Energy & Manufacturing Competitiveness Partnership

Leverage.

Phase II Sector Study: Energy

Compete.

Council on Competitiveness

Leverage.
Phase II Sector Study: Energy

THE COUNCIL ON COMPETITIVENESS is a nonprofit, 501(c) (3) organization as recognized by the U.S. Internal Revenue Service. The Council's activities are funded by contributions from its members, foundations, and project contributions. To learn more about the Council on Competitiveness, visit our home page at Compete.org.

Printed in the United States of America

Energy & Manufacturing Competitiveness Partnership

Leverage.

Phase II Sector Study: Energy

Table of Contents

Letter from the Co-Chairs

The Council on Competitiveness, Exelon Corporation, Penn State University and Argonne National Laboratory are pleased to present the final report on the Energy and Manufacturing Competitiveness Partnership (EMCP) dialogue on America's energy sector. *Leverage: Energy* provides an overview of this critical sector of the economy, as well as a set of recommendations on how America can address the challenges and capitalize on the opportunities presented by new-found energy abundance and an expanding supply of more sustainable, clean energy.

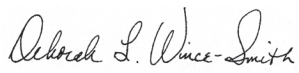
With one of the most complex supply portfolios of any industry, the U.S. energy sector is an enormous driver of research, innovation and manufacturing across a broad range of technologies and applications. Energy is the competitive advantage of our country, and our abundance of existing low-cost and low emission energy can continue to drive economic growth for the entire economy and create opportunities to advance our manufacturing capabilities.

But radical changes in the energy sector are happening faster than ever. From inconsistent market structures that threaten existing low emission resources to changing economic pressure and rising security threats, the challenges that accompany opportunities in the energy sector are numerous and complex. Because of the constant evolution of the energy sector and its significant role in America's ability to compete, this sector study is central to the themes and issues we have explored as part of the EMCP.

Among the key findings of this study, which builds on the first four sector studies conducted under the Council's leadership, are the need to: develop additional energy storage capacity; protect America's energy infrastructure from the threat of physical and cyber attacks; better guide research and investment in the energy sector to areas in a way that speeds the commercialization of new technologies; and encourage a multidisciplinary approach to education that provides the current and future workers with the skills needed to succeed in the various and evolving areas encompassed by the energy sector.

We recognize that none of this would be possible without the support of our members and key experts that provided their valuable input and unique perspectives and we thank them all for their continued work with us. We look forward to continuing engagement with national and regional leaders in industry, academia, national laboratories and government as we capture insights and recommendations across our sector dialogues and put forward an action plan to drive U.S. productivity and prosperity.

Sincerely,



The Honorable
Deborah L. Wince-Smith
President & CEO
Council on Competitiveness

Dr. Eric Barron
President
Penn State University

Mr. Christopher Crane
President & CEO
Exelon Corporation

Dr. Paul Kearns
Director
Argonne National Laboratory

Introduction

Energy is the linchpin of economic growth and prosperity. In its abundance, low-cost, efficient energy can create a competitive advantage for the United States, enabling increased productivity and efficiency across industries. The country's commitment to energy efficiency has helped not only to reduce the negative environmental impacts associated with heavy industrial and consumer reliance on energy, traditionally in the form of coal and other fossil fuels, but also to reduce costs and drive innovation and competitiveness.

As the world sits on the precipice of a clean energy revolution, energy resides as an attractive investment that both supports preserving the nation's existing zero emission technologies and enables new technologies and innovative strategies to reduce the carbon footprint and remain sustainable for generations to come. But America's energy security is also an issue of national security. As the United States continues to advance and modernize its energy systems, it is important to ensure grid modernization does not occur at the expense of security. Monitoring cyber activity and guarding against infiltrations of America's grid and nuclear plants are a significant concern, and grid security is a national security risk of the highest order.

In its 2011 report, *Make: An American Manufacturing Movement*, the Council declares "the image of manufacturing as dumb, dirty, dangerous and disappearing is inaccurate." In fact, today's manufacturing, underpinned by today's energy portfolio, is increasingly "smart, safe, sustainable and surging." But to transform this outlook into a clear competitive advantage for industry and workers, business practices, government policies and strategic investments must reflect the opportunities for and needs of the private sector. Capitalizing on the opportunities of America's energy-manufacturing nexus requires overcoming barriers in talent, technology, investment and infrastructure.

The Council on Competitiveness hosted the Energy and Manufacturing Competitiveness Partnership (EMCP) sector study dialogue on energy on May 31, 2017 in partnership with Exelon Corporation, Penn State University and Argonne National Laboratory to address these and other current issues in the energy economy. The dialogue focused on strategies for a sustainable, economically viable energy future that satisfies the sometimes-competing needs of consumers, industry and the environment. Based on the discussion, this report puts forth recommendations to capitalize on the current capabilities and future opportunities across the energy landscape.

Findings & Recommendations

- **Implement regulatory policies that encourage the preservation, development and implementation of more efficient, clean energy solutions.** With gains being made in efficient energy technologies, the United States is becoming more self-reliant and even an exporter of energy and energy technologies. The approach of preservation and investment provides a comparative advantage in many fuel-based sectors of the economy, increases cost-efficiency in major manufacturing sectors and promotes investment in existing and new technologies. Policymakers and regulators in the United States must embrace new scientific discoveries and modeling and simulation technologies to maximize efficiency for non-renewable energy sources and increase production of clean energy.
- **Direct funding and investment toward innovation in energy storage capabilities and clean energy technology.** It is widely accepted that innovation is responsible for one third of gains in economic growth in the United States. For example, by shifting focus toward innovation, nuclear plants have been able to increase operating capacity from 60 percent to more than 90 percent in the past 30 years.[1] Policymakers must create incentives that accelerate the pace of change in the energy sector, which would allow for more immediate returns on innovation as well as future economic development. This includes modernizing the energy grid, updating the energy infrastructure, preserving the nation's zero emission resources and focusing on clean, resilient and renewable energy sources.
- **Secure America's critical energy infrastructure from cyber attacks.** According to the Department of Homeland Security, last year, of the cyber incidents targeting industrial control systems in the 16 infrastructure sectors designated as critical, 20 percent were in the energy sector.[2] Technological advancements made in favor of energy efficiency are outpacing security and will continue to do so unless the approach to, and implementation of, cybersecurity strategies and practices changes. Protecting America's energy infrastructure against cyber attacks is an issue of national security, and requires a model for valuation of cyber security and best practices that includes input from a diverse group of stakeholders from industry, academia and government.
- **Utilize national labs to develop innovative energy technologies.** The national labs, when provided appropriate funding, have the means to design improvements for reliable and efficient energy equipment such as wind turbines or oil and gas drills that are cost-effective and less prone to traditional wear. By investing in national labs and making their resources available to private entrepreneurs and innovative start-ups, researchers can hope to foster major technological breakthroughs in the areas of energy production and storage.

1 *World Energy Needs and Nuclear Power*, World Nuclear Association, August 28, 2017.

2 ICS-CERT Year in Review, Industrial Control Systems Cyber Emergency Response Team, Department of Homeland Security, 2016.

- **Direct research to the market and provide guidance on where investment can be most impactful to speed the commercialization of new technologies.** Building the bridge between universities, national labs and the business world is critical to ensure research is not stranded in universities or labs. Universities, companies and the federal government must ensure adequate and predictable R&D spending to foster technological development and the federal government must encourage investments that put the United States in a more competitive position.
- **Encourage a multidisciplinary approach to education that includes opportunities for students to learn technical skills, soft skills, teamwork and critical thinking skills from early development through post-graduate education.** Education must distance from teaching by syllabus as this stifles creativity. Policymakers must provide funding for technical education in high schools and give students hands-on training while de-stigmatizing well-paying "blue collar" jobs. Students should have access to occupational engineers in hands-on problem solving, and teachers must continue to learn and communicate with industry experts to evolve science curriculum.
- **Encourage lifelong learning opportunities that allow students to gain more skills and stack credentials.** Every time a new technology is developed, there must be a ripple of new training within the industry so workers can operate these new machines and researchers can build on intermediary technologies to develop breakthrough inventions. Utilities, technical companies and labor unions can ensure their current employees' skill sets are meeting the evolving needs of the energy industry by providing education opportunities to people across diverse ages and stages of their careers.

