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Revitalizing American Leadership in Advanced Manufacturing
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Introduction

Chairwoman Stevens and Chairman Lamb, Ranking Members Baird and Weber, and the members of the Subcommittees, it is my privilege to address you on the topic of 'Revitalizing American Leadership in Advanced Manufacturing.' My name is Mitchell Dibbs and I am the Associate R&D Director of External Technology for The Dow Chemical Company (Dow). My organization oversees all of Dow's research collaboration with government agencies, government laboratories, universities and independent laboratories around the world. I am responsible for Dow's government research collaborations globally. I have 36 years of experience with Dow in research, product development & commercialization with considerable experience in external research collaborations both as a researcher and as a collaborations director.

Dow combines science and technology knowledge to develop premier materials science solutions that are essential to human progress. Dow has one of the strongest and broadest toolkits in the industry, with robust technology, asset integration, scale and competitive capabilities that enable it to address complex global issues. Dow's market-driven, industry-leading portfolio of advanced materials, industrial intermediates, and plastics businesses deliver a broad range of differentiated technology-based products and solutions for customers in high-growth markets such as packaging, infrastructure, and consumer care. Dow is a subsidiary of DowDuPont, Inc. but on April 1st will separate/emerge from DowDuPont, Inc. as an independent publicly traded material sciences company.

In 2018 Dow invested over $1.5 Billion on research and development. The majority was expended on internal programs; however, Dow also supports a broad portfolio of external R&D collaborations. Dow works with governmental institutions and agencies worldwide to advance the role of chemistry in solving the world's greatest challenges. Collaborations and research partnerships enable Dow to share information and insight into key scientific applications and combine strengths in pursuit of breakthrough solutions. Dow also supports the development of responsible, science-based laws, regulations, standards, practices and procedures that safeguard the community, workplace and environment. Another area of manufacturing innovation is sustainable

chemistry. Markets and regulations call for the development and use of chemicals with improved health and environmental profiles in all sorts of products, and along with our suppliers and customers, Dow is stepping up to this opportunity.

Dow's Partnership with the Advanced Manufacturing Institutes

Dow believes that manufacturing is the lifeblood of U.S. economic growth and has strongly supported the subject of today's hearing. Dow co-chaired the Advanced Manufacturing Partnership and the Advanced Manufacturing Partnership 2.0 that led to the 2012 report, *"Report to the President on Capturing Domestic Competitive Advantage in Advanced Manufacturing"* and the 2014 report, "*Report to the President on Accelerating U.S. Advanced Manufacturing"*. I was personally involved with the AMP 2.0 team and helped develop the recommendations for structuring the Manufacturing Innovation Institutes that are the foundation of Manufacturing USA. Dow strongly believes that a reinvigorated US manufacturing sector has the potential to positively address many of the challenges facing this country including maintaining technology leadership, promoting global competitiveness, and providing critical STEM workforce skills to sustain and grow an advanced technology economy.

Dow has had considerable experience with the Manufacturing USA Institutes having joined three of the fourteen directly and one indirectly as well as exploring several others. Dow is a member of the Digital Manufacturing & Design Innovation Institute (recently rebranded as MxD) and the Rapid Advancement in Process Intensification Deployment Institute (RAPID). We have taken leadership roles in these two institutes and are active in multiple projects. Dow is also an active member of the Institute for Advanced Composites Manufacturing Innovation (IACMI).

Examples of Dow's Institute collaborations include:

IACMI: Composite Products and Processes for high volume Automotive Parts

The next generation of high energy efficient automobiles must be lighter without sacrificing safety and reliability. A unique team consisting of a manufacturing OEM, suppliers, DOE national lab, and academic institutions are working together to develop the materials and processes for lightweight, low-cost, carbon fiber composite automotive components. The invention of unique chemistry and development of novel carbon fiber intermediates and ultrafast production methods led to achievement of OEM specifications and demonstrated viability for large-scale adoption by the OEM in its product lines. This collaboration enables Dow to work directly with customers, suppliers and top tier academic and lab researchers to solve the multitude of complex issues and bring these innovations to reality.

MxD: Scheduling and Control for Real-Time Optimization of Factory Operations

Application of the integrated real time optimization technology can greatly improve the efficiency of manufacturers by bringing automated and optimized decision-making to the shop floor. This project brought together large and small manufacturers, a process control supplier, and top academic computer specialists to develop a modelling framework that can simultaneously account for factors both in production scheduling and unit operation levels and reduce the impact of disturbances, both proactively and reactively. The technology also frees operators from repetitive tasks such as adjusting processing speed, minimizing the need of human interventions to the manufacturing process, and improving productivity.

MxD: Small Drone for Inspection in Confined Spaces

Dow, in collaboration with a small commercial drone company, developed a small, tethered drone, intended for use inspecting confined areas either indoors, or within industrial infrastructure, including tanks, conduits, and pipes. This will significantly reduce the safety risk of inspections by eliminating the need for confined space entries. The drone is an evolution of an existing technology, with the small size, and agility needed to carry a camera or sensor payload into difficult to reach or hazardous areas.

