Energy & Manufacturing Competitiveness Partnership

Leverage.

Phase I Sector Study: Water & Manufacturing

30TH ANNIVERSARY
U.S. Council on Competitiveness

Leverage.
Phase I Sector Study: Water & Manufacturing

THE U.S. 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 U.S. Council on Competitiveness, visit our home page at Compete.org.

Printed in the United States of America

Energy & Manufacturing Competitiveness Partnership

Leverage.

Phase I Sector Study: Water & Manufacturing

U.S. Council on Competitiveness

Table of Contents

Letter from the Co-Chairs 4

Introduction 5

Takeaways & Recommendations 6

Setting the Stage 8

Stakeholder Dialogue 10

Moving Forward 15

About the Energy & Manufacturing Competitiveness Partnership 16

About the U.S. Council on Competitiveness 17

U.S. Council on Competitiveness Members and Staff 18

Appendices 22

- EMCP Steering and Advisory Committees 22
- Participants 24
- Agenda 26
- White Paper 30

Letter from the Co-Chairs

On behalf of the U.S. Council on Competitiveness (Council), Marquette University and A. O. Smith Corporation, we are pleased to present you with a report on the Energy and Manufacturing Competitiveness Partnership (EMCP) sector study dialogue on water and manufacturing, held on February 16, 2016 at Marquette University in Milwaukee, WI.

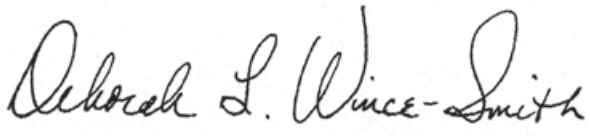
The Council's **U.S. Energy and Manufacturing Competitiveness Partnership (EMCP)** is a collaborative effort of national leaders from all sectors of the economy committed to deepening our understanding of the complexities of the energy and manufacturing nexus, and building a roadmap to ensure that America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

At the heart of the EMCP's agenda of discovery and action are sector studies that will examine industrial competitiveness through the lens of the energy-manufacturing nexus. They will identify the critical cross-cutting and distinct roadblocks in **technology, talent, investment and infrastructure** to leverage America's energy abundance and innovation ecosystem rebuilding national competitiveness on a strong foundation of manufacturing capacity.

Leverage: Water & Manufacturing provides a summary of the highlights and analysis on water and manufacturing as they relate to talent, technology, investment and infrastructure as well as background on why water is essential for businesses and communities to function, using Milwaukee and the surrounding region as a case study. Among the key findings of *Leverage: Water & Manufacturing* are a need to look at water management as an issue of stewardship rather than compliance, a need to improve how we gather and use big data to manage our water systems and a persistent stigmatization of technical jobs that perpetuates the gap between skills and needs in the job market.

Of course, none of this would be possible without the input and support of our members and key experts that provided their valuable input and unique perspectives. We look forward to further engaging national and regional leaders in industry, academia, national laboratories and government as we continue to capture insights and recommendations from this and future dialogues, and put forward an action plan to increase U.S. competitiveness and meet the goals of the Energy and Manufacturing Competitiveness Partnership (EMCP).

Sincerely,



The Honorable Deborah L. Wince-Smith
President and CEO
U.S. Council on Competitiveness

Dr. Michael Lovell
President
Marquette University

Mr. Ajita G. Rajendra
Chairman & CEO
A. O. Smith Corporation

Introduction

Carmel Ruffolo, Associate Vice President for Research and Innovation, Marquette University.

Water is necessary for industry, society and individuals to survive and thrive. Nearly half of industry water consumption is attributable to manufacturing products and services.[1] As fundamental changes such as urbanization and population growth take hold, innovation is needed in infrastructure, technology, investment and talent to meet the increasing demand for water. This requires taking a stewardship approach in which all sectors come together to look beyond compliance and view water as a finite resource that must be managed efficiently.

The EMCP sector study dialogue on water & manufacturing, hosted on February 16, 2016 by Marquette University in partnership with A. O. Smith Corporation and the Council, gathered national leaders and water experts from all sectors of the economy to discuss the important issues around water and manufacturing. The day, broken down into four sections—talent, technology, investment and infrastructure—featured robust conversations on these key pillars and led to a set of recommendations that will feed into the larger EMCP agenda and eventual action plan for the president-elect.

1 *Water and the Economy, Water's Value*, The Value of Water Coalition, 2015.

Takeaways & Recommendations

- **Use a stewardship approach to water management in which laws and regulations surrounding water reuse support natural processes whenever possible and treat water as the limited resources it is rather than a limitless commodity.** Industry uses approximately 350 billion gallons of water each day, nearly half of which is attributable to manufacturing products and services.[2] In some countries, safe water supply has the potential to increase GDP up to 7 percent, making it increasingly important to understand the true value of water and price the commodity appropriately in order to improve efficiency.[3]
- **Integrate natural infrastructure, including roof installments, rain barrels and constructed wetlands, into water management approaches to improve energy efficiency and water quality while reducing overall water infrastructure investment costs.** Green infrastructure is often considered a cheaper and more sustainable alternative to water management than traditional gray infrastructure. Operations and maintenance costs for natural infrastructure projects such as constructed wetlands can be dramatically lower than those associated with traditional wastewater treatment alternatives, with green infrastructure in general presenting a cost savings of more than $1.5 billion.[4,5] These projects also often have additional ancillary benefits for the community and environment and help companies comply with EPA water discharge requirements.
- **Encourage development and deployment of technologies and microbiological barriers that increase overall water supply by diversifying sources and improving quality and efficiency such as desalinization, nutrient recovery and wastewater re-use.** As America's population increases and converges on cities, demand for fresh water and dependence on reliable water infrastructure will grow exponentially. The resulting need to diversify water sources presents a distinct opportunity for these types of innovative solutions such as the development of advanced materials that can remove specific compounds in a more efficient manner.
- **Promote the uptake of sensors and monitoring equipment and aggregation of big data across sectors and geographies to improve water management and increase information available on water quality and efficiency.** Data on efficiency and water quality is scarce. This lack of information often means issues go unreported until catastrophes arise. Increased access to knowledge would allow water issues to be addressed proactively before they reach a point of crisis.

2 *Water and the Environment, Water's Value*, The Value of Water Coalition, 2015.

3 *Overview*, Water, The World Bank, 2016.

4 *Constructed Wetlands for Wastewater Treatment, Natural Infrastructure Case Study*, by France Guertin, Union Carbine Corporation, World Business Council for Sustainable Development, 2015.

5 *Green vs. Gray Infrastructure: When Nature is Better than Concrete*, By John Talberth and Craig Hanson, World Resources Institute, June 19, 2012.