Setting the Stage

In the past decade, the United States has developed into a world-leading net exporter of energy fuels, making significant gains in crude and natural gas exports. Residential and commercial energy demands remain relatively flat, whereas industry demand is growing. This is particularly true in the plastics and manufacturing industries, which rely heavily on petroleum (2 percent growth) and shale gas (3.5 percent growth).[3] All the while, renewable energy supply is stagnating at 1 percent annual growth. Fossil fuels persist as an attractive fuel source due to their storage capacity at a volume 20 times higher than batteries[4] and the increasing support of shale gas extraction infrastructure, which last year reached over $100 billion in investment from the chemical industry alone.[5]

Driven largely by economic growth, energy consumption is predicted to increase by 48 percent between 2012 and 2040.[6] Meanwhile, the coal- and gas-supported grid is foreseeably unreliable due to environmental instabilities such as hurricanes and snowstorms. The nation's focus, as recognized by the DOE in a recent Grid Study, must be on a reliable, resilient, diverse and flexible resource mix that encourages efficiency and supports the opportunity for investment in new technologies that benefit customers and their communities. With international governments and industry leaders increasingly in support of reducing their carbon footprints, the United States must make it a priority to preserve the existing zero emission resources and recognize new opportunities are available to replace traditional, environmentally damaging fossil fuels with cleaner energy sources.

Increased funding for research and development of advanced materials can foster major technological breakthroughs in efficient fuel extraction, storage and deployment of sustainable energy solutions. Such opportunities for new technologies will likely reside within national labs and with start-up entrepreneurs, in partnership with industry leaders and university partners.

America's aging energy grid and storage issues inherent to renewable energies, however, concern traditional investors. The energy economy faces slow speed-to-market innovations because of the deteriorating vital link between scientific research and the market, often the result of impatient capital. Although the research is happening in the United States, an often-convoluted regulatory environment doubles the construction time of nuclear plants[7] and offers investors only long-term (20-30 years) returns on wind and solar investments.[8] Producers are incentivized to move to places like China where relaxed environmental regulations result in faster construction of necessary infrastructure with higher returns. To combat this, a balance between regulations and industry speed must be struck.

Finally, when it comes to building a talented workforce in the energy sector, collaboration between university and industry leaders is necessary to

3 *Total Energy: Production: Crude Oil and Lease Condensate*, U.S. Energy Information Administration, 2017.

4 *Bu-1007: Net Calorific Value*, Battery University, March 6, 2016.

5 *U.S. Chemical Investment Linked to Shale Gas Reaches $100 Billion*, American Chemistry Council, February 20, 2014.

6 *EIA Projects 48% Increase in World Energy Consumption by 2040*, U.S. Energy Information Aministration, May 12, 2016.

7 *Nuclear Power in the USA*, World Nuclear Association, September 2017.

8 *Investors are Making Money on Renewable Energy*, Mindy Lubber, Forbes, March 20, 2012.

Participants discuss competitiveness in the energy sector at a dialogue hosted by Exelon at Workspring in Chicago, IL.

ensure emerging talent is able to compete in this changing landscape. With over 50 percent of the energy sector's workforce set to retire in the next decade,[9] educators are being called upon to offer hands-on technical education to students while unions and energy companies are realizing the need to develop updated teaching methods to ensure workers can operate new machines and researchers can develop breakthrough technologies.

9 *Who Will Replace Nuclear Power's Aging Work Force?*, Russell Ray, Power Engineering, February 5, 2015.

Stakeholder Dialogue

Advancing U.S. Energy—Infrastructure

New-found abundance of non-conventional fossil fuel—primarily the proliferation of low-carbon natural gas—heralds lower energy costs, a new generation of energy innovation and an energy productivity-driven renaissance in manufacturing. But increasing consumption from the industrial sectors and their heavy reliance on shale gas creates growing pressure on the extraction infrastructure.[10] Simultaneously, negative perceptions around nuclear energy and low visibility of private sector development—despite its viability as the largest clean alternative to fossil fuels—are pushing investment toward renewable energy sources.[11] Together, these factors present both challenges and opportunities to the energy sector as it continues to transform to meet current and future needs.

One of the most significant shifts in the energy matrix is the growing prevalence of natural gas, a potentially cleaner and cheaper choice over other fossil fuels. Increased natural gas dependency financially benefits consumers, but gas and coal grid coordination issues pose resiliency risks, with the possibility of incidents like service interruptions and delivery challenges. Pipeline capacity and the ability to deliver natural gas to consumers not living near drill sites significantly impacts prices, further compounded by federal policies pushing responsibility to expand infrastructure onto states.[12]

The replacement of traditional fossil fuels, such as coal, with natural gas and other cleaner energy sources is in part a consequence of regulations encouraging cleaner fuel options. Other variables also affect the reliability and utility of coal, such as the development of smart grids and the need to counter more frequent and more severe weather phenomena.[13] As the energy mix continues to transform, there is a need to adjust consumption patterns and develop the storage infrastructure to balance ebbs and flows in the supply of renewable energy. Energy must also remain affordable, meaning encouraging production and access is vital. Despite large investments, meeting the needs of industry and individuals while keeping energy abundant and cheap is a persistent challenge.

As the country's energy sector continues to evolve and innovate to meet changing demand and America continues to modernize its energy infrastructure and grid, the security of U.S. digital infrastructure supporting grid and energy operations is crucial. Recently, efficiency has been prioritized over security, making grid and nuclear plant monitoring, even infiltrations, a significant concern.[14] Grid security is a national security risk of the highest magnitude and requires public-private partnerships and cross-sector coordination. Policymakers must engage on potential impacts of cyber attacks and weigh costs and benefits.

10 *For the First Time, Majority of Americans Oppose Nuclear Energy*, Gallup, March 2016.

11 ibid.

12 *2013 Special Reliability Assessment: Accommodating an Increased Dependence on Natural Gas for Electric Power*, North American Electric Reliability Corporation, May 2013.

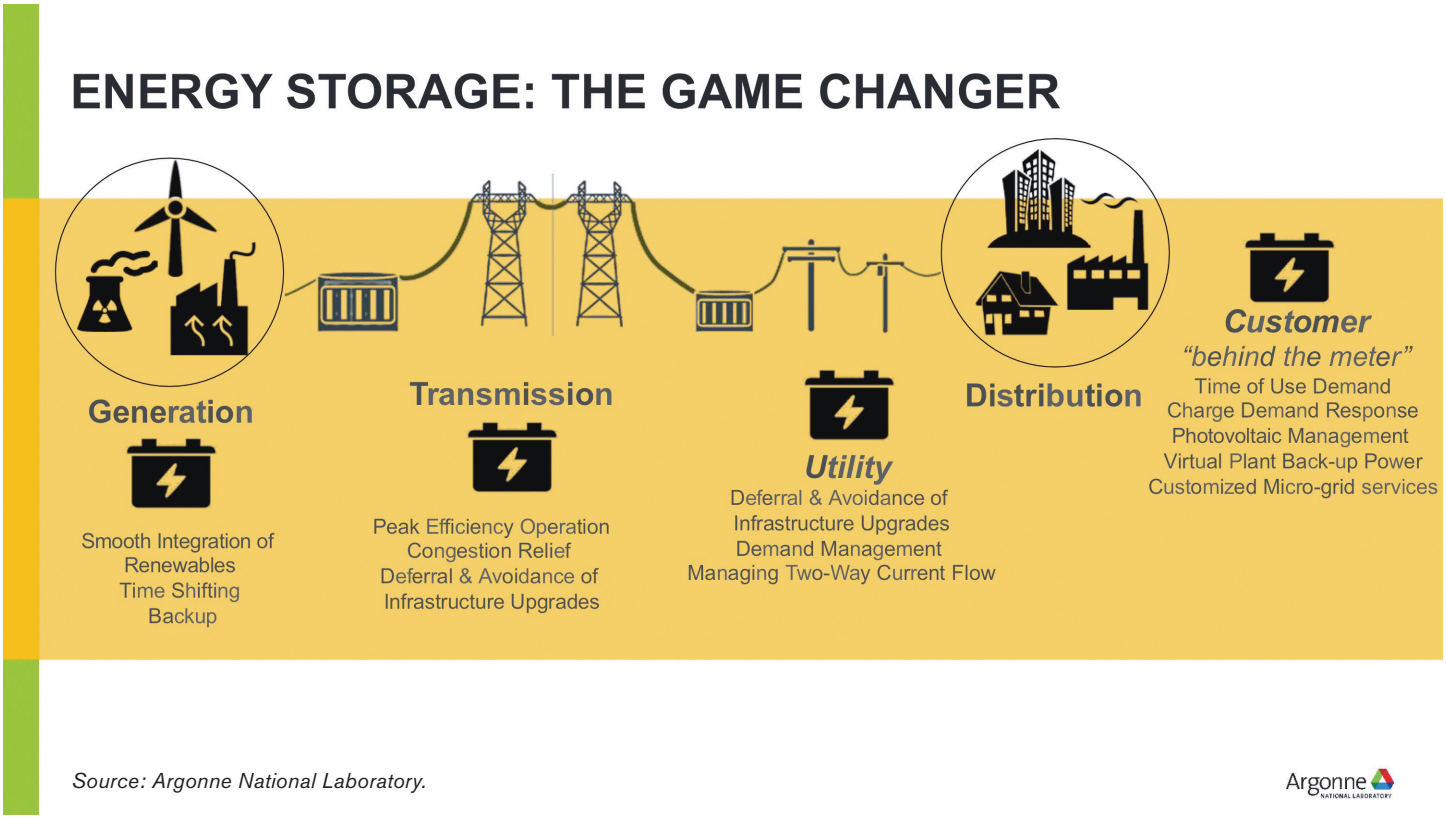
13 *Energize America: Invest in a Smarter Electricity Infrastructure*, Brigham Mccown, The Hill, July 11, 2017.

