great deal more for that water. Water-energy shortages may interact so as to amplify the economic impacts of climate change.

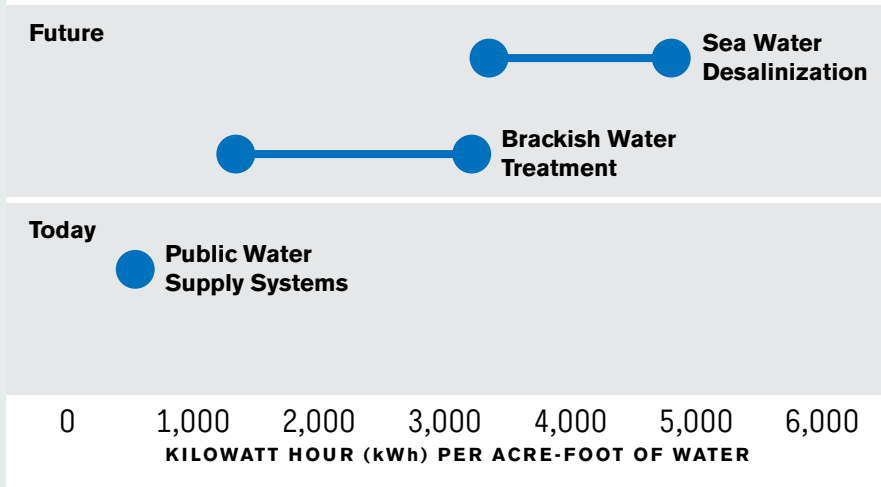
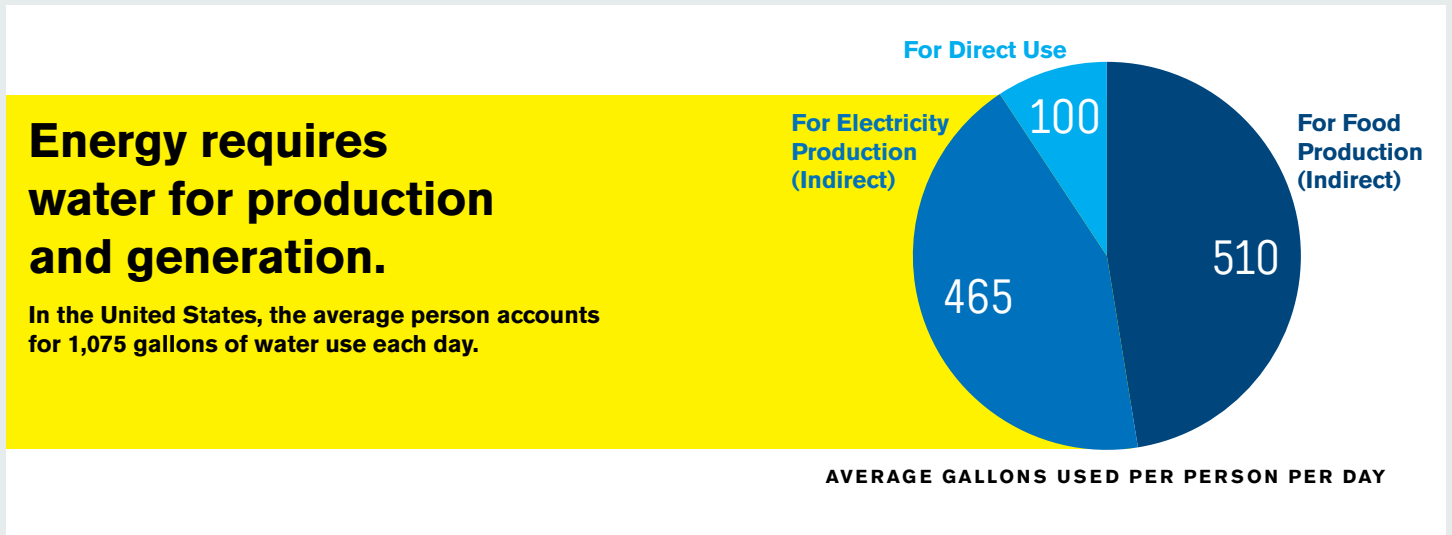
Saving water saves energy, and saving energy saves water. Traditional water saving programs, utilized in the United States during times of drought, require members of the public to reduce their average use of 100 gallons of water per day. Yet the public is not told to reduce their energy consumption or to change their choice of food in order to save water. As policymakers begin to recognize the high degree of integration between energy supply, water supply and land use, planning methods can be adapted to encompass more appropriate measures.