- **Increase federal funding available for water technology test beds to accelerate development and reduce cost and risk associated with deployment of advanced technologies for improving water quality and efficiency.** Affordability and awareness are significant impediments to uptake of new smart water and energy system technologies necessary for the water industry. Government funding and strategic placement of these testing facilities near the companies investing in new water technologies would de-risk the adoption of these technologies.
- **Model water consumption and availability using high performance computing to address gaps in supply and demand and reduce overall waste and costs associated with managing water and energy systems.** Approximately 1.7 trillion gallons of water are lost per year due to natural deterioration, damage and leaks resulting from aging infrastructure.[6] The use of new sensors and measurements, as well as high performance computers, would facilitate collection and dissemination of data in a universally accessible and understandable fashion.
- **Engage government and private sector stakeholders in an enhanced public awareness campaign to address water conservation needs.** Given the current pricing structure of water, neither the average consumer nor company fully understands the importance of conserving this resource. Social marketing and public awareness campaigns can elevate the visibility of water-related issues. This would likely include collaboration with existing initiatives to enhance the overall reach and level of knowledge regarding water issues among consumers.
- **Address the skills gap in the water and manufacturing sector by de-stigmatizing technical careers, reintroducing hands-on training in K-12 and encouraging cross-sector partnerships between industry and academia.** 2016 marks a peak in the number of people on social security benefits, amounting to nearly 2.4 times the number of total beneficiaries in 1970.[7] This creates a skills gap in which talent is not properly matched with available jobs. Partnerships between technical colleges and industry can bring talent directly onboard and highlight specific skill sets to produce a strong talent pipeline.

6 *Challenge, Challenge and Opportunity*, The Value of Water Coalition, 2015.

7 Table: *Number of beneficiaries receiving benefits on December 31, 1970-2015*, Social Security Beneficiary Statistics, Social Security Administration.

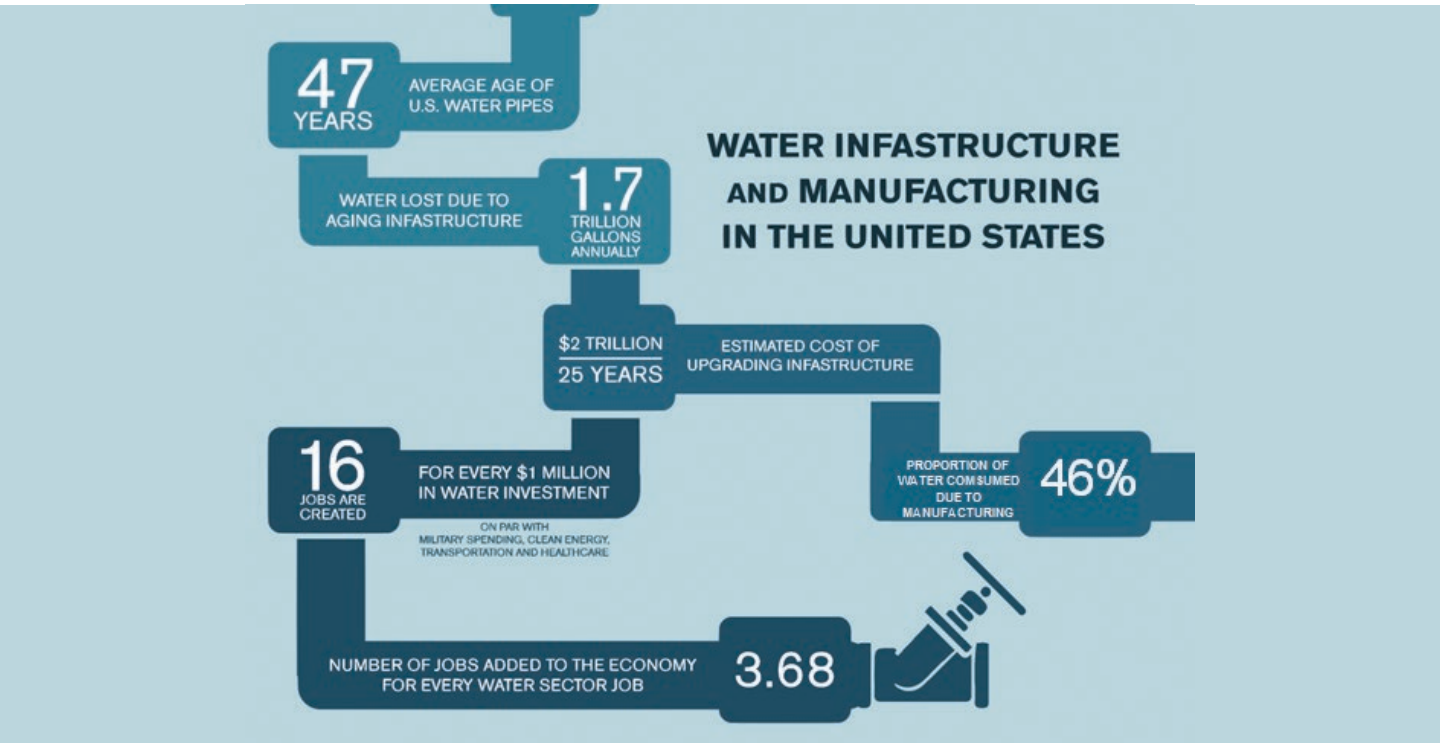
Setting the Stage

Water & Manufacturing

Water is integral to manufacturing operations. To gain a competitive advantage, companies must strategically manage water across their supply chain, innovate to improve efficiency and ensure a robust talent pipeline and investment pool exists.

Renewal and replacement of aging water and wastewater infrastructure is a top issue facing manufacturing companies and residential communities in the United States.[8] In terms of infrastructure, the average age of water pipes in America is 47 years. As a consequence of aging infrastructure, 1.7 trillion gallons of water are lost annually due to leaking pipes.[9] Breakdown in supply, inadequate treatment and loss of water and wastewater capacity seriously disrupts industry operations and daily life. Addressing water and sewer infrastructure needs could easily top $2 trillion over the next 25 years in the United States (see figure 1).[10]

Figure 1: Water infrastructure & manufacturing in the United States
Source: Infographic created by the U.S. Council on Competitiveness.[10,11,12]



8 *Challenge, Challenge and Opportunity*, The Value of Water Coalition, 2015.

9 *Ibid.*

10 *AWWA State of the Water Industry Report,* American Water Works Association, 2014.

The need for ample supply of water and the efficient use and re-use of water for manufacturing processes creates significant demand for further development in water technology and water policy. In fact, 46 percent of water consumed in the United States is used in manufacturing processes.[11] As the call to reduce energy and water use in manufacturing processes grows, opportunities arise to develop and deploy new technologies at the nexus of water and energy.

Water also presents a tremendous opportunity when it comes to job creation in the U.S. For every $1 million of water investment, 16 jobs are created[12]: on par with investment in military spending, clean energy, transportation and healthcare. Additionally, every job created in the water sector adds another 3.68 jobs in the national economy.[13]

But the aging of the baby boomer generation, a persistent negative perception toward technical jobs and an evolving complexity of manufacturing presents new challenges when looking at the work force in water-related occupations. The need for new technology, supporting infrastructure and a robust talent pipeline at the nexus of water, energy and manufacturing has changed the way the U.S. needs to think about education and technical training. Universities and industry must continually collaborate to shrink the skills gap, particularly as it relates to manufacturing.

Milwaukee—A Hub for Water & Manufacturing

86 percent of Wisconsin is bordered by water.[14] The state has over 100 years of industry expertise, and Milwaukee's economy was founded on manufacturing industries that were highly dependent on the abundance of fresh water, exemplifying the importance of access to and efficient use of water to manufacturers.[15]

Top: Ajita Rajendra, CEO, A. O. Smith Corporation.
Bottom: Michael Lovell, President, Marquette University.

Water is a critical resource to manufacturers not only in the U.S. but also around the world. Having an adequate and consistent supply of fresh water is more than just a competitive necessity: without water, in many cases, business operations would cease to function. If access to low-cost water is compromised, the long-term economic health of any manufacturer is at risk. Given the high density of water-related companies in and around Wisconsin, issues related to water and manufacturing are of significant importance in the region.