14 *Electric Grid Security and Resilience: Establishing a Baseline for Adversarial Threats*, Department of Energy, June 2016.

Although there are challenges in the U.S. energy sector, as an industry it has tremendous potential to contribute to overall economic growth. Labor, capital and innovation drive economic growth in energy with 1 percent of the annual U.S. growth rate due to modernization.[15] In the past 30 years, nuclear plants went from running at 60 percent capacity to 90 percent[16]—due largely to innovation as opposed to added labor—confirming the necessity of long-term industry drivers while creating incentives for immediate and future returns.[17] Changes in the energy industry happen slowly, though, and there is a need to better understand how to accelerate innovation and advancement, in order to grow industries and create new jobs.

Advancing U.S. Energy—Technology

Technological innovation is essential to capitalizing on the growing number of opportunities that exist in America's energy sector. The country's ability to



Source: Argonne National Laboratory.

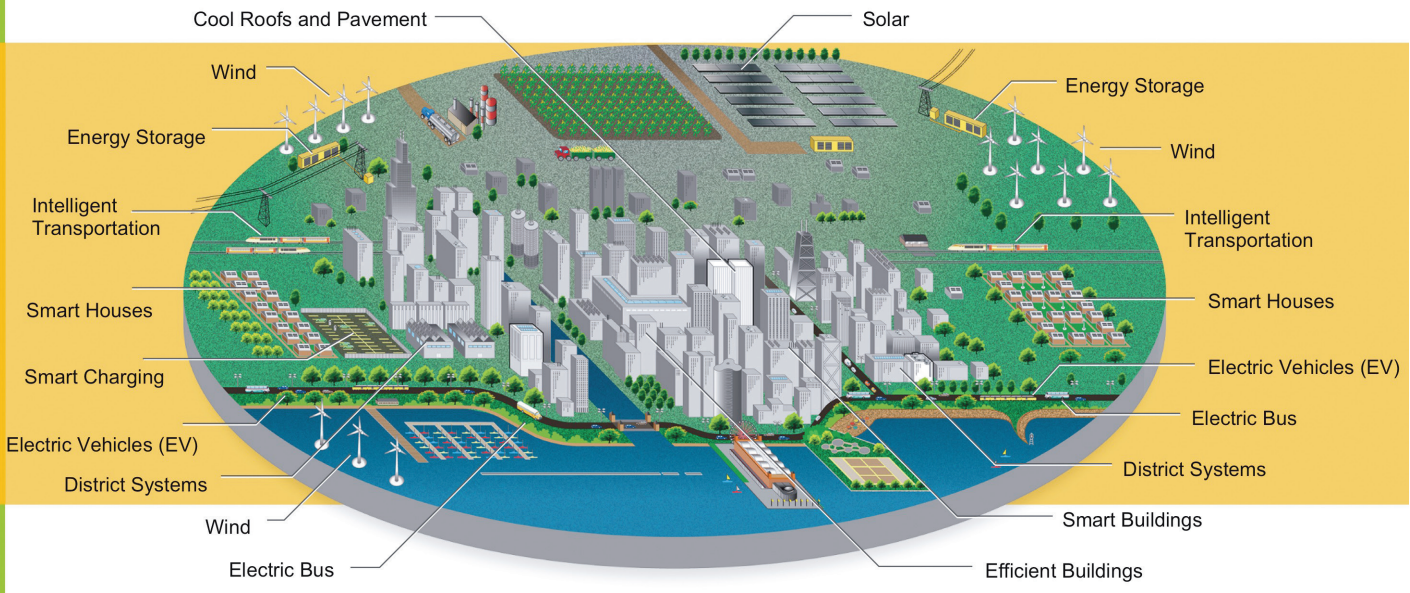
15 *Game Changer: Five Opportunities for US Growth and Renewal,* Susan Lund, James Manyika, Scott Nyquist, Lenny Mendonca and Sreenivas Ramaswamy, McKinsey & Company, July 2013.

16 *Nuclear Power in the USA*, World Nuclear Association, August 4, 2017.

17 ibid.

AN INTEGRATED SYSTEM

Energy intensive but efficient



Source: Argonne National Laboratory.

Argonne NATIONAL LABORATORY

make technical advancements in energy storage, for example, is perhaps the most prominent example and would be an industry game-changer in terms of global competitiveness. Improving the United States' ability to store renewable energy and therefore control distribution and provide a more consistent supply would further spur innovation in clean energy for manufacturing, heating and even vehicles.

Similarly, facilitating access to national laboratories for entrepreneurs and innovators across America's growing number of start-ups has the potential to kick start innovation not only in energy storage but also across various aspects of the energy sector. Innovation in advanced materials, for example, is also crucial, as they are building blocks for the energy sector and support production and usage of energy. But the usefulness of new advanced materials is reliant not only on research, but also design and deployment. Using computational science instead of trial-and-error in this process can lead to significant improvements. Designing metals less prone to traditional wear and tear for wind turbines or drilling equipment, for example, can increase reliability and efficiency while reducing costs.

Widespread evolution of the energy sector, however, requires a shift from an energy deficiency mentality to one of abundance. America is verging on transportation fuel self-sufficiency, with high job creation potential, thanks in part to new discoveries and well

simulation technologies. The United States may also be on the precipice of a carbon economy, with advancements in manufacturing enzymes and computation leading the way forward. But production and commercialization of new technologies are significant challenges, as the perceived cost to manufacturers of using new processes or materials often outweighs the supposed benefits. As a result, companies must take it upon themselves to be designers, producers and suppliers.

Another challenge is connecting science and manufacturing back to the market. Material development for only the sake of research is not useful, especially regarding technology innovation. Connecting universities and businesses is critical to accelerating innovation and ensuring research moves out of academia and is implemented.

Advancing U.S. Energy—Investment

When it comes to designing, developing and deploying new energy technologies, it is important to consider the investment cycle and analyze the market. Investors put significant thought into whether a product is truly innovative, what the market size is, whether the speed to market is viable and what execution of this cycle would cost. But as global competition grows, investment is becoming increasingly disconnected from the market.

One of the most persistent challenges in the energy sector is a lack of guidance when it comes to directing investment to areas with the highest potential for impact. Additionally, the regulatory environment in the United States is not keeping pace with innovation in the energy sector. New technologies often face regulations that impede the ability to secure early-stage capital funding. In these cases, while research may occur in the United States, the regulatory environment incentivizes production to move elsewhere—to countries like China, for example—where production is more viable and less costly as a consequence of a laxer regulatory environment.