Dow also works closely with federal and national laboratories under Cooperative Research and Development Agreements (CRADAs) providing access to unique facilities and top notch researchers to work side by side with Dow researchers to solve complex technical problems. These labs include Lawrence Berkeley National Lab, Oak Ridge National Lab, National Institute of Standards & Technology, Sandia National Lab, National Renewable Energy Lab, Argonne National Lab, Brookhaven National Lab, Environmental Protection Agency National Risk Management Research Laboratory, Federal Aviation Administration William J. Hughes Technical Center, and Department of the Interior Bureau of Reclamation to name a few of the more recent collaborators.

Lawrence Berkeley National Lab: Electron Microscopy for Imaging of Catalysts

By working together Dow and LBNL have made significant progress toward the development of catalyst imaging techniques. The ability to image the structure of atomic surfaces allows for the studying of catalysts in a previously unexplored manner. This research direction had not been previously pursued because of the air and radiation sensitivity of the catalyst support. An understanding of the variations of catalyst sites and correlation with polymer properties enable researchers to a better design the next generation of catalysts allowing US industry to strengthen its leading edge position. The implications of this work to the broader electron microscopy community should not be over-looked.

Attached at the end of this written testimony is a list of Dow's external collaborations from 2015 to 2019, intended to demonstrate the breadth of Dow's collaborations. It is important to note this list is not fully inclusive of all of Dow's external collaborations

with government entities. Fourteen collaborations out of the 36 are with Manufacturing USA Institutes.

The Manufacturing Institutes and federal labs provide a number of unique benefits to the country as a whole through both workforce and technology development. Primary among these benefits is the unique research environment that Institutes and federal labs provide. The labs have a number of facilities and capabilities that are unique in the world. In many cases the costs of the facility investments are justifiable only on a national scale; industry alone could not support these types of facilities. Federal labs and universities are intellectual powerhouses, led by researchers, professors and students who think outside the box, are not encumbered by traditional approaches, and are filled with energy and enthusiasm to drive innovative solutions.

The Institute's Role in Commercialization New Technology

The commercialization of new technology can be impeded by many factors including: the cost and scale of the research, lack of critical expertise, lack of needed infrastructure, and high perceived technical and/or business risk. Since the Institutes along with universities and federal labs are not in the business of product commercialization, these environments are ideal for bringing together manufacturers, suppliers, and customers of all sizes in precompetitive ways. Convening these groups and facilitating discussion which otherwise would not occur is a great way to uncover new concepts, and develop new product idea and innovations.

Government involvement can play a vital role in helping to alleviate the barriers to commercialization. The benefits of such arrangements are shared by government, partners, and society as a whole – as well as the companies. There are many reasons why government support for innovation is of value:

- Funding for a research program that is of interest to society.
- Providing the framework for pre-competitive consortia or collaborations for projects that are beyond the scope of a single company.
- Providing a mechanism to develop working relationships with sources of innovation such as universities and Government Labs.
- Encouraging partnerships with customers and suppliers.
- Making possible projects where a company does not have all the required skills or technology.
- Allowing a company to explore areas beyond its core expertise.
- Providing early contact with future product specifiers/buyers.
- Outside confirmation of the value of a company's research direction.
- Objective analysis of a company's research plans.

However, the government support for research brings with it some obligations that are not typical of internally supported research:

- The company is contractually obligated to perform the research and report results to the government.
- The company must comply with government accounting and audit requirements.
- The research must be carried out within the border of the country that provides the financial support
- Restrictions on sale or licensing of the Intellectual Property.
- Require manufacturing substantially within the country.
- The government march-in rights to use the technology for the government's own use if the company does not commercialize.
- The timeline for the process from proposal to close-out of the research program can be quite long, often 5-7 years. A funded project that aligns with business needs today may not align in 2-3 years.

Suggestions for Improving the Efficiency and Effectiveness of the Institutes

While the Institutes provide a number of important benefits, Dow has observed several areas where improvements could enhance the Institutes' goals. The Institutes have shown a tendency to be slow to launch and slow to implement projects. This could be minimized through better communication and with well written membership and project agreements. Each Institute has put together its own membership agreement and project process. The Institutes could benefit from shared practices and standardization of the agreement process. Such support was recommended in the AMP 2.0 report but not implemented.

Most of the Institutes operate under Cooperative Agreements which generally do not provide enough flexibility to develop a framework for the Institute that would allow the Institute to quickly implement approved projects. One way to improve this issue is for agreements using Other Transaction Authority (OTA) negotiated with the appropriate terms and conditions. This approach has been utilized for MxD which is reaching the end of its original agreement with the Department of Defense. MxD secured follow-on funding and negotiated a Technology Investment Agreement using OTA.

Closing

Thank you for holding this hearing on Revitalizing American Leadership in Advanced Manufacturing.

Dow recognizes the business and societal value of collaborative innovation, where technological advancements can be leveraged to create societal benefit. Sustained and substantial investments in R&D are critical to accelerate the fundamental expansion of knowledge. In particular, government investment in R&D and support of facilities, such as the National Labs, allows for the creation of unique capabilities that could not be built without government involvement.