11 *Water and the Economy, Water's Value*, The Value of Water Coalition, 2015.

12 National Economic & Labor Impact of Water Executive Report, Water Environmental Research Foundation, September 2014.

13 *Water and the Economy, Water's Value*, The Value of Water Coalition, 2015.

14 *Great Lakes and Wisconsin Water Facts*, University of Wisconsin Sea Grant Institute, 2013.

15 *Milwaukee Water Council*, Organizations, U.S. Cluster Mapping Project, 2014.

Stakeholder Dialogue

Water & Manufacturing: Infrastructure

The average age of pipes in American cities is 47 years old. Infrastructure breakdown due to the natural deterioration, damage and leaks lead to approximately 1.7 trillion gallons of water lost annually.[16] The cost of replacing pipes in American cities may be as much as $2 trillion over the next 25 years.[17] In Milwaukee alone, the total cost to replace lead pipes that threaten to contaminate drinking water supplies—a problem that's severity is exemplified in the recent Flint water crisis outlined in this section—is estimated at over $511 million.[18]

In addition to aging infrastructure, a core concern when it comes to effective water management is a simple issue of supply and demand. As population continues to grow and converge in U.S. cities, the pressure to replace existing infrastructure, improve efficiency, and find new sources of both water and investment increases.

When it comes to aging infrastructure, integrating natural or "green" infrastructure has the potential to reduce the 1.7 percent of combined sewer runoff that occurs annually in Milwaukee.[19] Natural infrastructure includes projects such as green roof installments, rain barrels and cisterns, constructed wetlands and porous pavement.

Joan Rose, Homer Nowlin Chair in Water Research, Michigan State University; Douglas Rotman, Program Director, Lawrence Livermore National Laboratory; and Martin Keller, Director, National Renewable Energy Laboratory.

Green infrastructure is cost-effective compared to single-purpose "gray" infrastructure, which includes conventional piped drainage and water treatment systems and can increase industry resilience to external economic and environmental stressors—particularly in water-intensive industries.[20] Green infrastructure can also be used to mitigate industrial wastewater discharge resulting from manufacturing processes such as heating, cooling and product processing.[21]

Despite the known economic and environmental benefits of green over gray infrastructure, constraints around limited funding hinder large scale implementation of green infrastructure as a viable, long-lasting alternative.

16 *Challenge, Challenge and Opportunity*, The Value of Water Coalition, 2015.

17 *AWWA State of the Water Industry Report*, American Water Works Association, 2014.

18 *Milwaukee faces daunting costs with lead water pipes*, by Don Behm, Journal Sentinel, January 27, 2016.

19 *MMSD Treats Nearly 99% of wastewater in 2015*, by Don Behm, Journal Sentinel, January 5, 2016.

20 *What is Green Infrastructure? Green Infrastructure*, U.S. Environmental Protection Agency, November 2, 2015.

21 *Green Infrastructure for Industrial Water & Wastewater,* By Robert McIlvaine, Water & Waste Digest, September 23, 2014.

Because water is an issue that touches all aspects of business, society and human life, collaborative partnerships between companies and non-political organizations can produce strong management systems capable of addressing a variety of water-related problems.

Water & Manufacturing: Technology

Given the tremendous and ever-increasing demand for water, new technologies to diversify water sources and promote efficiency are critical to the competitiveness of U.S. manufacturers. When it comes to the nexus of water and energy, there are two branches of opportunity: monitoring and scaling of technologies and reducing the overall industry water footprint.

Measurements and data collection are critical for tracking and understanding an appropriate versus excess amount of water use. The use of new sensors and measurements, as well as high performance computers, can enable the collection and dissemination of data in a way that is understandable and accessible to all—particularly those involved in urban and industrial planning. For example, use of optical sensors is a recent and promising advancement in water technology and water quality studies, where the absorbance and fluorescence of materials dissolved in water are measured to determine the quality of the water being tested. This device relies on the concentration of dissolved constituents, like nitrate and organic matter, to monitor the salinity of bodies of water such as rivers, lakes and estuaries.[22] Similar to this, the San Joaquin River Real-time Water Quality Management Program in California predicts water quality conditions for the lower San Joaquin River using telemetered stream stage, or a measurement that can compute how much water is flowing through a stream at any point in time, salinity data and computer models. This helps to maintain water quality standards and ensure improved water quality for agricultural, drinking water, and industrial uses.[23] These types of systems-oriented designs and approaches to advancing water technologies are essential to reducing the alarmingly large water footprint often made by manufacturers.

As it stands currently, there is little to no shared data on water systems, particularly when looking across geographies and industries. Increasing the use of water meters and other monitoring mechanisms has the potential to proactively address risks related to water quality. So why are these technologies not being widely used? The issue is one of both deployment and innovation. Deployment of water technologies presents a challenge for industry users who are currently unaware of their consumption and reuse habits and therefore lack incentive to implement these sometimes costly technologies. And while technologies are available to some degree, innovation of new and smart water and energy systems technologies—including development of advanced materials that can remove specific compounds and diversify clean water supplies—is still necessary.

The necessity to conserve water and make efficient use of this finite resource is of tremendous importance when it comes to U.S. competitiveness. In order to fully understand the importance of conserving water, proper value of water must be assessed

22 *Optical Sensors for Water Quality*, by Biran A. Pellerin and Brian A. Bergamaschi, LakeLine Magazine, Spring 2014.

23 *San Joaquin River Real-time Water Quality Program*, The Department of Water Resources- California, 2016.

Crisis in Flint, Michigan

In late 2015, Flint, Michigan—a city about 65 miles northwest of Detroit and a former automobile manufacturing hub—became a household name when it declared a state of emergency over lead contamination of its water supply. The toxic water due to the unmanaged corrosive properties of the Flint River water, combined with aging water infrastructure,[1] contributed not only to a health crisis but to significant economic downturn of the already-struggling Great Lakes city.

Water quality and availability are among the various factors manufactures must consider when establishing and maintaining facilities. One of Flint's largest manufacturers, General Motors, was notably impacted by the declining water quality in Flint following the city's decision to get its water from the Flint River as an austerity measure. In October 2014, worried the water would corrode auto parts, the company brokered a deal to switch its own water supply back to Lake Huron water. The plant uses an estimated 75,000 gallons of water daily,[2] and the switch was estimated to cost the city an estimated $400,000.[3] It was not until August 2015 that a team of researchers from Virginia Tech conducted a water quality study to analyze the true breadth and depth of the problem and its impact on local operations and residents.[4]

The crisis in Flint illustrates the complexity and importance of having a secure supply of water for manufacturing operations in both quality and quantity. Each of the four pillars of competitiveness—infrastructure, investment, technology and talent—if proactively addressed, could have mitigated the crisis and insulated companies like General Motors, the City of Flint and its citizens against the risks associated with poor water quality.

1 *Test Update: Flint River Water 19x more corrosive than Detroit water for Lead Solder; Now What?* by Siddhartha Roy, Flint Water Study Updates, September 11, 2015.

2 *General Motors shutting off Flint River water at engine plant over corrosion worries*, by Ron Fonger, Michigan Live, January 17, 2015.

3 *Flint Water Crisis Fast Facts*, CNN Library, May 22, 2016.