There is also a significant imbalance between funding available to areas such as software and biotechnology—which provide short-term payoff and present less risk—and energy, where innovation is often plagued by extended project lifecycles. Slow technical change in nuclear energy is a key example, as smaller water-based reactors are not expected to be operational until 2025 due to an average of four years of regulatory review required before construction begins.[18] In South Carolina, two reactor projects were recently scrapped mid-construction due to budgeting and regulation issues.[19]

Some entrepreneurial capital has entered the energy sector in the past five years despite long wait times, possibly due to a seismic global shift in demand toward low-carbon, cleaner energy options. This shift is less about specific policies or agreements and more the willingness and patience of investors to wait for the anticipated return on investment.

Policies do play a role, however, as some states have found regulations supporting low-carbon energy profitable. New York, for example, after studying how to achieve statewide goals of reducing carbon emissions by 40 percent and generating 50 percent

18 *Nuclear Innovators Say Public-Private Collaboration Vital*, Nuclear Energy Institute, May 19, 2016.

19 *U.S. Nuclear Comeback Stalls as Two Reactors Are Abandoned*, by Brad Plumer, The New York Times, July 31, 2017.

Mr. Christopher Crane, President and CEO, Exelon Corporation, addresses energy sector dialogue participants.

Dr. Eric Barron, President, Penn State University, leads the discussion on talent in the energy sector.

of the state's electricity with renewable sources by 2030, found that using Zero Emission Credits (ZECs) to keep existing nuclear plants operating can hold down carbon emissions during the transition phase necessary for these other carbon-free options to ramp up to scale. This would save New York customers about a billion dollars a year, or $12 billion by 2030, compared with immediately replacing the upstate nuclear plants with 100 percent renewables.[20] These types of pathways to long-term investment growth and consumer incentives are crucial to promoting clean energy and the goal of providing electricity to the 2.1 billion living without.

While industry has increased its research spending and venture capital is available, federal funding for R&D is essential to foster continued technological innovation and keep America's energy sector competitive. Data shows that federal investment in R&D has declined, while university investment has risen to a level that is likely unsustainable.[21] The electric utilities receive one of the lowest percentages of R&D spending despite the call for massive transformation of the system—demonstrating a significant disconnect.[22] Federal research and development investments are declining, causing concern across sectors and raising red flags around the ability of the U.S. energy sector to remain a global leader in the long-term.

Advancing U.S. Energy—Building Talent

Every instance of technological development requires training so workers can quickly grasp concepts and researchers can build on intermediary technologies

20 *Preserving Upstate Nuclear Saves New York Consumers Billions, Compared With Additional Renewables Beyond CES Goals*, by Dean Murphy and Mark Berkman, 2016.

21 *Trump's Cuts to Federal Science Funding Will Mean Less Industry R&D, Not More*, by Adams Nager, Information Technology and Innovation Foundation, March 17, 2017.

22 *Trends in Non-Defense R & D by Function*, American Association for the Advancement of Science, 2012.

Mr. Chris Gould, Senior Vice President, Corporate Strategy and Chief Sustainability Officer, Exelon Corporation, makes remarks during the energy sector dialogue.

to create breakthrough inventions. With technology advancing more quickly than some universities can update curricula, there is an opportunity for unions and technical organizations to teach the new workforce. Together, these groups can train and re-skill workers to meet the demands of today and tomorrow—a task that is not the responsibility of one sector but rather the collective obligation of universities, labor unions and industry. America's ability to prepare the energy sector workforce for current and future opportunities is a key aspect of the country's ability to remain competitive.

With regard to formal education, however, there must be a multidisciplinary approach that includes opportunities both inside and outside the classroom for students from early development through post-graduate education to obtain the skills to meet the needs of the energy industry. Rather than relying on a traditional method of learning by syllabus—which often stifles creativity rather than encouraging an entrepreneurial mindset—universities must provide training in four fundamental areas—technical skills, soft skills, teamwork and critical thinking. Students should learn from real engineers and hands-on problem-solving tasks, and teachers must communicate with industry to evolve curricula to meet workforce needs. Education in science and math, as well as cultivating interest, will be critical for developing the next generation of technicians and innovators.

Demand for new skills is unlikely to slow, increasing the value of lifelong learning that allows students to gain new skills and stack credentials. But while college-educated employees are crucial, they are only a part of the workforce. Utility workers comprise a large portion of the industry, and approximately 50 percent will retire in the next 10 years.[23] A lack of resources such as high school shop classes and hands on vocational training makes it difficult to enter the industry.

There is also a higher level of skill required now than there has been in the past as technology continually advances. This has meant a shift to more online learning that provides a higher skill level needed to operate smart grids and other new technologies but also requires partnerships between utilities and labor unions to ensure a base of employees with necessary fundamental skills remains. And while these used to be perceived as lifetime jobs, utilities are now beginning to see unemployment as some transition through attrition. These "blue-collar" jobs need a narrative change to remove the stigma surrounding them.

23 *Gaps in the Energy Workforce Pipeline 2013 Survey Results,* Center for Energy Workforce Development, 2013.

Moving Forward

Leverage: The Energy Sector is the second sector study dialogue held during Phase II of the EMCP. This dialogue addressed energy as its own, distinct sector of the economy and applied findings and themes from previous sector studies. The Council looks forward to continuing these deep-dive discussions on American competitiveness and, among other key policy efforts, engaging the Congress and the administration.

Phase II sector studies will conclude with a strategic focus on:

Aerospace

As the U.S. aerospace sector seeks more energy-efficient fleets and continues to rely on energy-intensive raw materials, manufacturers must out-innovate their global competitors. The competitiveness of the American aerospace sector over the next decade will be defined by the ability to develop, standardize and deploy advanced materials, technologies and processes on a broad scale supported by a highly skilled workforce. Building on some of the findings of the EMCP's Phase I sector study on advanced materials, the aerospace sector study looks at how the design and manufacturing of products and the associated physical and regulatory infrastructure will define the competitiveness of this sector as it seeks to out-innovate its global competition.

Pharmaceuticals and Medical Devices

With multifaceted industries such as drug manufacturing and medical devices, the United States healthcare sector can be seen as one of the most complex yet robust sectors in the world. As an energy-intensive sector and one with significant opportunities for advancement, this sector study will look at the pharmaceutical and medical device industries in the United States as an opportunity to leverage new production processes, and prototype and test new technologies and alternate fuel sources to hone its competitive cost-edge over competitors in Europe, India and East Asia and drive productivity and prosperity for the U.S. economy.

Cybersecurity

As the Council's EMCP builds upon the success of the first five sector studies on water and manufacturing, advanced materials, bioscience, agriculture and consumer water use, and energy, we continue to identify common themes, challenges and opportunities that apply across a wide swath of American industries and transcend sector boundaries. Among these key areas that has come to the forefront has been the issue of protecting America's critical infrastructure, intellectual property, and industrial operations from the growing threat of cyber attacks. In 2018, the Council and the EMCP will undertake an effort to develop a policy doctrine on American cybersecurity in partnership with Pacific Northwest National Laboratory, Verizon Enterprise Solutions and Carnegie Mellon University.

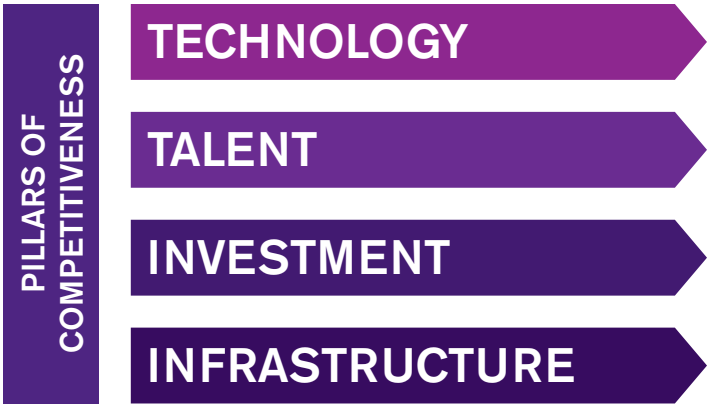
About the Energy & Manufacturing Competitiveness Partnership (EMCP)

The energy sector study is part of a larger initiative of the Council on Competitiveness known as the Energy and Manufacturing Competitiveness Partnership (EMCP). The EMCP, since it began in 2015, has united Council members to focus on the shifting global energy and manufacturing landscape and how energy transformation and demand is sharpening industries critical to America's prosperity and security.