For Dow, public-private partnerships have proven to be the most effective way to maximize public investment, and drive innovation and commercialization. The Manufacturing Institutes demonstrate what is possible when public investment is aligned to the mutual priorities of industry and federal agencies. They combine the unique capabilities of government with the scale and sophistication of industry, the theoretical knowledge in our research universities, and the innovation culture that drives many start-ups. Success has come through a focus on the collaborative aspects of innovation, letting industry and government both do what it does best.

Attachment

Selected Dow US Government Collaborations (2015-2019)	Start Date	End Date
Data Aggregation Platform and Knowledge Base for Manufacturing Intelligence (MxD*)	30/Sep/16	31/Dec/18
Integrated Scheduling and Control for Real-Time Optimization of Factory Operations (MxD*)	1/May/17	15/Oct/18
An Analytics Based Supply Chain Risk and Event Management Decision Support Framework (MxD*)	9/Jul/17	12/Nov/19
Robotic confined entry inspection (MxD*)	1/Oct/17	31/Oct/18
Digital Manufacturing Roadshow (MxD*)	1/Feb/18	1/Jun/18
Dynamic Intensification of the Operation of Dividing Wall Column (RAPID)	1/Apr/17	1/Oct/20
Energy-efficient separation of olefins and paraffin through a membrane (RAPID)	1/Oct/17	1/Oct/21
Formation of Rapid Center for Process Modeling (RAPID)	1/Oct/17	9/Sep/99
Synthesis of Operable Process Intensification Systems (RAPID)	14/Aug/18	14/Aug/21
RAPID Multiscale Modeling Infrastructure (RAPID)	1/Nov/18	1/Nov/22
An experimentally verified physical properties database for absorbent selection (RAPID)	11/Dec/18	11/Dec/20
Optimization modeling for advanced syngas to olefin reactive systems (RAPID)	30/Jul/18	9/Sep/99
Efficient chemicals production via chemical looping (RAPID)	1/Sep/17	1/Sep/21
Novel Chemistry-Enabled Fast Processing of Carbon Fiber Composites for the Transportation Industry (IACMI)	22/Apr/14	22/Apr/19
Clean Energy Research Center Building Energy Efficiency (LBNL)	7/Oct/10	31/Dec/18
Energy Efficient Housing Research Partnerships (NREL)	23/Mar/11	23/Mar/15
Development of High VI High Fuel Efficient Lubricant (NETL-VTP)	1/Jan/12	1/Apr/15
Scale-up of novel low cost Carbon Fibers (EERE-IMI)	1/Sep/12	1/Sep/15
Residential Cool Roof (ORNL)	11/Mar/13	11/Mar/15
Development of a Long Life Cycle, Highly Water Resistant, Solar Reflective Retrofit Roof Coating (LBNL & ORNL)	15/Feb/13	14/Feb/15
Integrated Computation Materials Engineering Development of Carbon Fiber Composites for Lightweight Vehicles (EERE-VTO)	1/Apr/15	30/Sep/18
Ambient pressure XPS for in situ studies of heterogeneous catalysts (LBNL)	16/Feb/16	31/Aug/19
Imaging Model Ziegler Natta Catalysts with Single-Atom Sensitivity (LBNL)	16/Feb/16	31/Aug/19
Advancing PV material performance using nanoscale opto-electrical characterization (Atomic Force Microscopy) (LBNL)	16/Feb/16	15/Aug/17
Additive Manufacturing of Polyurethane Materials (ORNL)	1/Feb/16	1/Feb/17
Modeling the Effect of Film Morphology on the Performance of an OLED Device (LBNL)	16/Feb/16	15/Feb/17
3D Structure and Organization in Polymeric and Organic Thin Films (LBNL)	16/Feb/16	30/Jun/18

Selected Dow US Government Collaborations (2015-2019)	Start Date	End Date
Bio-Syngas fermentation to C6-C14 alcohol production (EERE-BETO)	1/Oct/16	31/May/19
Development of an oxidative dehydrogenation (ODH) of ethane to ethylene technology (ARPA-E)	10/May/17	30/Sep/17
HPC4M: Polyurethanes Modeling (Sandia NL)	3/Dec/18	3/Dec/19
Integrated Hydrogen Combustion with Energy-Efficient Ethylene Production (EERE-AMO)	1/Sep/18	31/Aug/19
NIST CRADA Development and Validation of Neutron-based Characterization Methods for Morphology and Topology of Soft Materials Consortium	5/Sep/12	30/Nov/19
NIST CRADA National Voluntary Laboratory Accreditation Program	1/Jan/15	31/Dec/18
NIST CRADA: Service Life Prediction Methodologies and Metrologies for Building Joint Sealant Consortium	1/Oct/17	1/Nov/20
NIST CRADA Characterization And Modeling of the Surface/Interface of Polymeric Materials and Systems Consortium	1/Aug/15	31/Mar/19
NIST CRADA: Materials Characterization Using Synchrotron Radiation	22/Dec/98	22/Dec/18