4 The Virginia Tech Research Team, Flint Water Study Updates.

and integrated into business strategies. The WateReuse Research Foundation for example, in partnership with WateReuse California, launched the Direct Potable Reuse (DPR) Initiative in June 2012 as an effort to uphold the mission of "advancing the science of water recycling and desalination."[24] Through research on issues such as chemical contamination, industrial reuse, salinity management, and economics, this strategic initiative can ensure a safe, recycled water supply from water treatment facilities directly to human consumption. With nearly $6 million in funding raised, $500,000 matched funds from the Metropolitan Water District of Southern California and 34 DPR research projects underway,[25] water reuse initiatives such as this can be used to spread knowledge of the true value of water as a commodity, incentivizing manufacturers to support water technologies that promote efficiency and conservation.

Unfortunately, political barriers exist with regard to the deployment strategies for new technologies, which will likely differ on a regional level. As it stands, regulations surrounding water use tend to hinder rather than support efficiency in the water space. The need for public-private partnerships is evident at this junction. By encouraging water technology industries and water users to work together, the union has the potential to produce new water sustainability technologies that drastically reduce the water footprint.

24 *WateReuse Research Foundation: Research and DPR Initiative*, Direct Potable Reuse Research Initiative, WateReuse, 2016.

25 *California Direct Potable Reuse Initiative: Reporting on Significant Progress: Spring/Summer 2016*, The WateReuse Research Foundation.

Water & Manufacturing: Investment

Water is far too often viewed by major consumers, including industry, as a monthly utility cost—a dangerous mentality. There are significant investment opportunities for water particularly in three major areas: infrastructure, process and technology. Given the nature of water as a commodity, it is important to note that the first, best investment is increasing efficiency through upgrades to infrastructure and uptake of new technology as discussed in the previous two sessions.

The U.S. manufacturing industry as a whole would benefit from the creation of more efficient processes that spare excess water waste. Unfortunately, these are not inexpensive undertakings: upgrading wastewater infrastructure to 21st century standards could run up to $271 billion and the research and development and deployment stages of technological innovation require significant resources.[26]

One potential solution to the existing investment gap is the use of regional, government-funded test beds to help reduce risk around the adoption of new technologies. Strategic placement of these testing facilities near companies that could benefit most significantly from the use of these tested technologies would allow for reduced risk and increased uptake.

Recognizing that there are approximately 155,000 public water systems in the United States,[27] it is important to actively assess the risks around water quality and availability and use a coordinated approach to managing water, energy and waste. This will enable more effective lobbying for more investments in the water industry to ensure both infrastructure and technology improvements necessary to keep American industry competitive.

Deon Van As, Vice President, Technical and Packaging Services, MillerCoors; Jeanne Hossenlopp, Vice President, Research & Innovation, Marquette University; Sujeet Chand, Senior Vice President and Chief Technology Officer, Rockwell Automation; and Deborah McKeithan-Gebhardt, President, Tamarack Petroleum Company, Inc.

Water & Manufacturing: Talent

As of April of this year, the total number of social security beneficiaries peaked at about 60.4 million people- nearly 2.4 times the amount in 1970.[28],[29] This includes retired workers and their spouses and children, disabled workers and their families and survivors of deceased workers. With nearly 151 million Americans employed in either full-time or part-time jobs, this equals out to a ratio of approximately 1 beneficiary for every 2.5 American workers.[30]

The aging of the baby boomer generation will play a significant role in the future of U.S. jobs and a significant increase in competition in the workforce can be expected. The manufacturing sector, which had a highly esteemed reputation in the 1950s-1970s, now faces a perception problem. The changing complexity of the sector can be attributed to many factors, including the new immigrant labor force moving to the United States, new advanced technologies and the decline of basic technical skills among the younger workforce.

26 *EPA Says U.S. Requires Significant Spending on Wastewater Infrastructure*, by Catherine A. Cardno, Ph.D., Civil Engineering, The Magazine of the American Society of Civil Engineers, February 2, 2016. American Society of Civil Engineers.

27 *Information About Public Water Systems*, Drinking Water Requirements for States and Public Water Systems, United States Environmental Protection Agency, December 3, 2015.

28 Table 2: *Social Security Benefits*, April 2016, Monthly Statistical Snapshot, April 2016, Social Security Administration.

29 Table: *Number of beneficiaries receiving benefits on December 31, 1970-2015*, Social Security Beneficiary Statistics, Social Security Administration.

30 *Social Security Administration Beneficiaries Top 60,000,000*, by Terence P. Jeffrey, CSNNews.com, March 18, 2016.

Far too often, little light is shed on the possibilities for water careers. There is an increasing effort to provide real, tactical solutions to this issue and increase the attractiveness of water careers for people of all ages from "k-through-gray." This requires the union of industry and education under three key drivers of talent: existing technologies, macro changes and new policies. The talent pool needed to advance this space must be carefully crafted through specific training and education that can be achieved through public-private partnerships. In addition to increasing technical skills, it is crucial to consider interdisciplinary studies when thinking of the education opportunities needed to create a stronger talent pool.

Participants at the Water and Manufacturing Sector Study Meeting at Marquette University Law School in Milwaukee, WI.

Moving Forward

Phase 1 Sector Studies

Water & Manufacturing

Advanced Materials

The Council continued its energy and manufacturing sector studies with a workshop on Advanced Materials on April 12, 2016 together with Laurie Leshin, President of Worcester Polytechnic Institute and Aziz Asphahani, Chief Executive Officer of QuesTek Innovations, LLC. The discussion was built on three previous dialogues on advanced materials and addressed the four key pillars—infrastructure, technology, investment and talent—discussed in this study. Findings are being synthesized and recommendations are being made that transcend sector boundaries and address the issues at the root of U.S. competitiveness.

Advancing U.S. Biosciences

On July 27, 2016, the Council hosted a workshop on Advancing U.S. Biosciences with Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, Pacific Northwest National Laboratory, and Sandia National Laboratories. This dialogue was built upon the advanced biosciences research and development expertise at the national laboratories and the Council's long history of policy development and advocacy for energy and manufacturing competitiveness. Addressing the four key pillars, the findings and key recommendations provide new approaches to funding, organizing and leveraging biosciences research and development among federal agencies, universities, national laboratories, industry and philanthropic entities in an integrated fashion.

Agricultural & Consumer Water Use

The Council will continue its Phase 1 sector studies with a workshop on Agricultural & Consumer Water Use on November 18, 2016 with co-chair Jim Hagedorn, Chairman and Chief Executive Officer of The Scotts Miracle-Gro Company. We are currently in the process of identifying university, laboratory and labor leaders to co-chair this study and we look forward to addressing the Council's four key pillars, the challenges and opportunities concerning the agriculture sector and its impact on U.S. competitiveness

Future EMCP Sector Studies:

- Aerospace
- Automotive
- Chemicals
- Construction & Engineering
- Consumer Goods & Appliances
- Energy
- Information Technology
- Pharmaceuticals & Healthcare
- Textiles

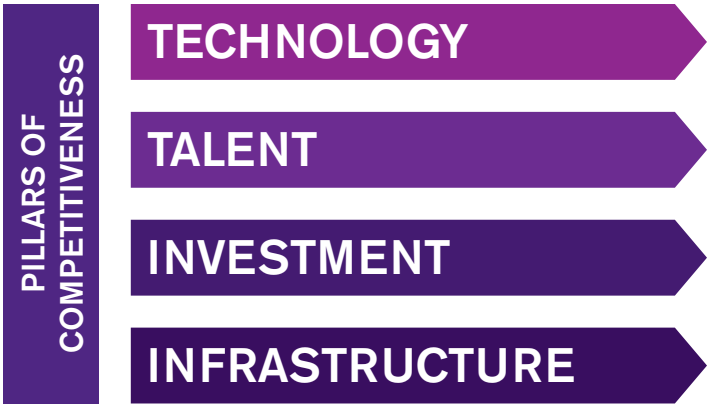
About the Energy & Manufacturing Competitiveness Partnership (EMCP)

The water and manufacturing sector study is part of a larger initiative of the U.S. Council on Competitiveness known as the Energy and Manufacturing Competitiveness Partnership (EMCP). The EMCP unites 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 taps into a diverse membership of leaders from business, academia, 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.