The EMCP has tapped into a diverse membership of leaders from business, academia, the national laboratories and the labor community to understand the discrete and distinct challenges critical sectors of the U.S. economy face in the energy-manufacturing convergence and how decision-makers can bolster the critical pillars of competitiveness—technology, talent, investment and infrastructure.

Throughout the first six EMCP sector studies, it has become increasingly apparent that while manufacturers face sector-specific challenges and opportunities at the national level, the enabling environment at the regional and local levels significantly influences America's competitiveness in the global economy. In 2018, the Council will employ a new, regional approach to looking at manufacturing competitiveness that will seek to catalyze change in a way that has sector- and economy-wide impacts on U.S. competitiveness. These aims will be achieved through a rebranded EMCP, to be called:

The Partnership for Talent & Production (PTAP): An Exploration of the Future of Work and U.S. Manufacturing.



The Energy & Manufacturing Competitiveness Partnership Concept Paper, August 2015.

About the Council on Competitiveness

For more than three decades, the Council on Competitiveness (Council) has championed a competitiveness agenda for the United States to attract investment and talent, and spur the commercialization of new ideas.

While the players may have changed since its founding in 1986, the mission remains as vital as ever—to enhance U.S. productivity and raise the standard of living for all Americans.

The members of the Council—CEOs, university presidents, labor leaders and national lab directors—represent a powerful, nonpartisan voice that sets aside politics and seeks results. By providing real-world perspective to Washington policymakers, the Council's private sector network makes an impact on decision-making across a broad spectrum of issues from the cutting-edge of science and technology, to the democratization of innovation, to the shift from energy weakness to strength that supports the growing renaissance in U.S. manufacturing.

The Council's leadership group firmly believes that with the right policies, the strengths and potential of the U.S. economy far outweigh the current challenges the nation faces on the path to higher growth and greater opportunity for all Americans.

Council on Competitiveness
900 17th Street, NW
Suite 700
Washington, D.C. 20006
+1 (202) 682-4292
Compete.org

Council on Competitiveness Members, Fellows and Staff

BOARD

Chairman
Mr. Samuel R. Allen
Chairman and Chief Executive Officer
Deere & Company

Industry Vice-chair
Dr. Mehmood Khan
Vice Chairman and Chief Scientific Officer of Global Research and Development
PepsiCo, Inc.

University Vice-chair
Dr. Michael M. Crow
President
Arizona State University

Labor Vice-chair Emeritus
Mr. William P. Hite
Former General President
United Association

Chairman Emeritus
Mr. Charles O. Holliday, Jr.
Chairman
Royal Dutch Shell, plc

President & CEO
The Honorable Deborah L. Wince-Smith
Council on Competitiveness

FOUNDER

Mr. John A. Young
Former Chief Executive Officer
The Hewlett Packard Company

EXECUTIVE COMMITTEE

Mr. Thomas R. Baruch
Managing Director
Baruch Future Ventures

Dr. Gene D. Block
Chancellor
University of California, Los Angeles

Mr. William H. Bohnett
President
Whitecap Investments LLC

Mr. James K. Clifton
Chairman and CEO
Gallup, Inc.

Dr. John J. DeGioia
President
Georgetown University

Mr. Jeff M. Fettig
Chairman
Whirlpool Corporation

Mr. George Fischer
Senior Vice President and Group President
Verizon Enterprise Solutions

Mr. Michael Fucci
Chairman
Deloitte, LLP

Dr. William H. Goldstein
Director
Lawrence Livermore National Laboratory

Mr. James S. Hagedorn
Chairman and CEO
The Scotts Miracle-Gro Company

Ms. Sheryl Handler
President and CEO
Ab Initio

The Honorable Shirley Ann Jackson
President
Rensselaer Polytechnic Institute

Dr. Pradeep K. Khosla
Chancellor
University of California, San Diego

Mr. J.B. Milliken
Chancellor
The City University of New York

Mr. Blake Moret
President and Chief Executive Officer
Rockwell Automation, Inc.

Mr. Brian T. Moynihan
Chairman and Chief Executive Officer
Bank of America

The Honorable Janet Napolitano
President
The University of California System-Regents

Dr. Harris Pastides
President
University of South Carolina

Mr. James M. Phillips
Chairman and CEO
NanoMech, Inc.

Mr. Nicholas T. Pinchuk
Chairman and Chief Executive Officer
Snap-on Incorporated

Professor Michael E. Porter
Bishop William Lawrence University Professor
Harvard Business School

Mr. Jonas Prising
Chairman and Chief Executive Officer
ManpowerGroup

Mr. Robert L. Reynolds
President and CEO
Putnam Investments

Mr. Matthew Riddle
President and Chief Executive Officer
Walbro Engine Management

Dr. Mark S. Schlissel
President
University of Michigan

Mr. Steve Stevanovich
Chairman and Chief Executive Officer, SGS Global Holdings; and Member, Board of Governors, Argonne National Laboratory

Mr. Lawrence Weber
Chairman
W2 Group, Inc.

Ms. Randi Weingarten
President
American Federation of Teachers, AFL-CIO

Dr. W. Randolph Woodson
Chancellor
North Carolina State University

Mr. Paul A. Yarossi
President
HNTB Holdings Ltd.

Dr. Robert J. Zimmer
President
The University of Chicago

GENERAL MEMBERS

Dr. Joseph E. Aoun
President
Northeastern University

Dr. Aziz Asphahani
Chief Executive Officer
QuesTek Innovations LLC

Mr. Jim Balsillie
Co-Founder
Institute for New Economic Thinking

Mr. Ajay Banga
President and Chief Executive Officer
MasterCard Worldwide

Dr. Eric Barron
President
Pennsylvania State University

The Honorable Sandy K. Baruah
President and Chief Executive Officer
Detroit Regional Chamber

Dr. Mark P. Becker
President
Georgia State University

Dr. Richard Benson
President
University of Texas at Dallas

Ms. Stephanie W. Bergeron
President
Walsh College

The Honorable Rebecca M. Blank
Chancellor
University of Wisconsin—Madison

Dr. Lee C. Bollinger
President
Columbia University

Dr. Robert A. Brown
President
Boston University

Mr. Al Bunshaft
Senior Vice President, Global Affairs
Dassault Systèmes Americas

Dr. James P. Clements
President
Clemson University

Mr. Christopher Crane
Chief Executive Officer
Exelon Corporation

Mr. Bruce Culpepper
Shell U.S. Country Chair & President
Shell Oil Company

The Honorable Mitchell E. Daniels, Jr.
President
Purdue University

Dr. Beverly Davenport
Chancellor
University of Tennessee, Knoxville

Mr. Ernest J. Dianastasis
Managing Director
CAI

Dr. Joseph A. DiPietro
President
The University of Tennessee

Dr. Michael V. Drake
President
The Ohio State University

Dr. Taylor Eighmy
President
The University of Texas at San Antonio

Dr. Carol L. Folt
President
The University of North Carolina at Chapel Hill

Mr. Robert Ford
Executive Vice president, Medical Devices
Abbott

Mr. Kenneth C. Frazier
Chairman and Chief Executive Officer
Merck & Co., Inc.

Dr. W. Kent Fuchs
President
University of Florida

The Honorable Patrick D. Gallagher
Chancellor
University of Pittsburgh

Dr. E. Gordon Gee
President
West Virginia University

Mr. Robert Graybill
President and Chief Executive Officer
Nimbis Services, Inc.