“Water and energy are interdependent. Maintaining a sustainable water supply in the future without greatly increasing energy use is a challenge...Competition for water is limiting energy.”

James McMahon, Lawrence Berkeley National Laboratory

Energy Requires Water. Water Requires Energy.

Source: U.S. Geological Survey, 1997



Water requires energy for pumping, treating and delivery, and will require more in the future.

Dialogue III Postscript

In each of the three Progressive Dialogues, experts broke into small groups to consider issues in more depth and to generate specific conclusions and actionable ideas for achieving the energy system transformation the United States so urgently requires. These conclusions and ideas are reflected throughout these proceedings. The Council is extremely appreciative of the candor and creativity of the experts who participated in Progressive Dialogue III as well as those who participated in the first two convenings. And while achievement of consensus was neither requested nor expected at any Dialogue, it has been enlightening to witness how several diverse and multi-disciplinary groups of individuals can come to align around key themes and conclusions.

The outcomes of Progressive Dialogues I-III have served as an invaluable resource to the deliberations of the Council and the CEO-level Steering Committee for the Energy Security, Innovation & Sustainability Initiative. In a few short weeks following the conclusion of Progressive Dialogue III, the Council distilled these many insights, findings and ideas into *Prioritize: A 100-Day Energy Action Plan for the 44th President of the United States*. The Council believes that immediate action by the

president in these areas will set the stage for a new wave of energy innovation and investment, while ensuring U.S. competitiveness as the nation transitions to a sustainable energy system.

It is important to stress that the actions recommended for the administration mark the beginning, not the end, of a concerted commitment it must make in order to ensure the United States achieves energy security in a sustainable manner, while ensuring the competitiveness of its workers, industries and economy. The Council will issue a comprehensive set of recommendations, addressing the need for both public and private sector action, at a National Energy Summit this fall. The president and his cabinet are invited to participate with the Council at this important event.

Notes

- 1 Energy Information Administration, *International Energy Outlook 2008*, U.S. Department of Energy (June 2008), <http://www.eia.doe.gov/oiaf/ieo/>.
- 2 IPCC Fourth Assessment Report, *Climate Change 2007*, Intergovernmental Panel on Climate Change (2007).
- 3 Oreskes, Naomi. "Beyond the Ivory Tower: The Scientific Consensus on Climate Change," *Science* 306, no. 5702 (December 3, 2004), <http://www.sciencemag.org/cgi/content/full/306/5702/1686>.
- 4 Bell, Nathan E. *Graduate Enrollment and Degrees: 1997 to 2007*, Council of Graduate Schools (Revised November 2008), http://www.cgsnet.org/portals/0/pdf/R_ED2007.pdf.
- 5 Remarks as Prepared for Delivery by Secretary Bodman for the U.S. Department of Energy National Science Bowl, May 5, 2008, <http://www.energy.gov/print/6205.htm>.
- 6 Ibid.
- 7 Davidson, Paul. "Utilities brace for worker shortage," USA TODAY, May 16, 2007, http://www.usatoday.com/money/economy/employment/2007-05-16-power-shortage-cover_N.htm.
- 8 Energy Information Administration, *International Energy Annual 2006*, U.S. Department of Energy (June 2008), <http://www.eia.doe.gov/emeu/iea/contents.html>.
- 9 Energy Information Administration, "Country Analysis Briefs: Canada," U.S. Department of Energy (May 2008), <http://www.eia.doe.gov/cabs/Canada/Background.html>.
- 10 RE-GO, <http://www.re-go.info/rego.html>.
- 11 Energy Information Administration, *Annual Energy Review 2007*, U.S. Department of Energy (June 2008), <http://www.eia.doe.gov/emeu/aer/overview.html>.
- 12 *Wasted Energy: How the U.S. Can Reach its Energy Productivity Potential*, McKinsey Global Institute (July 2007).
- 13 *The Case for Investing in Energy Productivity*, McKinsey Global Institute (February 2008).
- 14 Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2007*, U.S. Department of Energy (December 2008), [http://www.eia.doe.gov/oiaf/1605/ggrpt/pdf/0573\(2007\).pdf](http://www.eia.doe.gov/oiaf/1605/ggrpt/pdf/0573(2007).pdf).

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- Generating new policy ideas and concepts to shape the competitiveness debate
- Forging public and private partnerships to drive consensus
- Galvanizing stakeholders to translate policy into action and change

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