Over the course of the three-year EMCP, the Council will develop an ambitious roadmap to focus national attention on the intersection of energy and manufacturing. Through a range of activities and dialogues such as the EMCP water and manufacturing sector study workshop, the EMCP will deliver action-oriented recommendations to decision-makers at the highest levels of government and industry.

The EMCP is especially designed to culminate with the delivery of a concrete, 100-day action plan ahead of the 2016 national elections, detailing and prioritizing the policies, tools and partnerships the incoming president and Congress should leverage to unleash a sustainable manufacturing renaissance in the United States.



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

About the U.S. Council on Competitiveness

Who We Are

The U.S. Council on Competitiveness' mission is to set an action agenda to drive U.S. competitiveness, productivity and leadership in world markets to raise the standard of living for all Americans.

The U.S. Council on Competitiveness is the only group of CEOs, university presidents, labor leaders and national laboratory directors committed to ensuring the future prosperity of all Americans and enhanced U.S. competitiveness in the global economy through creation of high-value economic activity in the United States.

U.S. Council on Competitiveness
900 17th Street, NW, Suite 700
Washington, D.C. 20006, USA
T 202 682 4292
F 202 682 5150
Compete.org

How We Operate

The key to U.S. prosperity in a global economy is to develop the most innovative workforce, educational system and businesses that will maintain the United States' position as the global economic leader.

The Council achieves its mission by:

- Identifying and understanding emerging challenges to competitiveness
- 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

U.S. Council on Competitiveness Members and Staff

BOARD

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

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

University Vice Chairman
Dr. Michael M. Crow
President
Arizona State University

Labor Vice Chairman
Mr. William P. Hite
General President
United Association of Plumbers and Pipefitters

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

President & CEO
The Honorable Deborah L. Wince-Smith
U.S. 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

Ms. Cathy Engelbert
Chief Executive Officer
Deloitte LLP

Mr. Jeff M. Fettig
Chairman and CEO
Whirlpool Corporation

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

Dr. Steven Knapp
President
The George Washington University

Mr. Mario Longhi
President and CEO
United States Steel Corporation

Dr. Thomas E. Mason
Laboratory Director
Oak Ridge National Laboratory

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 CEO
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. Kenan E. Sahin
Founder and President
TIAX LLC

Dr. Mark S. Schlissel
President
University of Michigan

Dr. Lou Anna K. Simon
President
Michigan State University

Mr. Edward M. Smith
President and CEO
Ullico Inc.

The Honorable Subra Suresh
President
Carnegie Mellon University

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

MEMBERSHIP

Dr. Joseph E. Aoun
President
Northeastern University

Dr. Aziz Asphahani
Chief Executive Officer
QuesTek Innovations LLC

Dr. Dennis Assanis
President
University of Delaware

Mr. Ajay Banga
President and Chief Executive Officer
MasterCard Worldwide

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

Dr. Mark P. Becker
President
Georgia State University

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

Dr. Lee C. Bollinger
President
Columbia University

Dr. Mauro Borges Lemos
Chief Executive Officer
CEMIG

Dr. Richard H. Brodhead
President
Duke 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

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

Dr. Beverly Davenport
President
University of Cincinnati

Mr. Ernest J. Dianastasis
Managing Director
CAI

Dr. Joseph A. DiPietro
President
The University of Tennessee

Dr. Nicholas Dirks
Chancellor
University of California, Berkeley

Dr. Michael V. Drake
President
The Ohio State University

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

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

Dr. W. Kent Fuchs
President
University of Florida

Dr. Sharon Gaber
President
University of Toledo

The Honorable Patrick D. Gallagher
Chancellor
University of Pittsburgh

Dr. E. Gordon Gee
President
West Virginia University

Dr. Howard Gillman
Chancellor
University of California, Irvine

Mr. Gregory Glaros
Founder and Chief Executive Officer
SYNEXXUS, Inc.

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

Dr. Amy Gutmann
President
University of Pennsylvania

Mr. V. Burns Hargis
President
Oklahoma State University

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

Dr. Ralph Hexter
Acting Chancellor
University of California, Davis

Dr. John C. Hitt
President
University of Central Florida

Mr. Jeffrey R. Immelt
Chairman and Chief Executive Officer
General Electric Company

Rev. John I. Jenkins
President
University of Notre Dame

Dr. Robert E. Johnson
President
Becker College

Mr. Adam Khan
Founder and Chief Executive Officer
AKHAN Semiconductors

Mr. David W. Leebron
President
Rice University

Dr. Laurie Leshin
President
Worcester Polytechnic Institute

Dr. Michael Lovell
President
Marquette University

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

Dr. Michael A. McRobbie
President
Indiana University

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

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

Mr. Ajita Rajendra
Chairman and Chief Executive Officer
A.O. Smith Corporation

Dr. Edward Ray
President
Oregon State University

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

Dr. Jean Robillard
Vice President for Medical Affairs
University of Iowa

Mr. John Rogers
President and CEO
Local Motors

Dr. Thomas F. Rosenbaum
President
California Institute of Technology

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

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

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

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

Dr. John D. Simon
President
Lehigh University

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

Mr. Addison Snell
Chief Executive Officer
Intersect360 Research

Dr. Elisa Stephens
President
Academy of Art University

Dr. Elizabeth Stroble
President
Webster University

Dr. Teresa Sullivan
President
University of Virginia

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 and CTO
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

NATIONAL LABORATORY PARTNERS

Dr. Steven F. Ashby
Director
Pacific Northwest National Laboratory

Dr. Martin Keller
Director
National Renewable Energy Laboratory

Dr. Peter B. Littlewood
Director
Argonne National Laboratory

Dr. Mark Peters
Director
Idaho National Laboratory

Dr. Adam Schwartz
Director
Ames National Laboratory

Dr. Michael Witherell
Director
Lawrence Berkeley National Laboratory

CORPORATE PARTNERS

Baker Hughes

Biogen Inc.

The Boeing Company

United Technologies Corporation

Intrexon Corporation

UNIVERSITY PARTNERS

Oklahoma University

Texas A&M University

Texas A&M System

NATIONAL AFFILIATES

Ms. Lynne Brickner
President
ARCS Foundation Inc.

Ms. Molly C. Broad
President
American Council on Education

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

Dr. Thomas M. Connelly, Jr.
Executive Director and Chief Executive Officer
American Chemical Society

Mr. Jeffrey Finkle
President
International Economic Development Council

Dr. Norman Fortenberry
Executive Director
American Society for Engineering Education

Mr. Richard Grefé
Executive Director
AIGA

The Honorable Rush Holt
Chief Executive Officer
American Association for Advancement of Sciences

Mr. Peter Eckstein
President
IEEE-USA

Dr. Dominik Knoll
Chief Executive Officer
World Trade Center New Orleans

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

Lieutenant Colonel Harrison A. Page USMC (Ret.)
President and Chief Executive Officer
Oak Ridge Associated Universities

Dr. Mary Sue Coleman
Association of American Universities

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

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

Dr. Robert L. Bryant
Fellow
American Mathematical Society

FELLOWS

The Honorable Erich Bloch, Distinguished Fellow
Huron Consulting LLP; and
Former Director, National Science Foundation

Mr. Bray Barnes, Senior Fellow
Fellow, National Cybersecurity Institute at Excelsior College; and
Founder and Principal, Security Evaluation and Solutions Group, LLCMs.