Dr. Amy Gutmann
President
University of Pennsylvania

Ms. Marillyn A. Hewson
Chairman President and CEO
Lockheed Martin

Dr. John C. Hitt
President
University of Central Florida

Dr. Farnam Jahanian
Interim President
Carnegie Mellon University

Rev. John I. Jenkins
President
University of Notre Dame

Mr. R. Milton Johnson
Chairman and Chief Executive Officer
Hospital Corporation of America

Dr. Robert E. Johnson
Chancellor
University of Massachusetts Dartmouth

Dr. Eric Kaler
President
University of Minnesota

Mr. Adam Khan
Founder and Chief Executive Officer
AKHAN Semiconductor

Mr. David W. Leebron
President
Rice University

Dr. Laurie Leshin
President
Worcester Polytechnic Institute

Dr. Michael Lovell
President
Marquette University

Dr. Gary May
Chancellor
University of California, Davis

Mr. Sean McGarvey
President
North America's Building Trades Unions

Dr. H. Keith Moo-Young
Chancellor
Washington State University Tri-Cities

Mr. Jere W. Morehead
President
University of Georgia

Dr. John Opperman
President
Texas Tech University

Dr. Eduardo J. Padrón
President
Miami Dade College

Dr. G.P. "Bud" Peterson
President
Georgia Institute of Technology

Dr. Neville Pinto
President
University of Cincinnati

Mr. Scott Pulsipher
President
Western Governors University

Mr. John Pyrovolakis
CEO
Innovation Accelerator Foundation

Dr. L. Rafael Reif
President
Massachusetts Institute of Technology

Mr. Ralph Resnick
President and Executive Director
National Center for Defense Manufacturing and Machining

Mr. Rory Riggs
Managing Member
Balfour, LLC

Mr. John Rogers
President and CEO
Local Motors

Mr. Douglas Rothwell
President and Chief Executive Officer
Business Leaders for Michigan

Dr. David Rudd
President
University of Memphis

Vice Admiral John R. Ryan USN (Ret.)
President and Chief Executive Officer
Center for Creative Leadership

Dr. Timothy D. Sands
President
Virginia Polytechnic Institute and State University

Dr. Richard Schneider
President
Norwich University

Mr. Paul Scialla
Founder and Chief Executive Officer
Delos Living LLC

Mr. John Sharp
Chancellor
The Texas A&M University System

Dr. David E. Shaw
Founder
D.E. Shaw Research

Mr. Frederick W. Smith
President and Chief Executive Officer
FedEx Corporation

Dr. Elisa Stephens
President
Academy of Art University

Mr. Lonnie Stephenson
International President
IBEW

Dr. Elizabeth Stroble
President
Webster University

Dr. Satish K. Tripathi
President
State University of New York at Buffalo

Dr. Thomas M. Uhlman
Founder and Managing Partner
New Venture Partners LLC

Dr. Steven J. Visco
Chief Executive Officer
PolyPlus Battery Company

Dr. Jeffrey Wadsworth
Chief Executive Officer and President
Battelle Memorial Institute

Dr. Kim A. Wilcox
Chancellor
University of California, Riverside

Mr. Keith E. Williams
Chief Executive Officer
Underwriters Laboratories Inc.

Dr. Mark S. Wrighton
Chancellor
Washington University in St. Louis

Dr. Michael Young
President
The Texas A&M University

NATIONAL LABORATORY PARTNERS

Dr. Steven F. Ashby
Director
Pacific Northwest National Laboratory

Dr. Paul Kearns
Director
Argonne National Laboratory

Dr. Martin Keller
Director
National Renewable Energy Laboratory

Dr. Mark Peters
Director
Idaho National Laboratory

Dr. Michael Witherell
Director
Lawrence Berkeley National Laboratory

Dr. Thomas Zacharia
Director
Oak Ridge National Laboratory

CORPORATE PARTNERS

Baker Hughes

Cray Inc.

Intel Corporation

The Boeing Company

United Technologies Corporation

Intrexon Corporation

UNIVERSITY PARTNERS

Oklahoma University

University of Illinois System

University of California, Irvine

NATIONAL AFFILIATES

Ms. Caitlin Cain
Chief Executive Officer
World Trade Center New Orleans

Mr. C. Michael Cassidy
President and Chief Executive Officer
Georgia Research Alliance

Dr. Jonathan Fanton
President
American Academy of Arts and Sciences

Mr. Jeffrey Finkle
President
International Economic Development Council

Dr. Norman Fortenberry
Executive Director
American Society for Engineering Education

Mr. Richard Grefé
Executive Director
AIGA

Mr. Matthew Loeb
Chief Executive Officer
ISACA

Dr. Anthony Margida
Chief Executive Officer
TechGrit AMX2 LLC

Mr. Jack E. Middleton
President and Chief Executive Officer
SMC3

Ms. Karen Pedersen
President
IEEE-USA

Ms. Andrea Purple
President
ARCS Foundation Inc.

Dr. Catherine Roberts
Executive Director
American Mathematical Society

Dr. Richard M. Soley
Chairman and Chief Executive Officer
Object Management Group, Inc.

Mr. Greg Wetstone
President and Chief Executive Officer
American Council on Renewable Energy

FELLOWS

Mr. Bray Barnes, Senior Fellow
Founder and Principal, Security Evaluation and Solutions Group, LLCMs.

Ms. Jennifer S. Bond, Senior Fellow
Former Director, Science & Engineering Indicators Program
National Science Foundation

Dr. Thomas A. Campbell, Senior Fellow
Former National Intelligence Officer for Technology, Office of the Director of National Intelligence

Ms. Dona L. Crawford, Senior Fellow
President, Livermore Lab Foundation
Former Associate Director, Computation, Lawrence Livermore National Laboratory

The Honorable Bart J. Gordon, Distinguished Fellow
Partner, K&L Gates LLP; and
Former United States Representative (TN)

Mr. Thomas Hicks, Distinguished Fellow
Principal, The Mabus Group; and Former Undersecretary of the Navy, U.S. Department of Defense

Dr. Paul J. Hommert, Distinguished Fellow
Former Director, Sandia National Laboratories; and Former President, Sandia Corporation

Dr. Lloyd A. Jacobs, Distinguished Fellow
President Emeritus, The University of Toledo

Dr. Ray O. Johnson, Distinguished Fellow
Executive in Residence, Bessemer Venture Partners; and Former Senior Vice President and Chief Technology Officer, Lockheed Martin

The Honorable Alexander A. Karsner, Distinguished Fellow
Chairman and CEO, Manifest Energy LLC; and Former Assistant Secretary for Energy Efficiency and Renewable Energy, U.S. Department of Energy

Mr. Dominik Knoll, Senior Fellow
Former Chief Executive Officer
World Trade Center of New Orleans

The Honorable Steven E. Koonin, Distinguished Fellow
Director, Center for Urban Science and Progress, and Professor, Information, Operations & Management Sciences, Leonard N. Stern School of Business, New York University; and Former Second Under Secretary of Energy for Science, U.S. Department of Energy

The Honorable Alan P. Larson, Distinguished Fellow
Senior International Policy Advisor, Covington & Burling LLP; and Former Under Secretary of State for Economics, U.S. Department of State

Mr. Alex R. Larzelere, Senior Fellow
President, Larzelere & Associates LLC; and Former Director, Modeling and Simulation Energy Innovation Hub, Office of Nuclear Energy, U.S. Department of Energy

Mr. Edward J. McElroy, Distinguished Fellow
Former Chief Executive Officer, Ullico, Inc.; and President Emeritus, American Federation of Teachers, AFL-CIO

The Honorable Julie Meier Wright, Senior Fellow
Former Chief Executive, San Diego Regional Economic. Development Corporation; and Former First Secretary of Trade & Commerce, State of California

Mr. Mark Minevich, Senior Fellow
Principal Founder, Going Global Ventures

Ms. Michelle Moore, Senior Fellow
Chief Executive Officer, Groundswell; and Former Senior Advisor to the Director, Office of Management and Budget, Executive Office of the President of the United States

Dr. Luis M. Proenza, Distinguished Fellow
President Emeritus, The University of Akron

Mr. Allen Shapard, Senior Fellow
Senior Director, Chair of Public Engagement Strategies
APCO Worldwide

Dr. Anthony J. Tether, Distinguished Fellow
Former Director, Defense Advanced Research Projects Agency, U.S. Department of Defense

Dr. Thomas M. Uhlman, Distinguished Fellow
Founder and Managing Partner
New Venture Partners LLC

Dr. William Wescott, Senior Fellow
Managing Partner, BrainOxygen, LLC.

Dr. Mohammad A. Zaidi, Distinguished Fellow
Member, Strategic Advisory Board, Braemer Energy Ventures; and Former Executive Vice President and Chief Technology Officer, Alcoa, Inc.