The Honorable Erich Bloch, Distinguished Fellow
Huron Consulting LLP; and
Former Director, National Science Foundation

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

The Honorable Daniel S. Goldin, Distinguished Fellow
Chairman and CEO, The Intellisis Corporation; and
Former Administrator, National Aeronautics and Space Administration (NASA)

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

Dr. Paul J. Hommert, Distinguished Fellow
Former Director, Sandia National Laboratory; 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

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. Richard Sergay, Senior Fellow
Founder and Principal
Rebel Media Productions

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

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.

U.S. COUNCIL ON COMPETITIVENESS STAFF

Mr. William C. Bates
Executive Vice President and Chief of Staff

Mr. Chad Evans
Executive Vice President, Policy and Programs

Mr. Jay Hamilton
Senior Vice President, Communications and Outreach

Patricia Hennig
Vice President, Finance & Operations

Marcy Jones
Special Assistant to the President/Office Manager

Chris Mustain
Vice President, Innovation Policy & Programs

Gourang Wakade
Vice President, Membership & Strategic Development

Michael Bernstein
Senior Policy Director, Innovation Policy & Programs

Katie Sarro
Senior Policy Director, Energy & Manufacturing Initiatives

Tanisha Scott Baker
Director, Information Technology and Services

Sam Wineka
Communications Director

William Council
Membership & Communications Manager

Jessica Lovingood
Policy Analyst

Shannon Perry
Policy Analyst

Davon Speight
Assistant Comptroller

APPENDIX A

EMCP Steering and Advisory Committees

EMCP STEERING COMMITTEE

Horst Simon
Deputy Director
Lawrence Berkeley National Laboratory

Samuel Allen
Chairman & CEO
Deere & Company

Steven Ashby
Laboratory Director
Pacific Northwest National Laboratory

Thomas Baruch
Partner
Baruch Future Ventures

Rebecca Blank
Chancellor
University of Wisconsin—Madison

William Bohnett
President
Whitecap Investments LLC

Mauro Borges Lemos
CEO
Companhia Energetica de Minas Gerais

Richard Brodhead
President
Duke University

Curtis Carlson
President & CEO Emeritus
SRI International

James Clements
President
Clemson University

Jeff Fettig
Chairman & CEO
Whirlpool Corporation

Carol Folt
Chancellor
University of North Carolina Chapel Hill

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

Howard Gillman
Chancellor
University of California, Irvine

William Goldstein
Director
Lawrence Livermore National Laboratory

Jim Hagedorn
Chairman & CEO
The Scotts Miracle-Gro Company

Steven Knapp
President
The George Washington University

Laurie Leshin
President
Worcester Polytechnic Institute

Peter Littlewood
Director
Argonne National Laboratory

Michael Lovell
President
Marquette University

Thomas Mason
Director
Oak Ridge National Laboratory

Sean McGarvey
President
Building and Construction Trades Department, AFL-CIO

Keith Nosbusch
Chairman & CEO
Rockwell Automation, Inc.

John Opperman
Interim President
Texas Tech University

Harris Pastides
President
University of South Carolina

James Phillips
Chairman & CEO
NanoMech, Inc.

Ajita Rajendra
Chairman & CEO
A. O. Smith Corporation

Lou Anna Simon
President
Michigan State University

Teresa Sullivan
President
University of Virginia

Subra Suresh
President
Carnegie Mellon University

Kim Wilcox
Chancellor
University of California, Riverside

Keith Williams
President & CEO
Underwriters Laboratories Inc.

W. Randolph Woodson
Chancellor
North Carolina State University

EMCP ADVISORY COMMITTEE

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

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

John Ballato
Vice President, Economic Development
Clemson University

M. Katherine Banks
Dean of Engineering
Texas A&M University

Richard Benson
President
University of Texas at Dallas

Nora Brownell
Founding Partner
ESPY Energy Solutions, LLC

Dona Crawford
Associate Director for Computation
Lawrence Livermore National Laboratory

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

Bob Heideman
Senior Vice President & Chief Technology Officer
A. O. Smith Corporation

Mark Heinrich
President & CEO
Associated Aircraft Manufacturing and Sales, Inc.

Klaus Hoehn
Vice President, Advanced Technology & Engineering
Deere & Company

Glen Lewis
Principal
Glen Lewis Group, LLC
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

Doug Rotman
Program Director
Lawrence Livermore National Laboratory

Carmel Ruffolo
Associate Vice President for Research and Innovation
Marquette University

Alfred Sattelberger
Deputy Director for Programs
Argonne National Laboratory

Lawrence Schook
Vice President for Research
University of Illinois at Urbana-Champaign

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 B

Participants

Dean Amhaus
President & CEO
The Water Council

Dave Averbeck
Chief Engineer—Water Treatment
A. O. Smith Corporation

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

Wolfgang Bauer
University Distinguished Professor, Department of Physics & Astronomy
Michigan State University

Satish Bukkapatnam
Director, TEES Institute for Manufacturing Systems
Texas A&M University

Elizabeth Cantwell
Vice President, Research Development, Office of Knowledge Enterprise Development
Arizona State University

Sujeet Chand
Senior Vice President and Chief Technology Officer
Rockwell Automation

Junhong Chen
Director, NSF I/UCRC on Water Equipment and Policy (WEP)
University of Wisconsin, Milwaukee

Jill Engel-Cox
Director, Clean Energy Manufacturing Analysis Center
National Renewable Energy Laboratory (NREL)

David Garman
Associate Vice Chancellor for Water Technology and Research & Development
University of Wisconsin-Milwaukee

Bob Heideman
Senior Vice President & Chief Technology Officer
A. O. Smith Corporation

Carey Hidaka
Smart Water Management
IBM

Jeanne Hossenlopp
Vice President, Research & Innovation
Marquette University

Matthew Howard
Director, Alliance for Water Stewardship-North America
The Water Council

Bill Hubiak
Director
Engineering & Research, Rexnord

Jim Hurley
Director
University of Wisconsin Aquatic Sciences Center

Martin Keller
Director
National Renewable Energy Laboratory (NREL)

James Klausner
Chair, Department of Mechanical Engineering
Michigan State University

Steve Koshere
EHS&E Manager
CNH Industrial Racine Plant

Minh Le
Senior Advisor
Office of Management and Budget
Executive Office of the President

Michael Lovell
President
Marquette University

Jessica Lovingood
Policy Analyst
U.S. Council on Competitiveness

Mike Luettgen
Senior Principal Engineer—Applied Technology
Kohler Co.

Jordan Macknick
Energy and Environmental Analyst
National Renewable Energy Laboratory (NREL)

Matt Magruder
Environmental Research Manager
MMSD

Deb McKeithan-Gebhardt
President
Tamarack Petroleum Company, Inc.