STAFF

Mr. William Bates
Executive Vice President & Chief of Staff

Mr. Chad Evans
Executive Vice President

Ms. Marcy Jones
Special Assistant to the President & CEO and Office Manager

Ms. Patricia Hennig
Vice President for Finance

Mr. Chris Mustain
Vice President for Innovation Policy and Programs

Mr. Gourang Wakade
Vice President

Ms. Eliza White
Vice President

Mr. Michael Bernstein
Senior Policy Director for Innovation Policy and Programs

Ms. Katie Sarro
Senior Policy Director for Energy and Manufacturing Initiatives

Ms. Ta Tanisha Scott-Baker
Director for Information Technology and Services

Mr. Patrick French
Policy Analyst

Ms. Rachel O'Meara
Membership and Events Coordinator

Ms. Amber O'Rourke
Policy Analyst

Mr. DeWayne Johnson
Finance Manager

EMCP Steering and Advisory Committees

EMCP STEERING COMMITTEE

Samuel Allen
Chairman and CEO
Deere & Company

Steven Ashby
Director
Pacific Northwest National Laboratory

Aziz Asphahani
Chief Executive Officer
QuesTek Innovations

Eric Barron
President
Pennsylvania State University

Richard Benson
President
University of Texas at Dallas

Rebecca Blank
Chancellor
University of Wisconsin—Madison

Gene Block
Chancellor
University of California, Los Angeles

William Bohnett
President
Whitecap Investments LLC

James Clements
President
Clemson University

Christopher Crane
President & CEO
Exelon Corporation

Jeff Fettig
Chairman
Whirlpool Corporation

George Fischer
Group President
Verizon Enterprise Solutions

Carol Folt
Chancellor
University of North Carolina Chapel Hill

Robert Ford
Executive Vice President Medical Devices
Abbott Laboratories

Craig Giffi
Vice Chairman Leader U.S. Consumer
& Industrial Products
Deloitte LP

Howard Gillman
Chancellor
University of California, Irvine

William Goldstein
Director
Lawrence Livermore National Laboratory

Jim Hagedorn
Chairman & CEO
The Scotts Miracle-Gro Company

Mark Hussey
Vice Chancellor
Texas A&M University

Greg Hyslop
Chief Technology Officer
The Boeing Company

Farnam Jahanian
Interim President
Carnegie Mellon University

Robert Johnson
Chancellor
University of Massachusetts Dartmouth

Paul Kearns
Director
Argonne National Laboratory

Martin Keller
Director
National Renewable Energy Laboratory

Laurie Leshin
President
Worcester Polytechnic Institute

Michael Lovell
President
Marquette University

Blake Moret
President and CEO
Rockwell Automation, Inc.

Harris Pastides
President
University of South Carolina

Mark Peters
Director
Idaho National Laboratory

James Phillips
Chairman & CEO
NanoMech, Inc.

Richard Schneider
President
Norwich University

Horst Simon
Deputy Director
Lawrence Berkeley National Laboratory

Kim Wilcox
Chancellor
University of California, Riverside

Keith Williams
President & CEO
Underwriters Laboratories Inc.

W. Randolph Woodson
Chancellor
North Carolina State University

Thomas Zacharia
Director
Oak Ridge National Laboratory

EMCP ADVISORY COMMITTEE

Diran Apelian
Alcoa-Howmet Professor of Engineering, Metal Processing Institute
Worcester Polytechnic Institute

Glenn Baker
Director of Engineering, Technology & Quality Services
Deere & Company

John Ballato
Vice President Economic Development
Clemson University

M. Kathrine Banks
Vice Chancellor for Engineering
Texas A&M University System

Margaret Brooks
Office of Customer Success
Verizon Enterprise Solutions

Nora Brownell
Founding Partner
ESPY Energy Solutions, LLC

Todd Combs
Associate Laboratory Director for Energy and Environment Science & Technology
Idaho National Laboratory

Dona Crawford
Associate Director for Computation Emeritus
Lawrence Livermore National Laboratory

James Davis
Vice Provost, Information Technology
University of California, Los Angeles

Chris Gould
Senior Vice President—Corporate Strategy
& Chief Sustainability Officer
Exelon Corporation

Klaus Hoehn
Vice President Advanced Technology & Engineering
Deere & Company

Gene Huang
Vice President & Chief Economist
Abbott Laboratories

Glen Lewis
Principal
Glen Lewis Group, LLC; and
Operations, Energy & Supply Chain Management
Advisor
University of California, Davis

Ajay Malshe
Founder, Executive Vice President & Chief
Technology Officer,
NanoMech, Inc.

Sethuraman Panchanathan
Senior Vice President Office of Knowledge
Enterprise
Arizona State University

Robert Pleasure
Senior Advisor to the President
North America's Building Construction Trades
Department, AFL-CIO

James Porter
Founder & President
Sustainable Operations Solutions, LLC

Ramamoorthy Ramesh
Associate Laboratory Director for Energy
Technologies
Lawrence Berkeley National Laboratory

Douglas Rotman
Program Director
Lawrence Livermore National Laboratory

Carmel Ruffolo
Associate Vice President for Research
and Innovation
Marquette University

Mark Slavens
Vice President of Environmental Affairs
The Scotts Miracle-Gro Company

Dave Swihart
Senior Vice President Global Technology
& Operations
The Scotts Miracle Gro Company

David Szczupak
Executive Vice President Global Product
Organization
Whirlpool Corporation

Satish Udpa
Executive Vice President for Administrative
Services
Michigan State University

Bodgan Vernescu
Professor of Mathematical Sciences & Vice Provost
for Research
Worcester Polytechnic Institute

Mohammad Zaidi
Senior Advisor
Braemar Energy Ventures

APPENDIX A

Participants

Monty Alger
Director—Institute of Natural Gas Research
Penn State University

Aziz Asphahani
Chief Executive Officer
QuesTek Innovations

Eric Barron
President
Penn State University

William Bates
Executive Vice President & Chief of Staff
Council on Competitiveness

Wolfgang Bauer
Department of Physics and Astronomy
Michigan State University

Mary Blanchard
Associate Director
Wisconsin Energy Institute

Steve Bohlen
Global Security E-Program Manager
Lawrence Livermore National Laboratory

Bill Bohnett
President
Whitecap Investments

Donnie Colston
Director—Utility Department
International Brotherhood of Electrical Workers

Ron Coutu
V. Clayton Lafferty Endowed Chair
Marquette University

Christopher Crane
President & CEO
Exelon Corporation

Matthew Crozat
Senior Director of Policy Development
Nuclear Energy Institute

Michelle Drew Rodriguez
Manufacturing Leader—Center for Industry Insights
Deloitte Services LP

Chris Gould
Senior Vice President—Corporate Strategy, Chief Sustainability Officer
Exelon Corporation

Steven Hauser
Chief Executive Officer
GridWise Alliance

Paul Kearns
Interim Director
Argonne National Laboratory

Cyril Martinand
Division Manager—Procurement, Energy & Iron Ore
ArcelorMittal USA LLC

Katrina McMurrian
Executive Director
Critical Consumer Issues Forum (CCIF)

Thomas Meyer
Arey Distinguished Professor of Chemistry
University of North Carolina

Reid Miller
U.S. Power & Utilities Sector Leader
Deloitte

Michael Pacilio
Executive Vice President
Exelon Corporation

James Porter
Founder & President
Sustainable Operations Solutions

Bruce Quinn
Vice President—Government Affairs
Rockwell Automation, Inc.

Carmel Ruffolo
Associate VP for Research and Innovation
Marquette University

Katie Sarro
Senior Policy Director
Council on Competitiveness

Neil Sharkey
Vice President, Research
Penn State University

Lonnie Stephenson
International President
International Brotherhood of Electrical Workers

Steve Stevanovich
Chief Executive Officer
SGS Global Holdings

Deborah L. Wince-Smith
President & CEO
Council on Competitiveness

APPENDIX B

Agenda

MORNING

8:30 Registration and Light Breakfast

9:00 Welcome and Opening Remarks

Mr. Chris Crane
President & CEO
Exelon Corporation

Dr. Eric Barron
President
Penn State University

Dr. Paul Kearns
Interim Director
Argonne National Laboratory

9:15 The Council & and the Goals of Today's Dialogue

The Honorable Deborah L. Wince-Smith
President & CEO
Council on Competitiveness

Mr. William Bates
Executive Vice President and Chief of Staff
Council on Competitiveness

Today, America's competitiveness is shaped by the convergence of a distinctly modern breed of energy abundance with a re-emergent manufacturing sector. Challenges from globalization to climate change are forcing us to understand the nexus of energy and manufacturing as a whole more powerful than the sum of its parts.