Rich Meeusen
President
Badger Meter

Joe Muehlbach
Vice President—Integration & Program Management Office
Quad/Graphics

Adel Nasiri
Associate Dean for Research, College of Engineering and Applied Sciences
University of Wisconsin, Milwaukee

Alan Perlstein
Executive Director and CEO
Midwestern Energy Research Consortium

Catherine Potter
Director, Global Environmental Affairs
Johnson Controls, Inc.

Ajita Rajendra
Chairman & CEO
A. O. Smith Corporation

Wellington Reiter
Senior Advisor to the President
Arizona State University

Kris Ropella
Opus Dean, Opus College of Engineering
Marquette University

Joan Rose
Homer Nowlin Chair in Water Research
Michigan State University

Doug Rotman
Program Director
Lawrence Livermore National Laboratory

Carmel Ruffolo
Associate Vice President for Research and Innovation
Marquette University

Katie Sarro
Senior Policy Director, Energy & Manufacturing Initiatives
U.S. Council on Competitiveness

Joseph Schimmels
Associate Dean for Research, College of Engineering
Marquette University

Kevin Shafer
Executive Director
Milwaukee Metropolitan Sewerage District

Seth Snyder
Water-Energy-Sustainability
Argonne National Laboratory

Jeff Stone
Administrator—Division of Water,
Telecommunications & Consumer Affairs
Public Service Commissions of Wisconsin

David Strifling
Director, Water Law and Policy Initiative
Marquette University

Matt Stuyvenberg
Engineering Manager
Badger Meter

Elizabeth Thelen
Director of Entrepreneurship & Talent
The Water Council

Deon Van As
Vice President, Technical and Packaging Services
MillerCoors LLC

Audrey Van Dyke
Corporate Manager Environment & Energy
CNH Industrial America, LLC

Sammis White
Professor, Associate Director School of Continuing
Education
University of Wisconsin, Milwaukee

Robert Zimmerman
Senior Manager—Sustainability
Kohler Co.

Dan Zitomer
Director, Water Quality Center
Marquette University

APPENDIX C

Agenda

MORNING

8:30 Registration and Light Breakfast

9:00 Welcome and Opening Remarks

Michael Lovell
President
Marquette University

Ajita G. Rajendra
Chairman & CEO
A. O. Smith Corporation

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

Building upon more than a decade of work on energy and manufacturing policy, the Council launched the Energy and Manufacturing Competitiveness Partnership (EMCP). This c-suite group of leaders from the private sector, academia, labor and the national laboratories is assessing the challenges faced by America's energy and manufacturing sectors, and will present to national policymakers and private sector leadership a roadmap for concrete actions all stakeholders in the U.S. economy must take to leverage the seminal opportunity presented by today's energy and manufacturing landscape. Critically, this initiative approaches America's diverse industrial landscape not as a monolith, but as a network of distinct but interdependent productive sectors, each with its own challenges and opportunities. The EMCP will explore how crosscutting factors play out within each sector, identify the discrete factors shaping different sectors and assess common challenges and opportunity threads across all sectors.

9:15 Defining the Critical Goals and objectives: Water & Manufacturing Sector Study

Carmel Ruffolo
Associate Vice President for Research and Innovation
Marquette University

Robert Heideman
Senior Vice President & Chief Technology Officer
A. O. Smith Corporation

The Council's sector studies are designed to gather subject matter expertise on key sectors of the U.S. economy and explore the Council's four cross-cutting pillars- infrastructure, technology, investment and talent- to produce tangible policy recommendations for future growth and development in energy and manufacturing. The nexus of water, manufacturing & energy, in particular, plays a vital role as water is a raw material, process component or both in the supply chain and final production of many products and services in the manufacturing space. Overall, this sector study will identify and evaluate water use and re-use, analyze water-related risks, assess current technologies for water use efficiency and highlight areas of improvement in industrial applications.

9:45 Water and Manufacturing--Infrastructure

Presenter

Kevin Shafer
Executive Director
Milwaukee Metropolitan Sewerage District

Increases in extreme weather events, shifting weather patterns and environmental damage may result in land-use change or disruption of critical water infrastructure. Additionally, renewal and replacement of aging water and wastewater infrastructure is the top issue facing the water industry with breakdown in supply, inadequate treatment and loss of water and wastewater capacity seriously disrupting industry and creating disincentives for investment. Addressing water and sewer infrastructure needs could easily top $2 trillion over the next 25 years in the United States.

This session will:

- Assess regional and local areas at greatest risk for water or wastewater service disruption due to poor infrastructure
- Identify transport and supply chain factors that present the greatest risk for industry as well as strategic alternatives across all areas of supply chain management
- Identify the needs of high-intensity water users and examine the processes by which water and energy are used

Kickoff Discussants

Carey Hidaka
Smart Water Management
IBM

Matthew Howard
Director, Alliance for Water Stewardship, North America
The Water Council

David Strifling
Director, Water Law and Policy Initiative
Marquette University

10:45 Coffee Break

11:00 Water and Manufacturing—Technology

Presenter

Martin Keller
Director
National Renewable Energy Laboratory

The need for ample supplies of water and the efficient use and re-use of water for manufacturing provides significant opportunities for further development in water technology and water policy. As the call to reduce energy and water use in manufacturing processes grows, opportunities arise to develop and deploy new technologies at the nexus of water and energy. Technologies to improve efficiency in water use might include: 1) Internet of Things of connected enterprises; 2) advanced sensors for metering and monitoring; 3) new and novel materials; and 4) methods and technology for waste water treatment, re-use, and purification.

This session will:

- Identify new technologies to respond to water-related risks and encourage water use efficiency (re-use, recycling, and alternative processes) while maintaining and potentially increasing productivity
- Discuss regulations and policy interventions that would enhance innovations and accelerate the development and deployment of new water technologies
- Identify key challenges that must be solved to optimize the use and re-use of water in manufacturing

Kickoff Discussants

David Garman
Associate Vice Chancellor for Water Technology and Research & Development
University of Wisconsin-Milwaukee

Doug Rotman
Program Director
Lawrence Livermore National Laboratory

Dan Zitomer
Professor; Director, Water Quality Center
Marquette University

AFTERNOON

12:00 Networking lunch

12:50 Perspectives from the administration

Minh Le
Senior Advisor
Office of Management and Budget
Executive Office of the President

1:00 Water and Manufacturing—Investment

Presenter

Sujeet Chand
Senior Vice President and Chief Technology Officer
Rockwell Automation

As investors become more aware of potential risk exposure to water-related challenges, they will seek to assess the ability of companies to anticipate and respond to these challenges. Companies without sound measures to manage water use sustainably are likely to face restricted access to capital and higher loan rates and insurance premiums. Analyzing water-related risks can open the door to alternative financing mechanisms that can help fund the research and development of new technologies to mitigate these risks and improve efficiency of water use in manufacturing processes.

This session will:

- Identify innovative financing mechanisms that will enable an increase in development and deployment of new technologies and processes for manufacturers in the water and energy space
- Discuss how industry-university collaborations and corporate networking alliances, partnerships, and joint ventures on company performance can advance innovation in a time of constrained budgets
- Identify strategies can for those involved in the R&D process to invest smarter and get more out of each dollar invested in R&D

Kickoff Discussants

Barry Johnson
Division Director
National Science Foundation

Elizabeth (Betsy) Cantwell
Vice President, Research Development
Office of Knowledge Enterprise Development
Arizona State University

Joe Muehlbach
Vice President of Program Management Office
QuadGraphics

2:00 Water and Manufacturing—Talent

Presenter

Sammis White
Professor, Associate Director School of Continuing Education
University of Wisconsin-Milwaukee

The need for new technology, supporting infrastructure and a robust talent pipeline at the nexus of water, energy and manufacturing has changed the way the U.S. needs to think about education and technical training. Universities and industry must continually collaborate to shrink the skills gap, particularly as it relates to manufacturing. For example, in the water sector, over 60% of energy is created with freshwater supply, a limited natural resource, and variability in supply quantity and quality as well as reliability adds a new dimension to the skills necessary to develop and implement sound strategies in the water, energy and manufacturing space.