The Energy and Manufacturing Competitiveness Partnership (EMCP) is a collaborative effort of national leaders from all sectors of the economy committed to deepening our understanding of the complexities of the energy landscape and building a roadmap to ensure that America captures the competitiveness opportunity of this new frontier.

9:45 America's Energy Infrastructure

As the United States faces unprecedented energy demands and changing climates, the imperative to maintain and upgrade the country's energy infrastructure is key to enabling continued research, development and implementation of new energy sources systems and services.

Presenter
Chris Gould
Senior Vice President, Corporate Strategy & Chief Sustainability Officer
Exelon Corporation

Discussants
Steve Hauser
Chief Executive Officer
GridWise Alliance

Matthew Crozat
Senior Director, Policy and Development
Nuclear Energy Institute

Key Questions

- What investments in infrastructure are necessary to fully exploit the opportunity of America's growing energy strength and innovation ecosystem?
- Looking at infrastructure from a regulatory perspective, what are the costs and benefits that should be considered as we modernize and expand America's energy portfolio?
- In efforts to optimize the nation's full energy potential—and consequent competitiveness—how can policymakers and the nation's business, research and labor communities come together to resolve conflicts hindering the build-out the nation's energy infrastructure, including pipelines, the grid, and new technology deployment?

10:45 Networking Break

11:00 Innovative Energy Technologies

The United States is one of the world's largest producers and consumers of energy. To remain competitive, the country must create and commercialize a wide range of innovative and advanced technologies in this sector.

Presenter
Paul Kearns
Interim Director
Argonne National Laboratory

Discussants
Aziz Asphahani
Chief Executive Officer
QuesTek Innovations

Steve Bohlen
Global Security E-Program Manager
Lawrence Livermore National Laboratory

Key Questions
- What role are energy abundance and innovation playing in increasing the productivity and competitiveness of American manufacturing?
- What innovations are occurring—or are urgently needed—for manufacturers to leverage natural gas, renewables, and efficiency technologies to improve their competitiveness in the global marketplace?
- How is demand for new energy technologies and sources (natural gas, biofuels, batteries/ storage, renewables, and efficiency technologies) impacting innovation, manufacturability, and business outlooks for domestic technology manufacturing?
- What regulations and policy interventions could enhance innovation and accelerate the development and deployment of energy technologies and greater industrial energy productivity?

AFTERNOON

12:00 Lunch

12:45 Guest Presentation: Sunny Elebua, Vice President—Corporate Strategy, Exelon Corporation

1:00 Investing in American Energy

As consumer behavior evolves and a changing regulatory landscape encourages development of alternative energy sources, the need for public and private sector investments as well as innovative financing models is required to spur the creation of new, innovative technologies and renewable energy systems.

Presenter
Bill Bohnett
President
Whitecap Investments

Discussant
Steve Stevanovich
Chief Executive Officer
SGS Global Holdings

Key Questions
- What investments are U.S. manufacturers making in response to growing demand for new energy technologies, products, and services?
- How is America's energy abundance reflected in the competitiveness of sectors downstream from energy-intensive sectors of the economy?
- What new institutions, mechanisms, and knowledge-transfer systems must the investment community create to capture U.S. technology innovation and scale it domestically?

2:00 Building Talent in the Energy Sector

This final session will take a closer look at the key challenges related to the education and skills needed to capitalize on opportunities for the current and incoming workforce in the energy sector. The mismatch between opportunities and skills could be a significant roadblock to fully realizing the economic growth potential of this sector.

Presenter
Eric Barron
President
Penn State University

Discussant
Lonnie Stephenson
International President
International Brotherhood of Electrical Workers

Key Questions

- What skills will define the 21st century energy and manufacturing economy?
- What domestic skill shortages and talent deficits hinder America's ability to achieve the full potential of the new energy economy?
- What formal, alternative and continuing education platforms must be established or strengthened to ensure a robust talent pipeline and domestic workforce in the energy sector?

3:00 Conclusion and Next Steps

APPENDIX C

Compete.
Council on Competitiveness

Energy: A Sector Study of the Energy & Manufacturing Competitiveness Partnership

U.S. and global energy systems are undergoing unprecedented changes and experiencing intense new pressures. The U.S. Energy Information Administration projects world energy consumption will grow by 48% between 2012 and 2040[1], challenging existing supplies and strategic reserves of conventional fuels, as well as straining America's aging energy generation, transmission and distribution infrastructure. Concerns about increasing demand, the climate impacts of fossil fuel emissions and rising long-term global oil prices support expanded use of renewable energy sources and nuclear power.

While energy is an economy-wide competitiveness linchpin, it is in its own right a formidable, diverse and transforming industry. With one of the most complex supply portfolios, the U.S. energy sector is an enormous driver of research, innovation and manufacturing across a broad range of technologies and applications.

For the last decade, the Council has been studying and bringing together experts across the energy sector to explore the challenges and opportunities related to the changing energy landscape. The 2008 Energy Security, Innovation and Sustainability Initiative (ESIS) presented a blueprint for America's energy agenda to the private sector and to President Obama ahead of the 2008 presidential election. More recently, the Council's long-term collaboration with the Department of Energy, including the Accelerating Energy Productivity 2030 Partnership and the multi-year American Energy and Manufacturing Competitiveness (AEMC) Partnership, has contributed to a tectonic shift in how the United States consumes energy and how our public and private sector leaders conceive of energy as an input to manufacturing and the competitiveness equation.

In response to continuing challenges around evolving consumer behavior and expectations and a changing regulatory landscape, the U.S. needs a more dynamic and resilient energy system in which emerging technologies lead to new business models, energy products and services. Efforts by both the public and private sectors to increase the development and deployment of clean energy technologies and alternative and renewable energy sources are accelerating at a record pace. An all-of-the-above strategy will be key to ensuring a reliable, affordable and sustainable energy portfolio to drive the U.S. economy—especially its manufacturing sector.

The public and private sectors must come together, with the nation's academic, research, and investment communities, to overcome impediments to innovation and commercialization. And—critically—policymakers must build strategies to ensure that investments in innovation and R&D are captured and commercialized here in the United States.

[1] http://www.eia.gov/todayinenergy/detail.php?id=26212

900 17th Street, NW | Suite 700 | Washington, DC 20006 | T 202 682 4292 | F 202 682 5150 | Compete.org

Key Questions for the Sector Study to Address

1. What role are energy abundance and innovation playing in increasing the productivity and competitiveness of American manufacturing?

2. How is demand for new energy technologies and sources (natural gas, biofuels, batteries/storage, renewables, and efficiency technologies) impacting innovation, manufacturability and business outlooks for domestic technology manufacturing?

3. How are sectors across the economy leveraging new energy resources, technologies and processes to increase margins and expand operations?

4. What regulations and policy interventions could enhance innovation and accelerate the development and deployment of energy technologies and greater industrial energy productivity?

5. What skills will define the 21st-century energy and manufacturing economy? How is the private sector communicating needs to educators and students?

6. How are the tectonic shifts occurring across today's energy landscape—as the U.S. moves from "energy weak" to "energy strong"—changing the decision-making processes and competitiveness propositions for domestic and foreign manufacturers?

7. How is America's energy abundance reflected in the competitiveness of sectors downstream from energy-intensive sectors of the economy?

8. What investments in infrastructure are necessary to fully exploit the opportunity of America's growing energy strength and innovation ecosystem?

9. In efforts to optimize the nation's full energy potential, how can policymakers and the nation's business, research and labor communities come together to resolve conflicts hindering the build-out the nation's energy infrastructure?

The EMCP Methodology

Energy and manufacturing are inextricably linked with America's new found energy abundance creating a window of opportunity for the nation. How this opportunity manifests across different sectors of the economy is the central question of the EMCP. For each sector study, the EMCP will explore four cross-cutting pillars—technology, talent, investment and infrastructure—with the end goal to find commonalities across sectors as well as key differences or even policy conflicts.

Council on Competitiveness
900 17th Street, NW, Suite 700, Washington, D.C. 20006, T 202 682 4292
Compete.org

@CompeteNow
facebook.com/USCouncilonCompetitiveness
linkedin.com/company/council-on-competitiveness/