This session will:

- Identify specific skills needs and gaps in the water and manufacturing sector
- Identify the longer term needs of the manufacturing workforce with the goal of optimizing training and education programs for jobs of the future
- Discuss how universities and the private sector can work together to meet this need and what role government might play to facilitate and/or support this interaction

Kickoff Discussants

Wolfgang Bauer
University Distinguished Professor
Department of Physics & Astronomy
Michigan State University

James Hurley
Director, Aquatic Science Center
University of Wisconsin-Madison

Alan Perlstein
Executive Director and CEO
Midwestern Energy Research Consortium

Elizabeth Thelen
Director of Entrepreneurship & Talent
The Water Council

3:00 Coffee Break

3:15 Connecting Key Themes & End of Day Summary

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

Staff will capture main themes of the day and gather closing thoughts, key ideas, and insights to facilitate a final wrap-up discussion.

4:15 Conclusion & Next Steps

Michael Lovell
President
Marquette University

APPENDIX D

ENERGY AND MANUFACTURING COMPETITIVENESS PARTNERSHIP (EMCP)

Water and Manufacturing Sector Study

Introduction – Water Security as a Business Driver and Risk Factor

Water is integral to many manufacturing operations as a raw material, a process component, or both. To gain a competitive advantage in the modern marketplace, companies must proactively identify and strategically manage water-related risks across the supply chain through final production. Yet corporate water strategy is generally lacking. Although an increasing number of corporations are realizing that they are facing water-related risk, water remains an understated and under-recognized risk particularly in the manufacturing sector. A recent survey revealed that 66% of responding US manufacturers have evaluated how water-related risks could impact growth over the next few years. Many small and medium enterprises have not even considered water-related risk factors. US companies increasingly acknowledge that this is an under-weighted risk with little leadership or policy framework within which to operate. If inadequately managed, water-related risks are likely to have a negative impact on profitability and on the very sustainability of the business model. In some industries, such as food and beverage, production stops (and substantial financial losses) occur when a water supply of acceptable quality cannot be maintained.

At the same time, these risks offer significant opportunities for businesses to contribute knowledge, innovation, goods and services to outcompete rivals, and to develop and implement sustainable water management solutions at the required scale. In short, the need for ample supplies of water and the efficient use and re-use of water for manufacturing provides significant opportunities for further development in water technology and water policy.

To ensure that US manufacturing can stay competitive globally, this sector study will identify and evaluate water use and re-use in manufacturing, identify water use-related risks and highlight opportunities for developing a more efficient and productive use of water in the manufacturing sector It will identify new technologies for water use efficiency and strategies fundamental to overcoming business risks. .The study will cover roadblocks to water efficiency, and water re-use, policy, as well as ensuring a future water supply that is adequate in quantity and quality. It will include an assessment of current technologies and areas for improvement, potentially including: 1) Internet of Things of connected enterprises; 2) advanced sensors for metering and monitoring; 3) new and novel materials; and 4) methods and technology for waste water treatment, re-use, and purification. It will also analyze policy strategies and best practices to promote optimum use and re-use of water in manufacturing and industrial applications.

Impacts of Water on Industry

Traditionally, industries' major water concerns have been with process water as an input cost or as a waste and as a liability and cost. The major risk has been non-compliance and increasingly stricter limits for discharges requiring new capital expenditure. These risks are commonly recognized and readily managed.

Recent events have shown that water can impact every part of the supply chain for manufacturing and has significant impacts on profitability, market share, competitiveness and business efficiency:

- Transport – goods and materials supply and delivery
- Raw material supply - disruption of traditional markets and materials supply
- Process water – variability in supply quantity and quality as well as reliability
- Energy supply – over 60% of energy is created with freshwater supply; with increasing variability energy becomes an embedded risk
- Product distribution – Extreme events are increasingly disrupting supply chains and market services as well as production.

Uncontrollable factors such as climate threaten to expose the vulnerability of the supply chain as increases in extreme weather events, shifting weather patterns and environmental damage may result in supply volatility of raw materials, land-use change or disruption of critical infrastructure. This is especially pertinent for operations located on coastal areas. In addition supply chain vulnerability has increased as a consequence of globalization. Businesses especially manufacturing have prioritized short-term cost efficiency, including offshoring and outsourcing manufacturing, and are maintaining reduced inventory capacities. They have come to rely on single sourcing rather than having alternative suppliers from which to draw (SCR, 2003). The most significant impacts of disruption are reported as loss of orders and revenue, followed by a delayed cash flow.

Other risks potentially affecting manufacturing operations include:

- Infrastructure for water and wastewater – the capital replacement costs could be as much $1 trillion with much infrastructure replacement or upgrading being deferred or not initiated. Breakdowns in supply, inadequate treatment and loss of water and wastewater capacity seriously disrupt industry, with an estimated cost to business of $7.5 trillion in sales and $4.1 trillion in GDP.
- Climate variability –extremes of weather patterns – longer droughts, more intense floods and storms, more frequent extremes of weather and impacts on sea levels, groundwater and surface water. Extreme weather events also disrupt workforce access.
- Technology –Inability to develop cost effective technologies that optimizes water use and re-use.
- Reputational and regulatory risks - companies' licenses to operate depend on their ability to access water. Company water use competes with local community needs. Businesses also risk new fines and fees, government regulations and lawsuits, where their water use is seen as conflicting with the public good or prior use rights.
- Financial risks - as investors become more aware of potential risk exposure to water-related challenges, they will seek to assess the ability of companies to anticipate and respond to these challenges, turning them into opportunities. Companies without sound measures to manage water use sustainably are likely to face restricted access to capital, higher loan rates and insurance premiums. Institutional investors have become increasingly focused on evaluating water management, and one large group of such investors recently made an express identification of companies identified as poor water performers.

Key areas for this sector study:

1. Identify high-intensity water users and examine the amounts of water and energy used.
2. Identify visible and hidden costs of high water use - purchase, treatment, disposal and energy.
3. Identify the key needs of manufacturers that will help drive them toward (or encourage or make economically viable) the optimal use of water and water re-use in manufacturing.

4. Identify the key technical and policy challenges that must be solved to optimize the use and re-use of water in manufacturing
5. Identify new technologies and policy strategies to respond to water-related risks and to encourage water use efficiency (re-use, recycling, and alternative processes) while maintaining and potentially increasing productivity.
6. Identify best practices for water use optimization and efficiency maximization.
7. Assess regional and local areas at greatest risk for water or wastewater service disruption due to poor infrastructure. Identify transport and supply chain factors that are at greatest risk for industry, and work with industry to provide strategic alternatives in the areas of supply chain management across the spectrum of raw materials to finished goods and their distribution and sale. Provide support for supply chain diversification and resource stockpiles.

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.


100% green power
wind & solar


PARTNER
Carbonfree™
Carbonfund.org


Vegetable Ink

U.S. 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/

U.S. Council on Competitiveness