



Ideas To Empower America's Emerging Shale-Based Manufacturing Renaissance

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American
Shale &
Manufacturing
Partnership

The development of domestic shale resources is an economic driver, providing an abundant and affordable supply of energy and raw materials used in manufacturing.

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Foreword



American
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Partnership

The American Shale & Manufacturing Partnership (ASMP), an informal group of academic institutions, trade groups, think tanks, foundations, labor organizations, non-governmental entities and business development groups, held workshops across the country in 2013 and 2014 to examine the impact of abundant natural gas and oil due to shale development on U.S. manufacturing and to explore how to enhance the nation's global competitiveness. The ASMP supports the premise of an American manufacturing renaissance through responsible shale development. The result, "Ideas to Empower America's Emerging Shale-Based Manufacturing Renaissance," identifies issues that should be addressed and suggests steps toward achieving the goal of a manufacturing renaissance. Note that this document is not a consensus report, but rather a collection of ideas that the ASMP hopes will drive thoughtful discussion.

ASMP Steering Group member organizations are:

- Allegheny Conference on Community Development
- American Fuel & Petrochemical Manufacturers
- America's Natural Gas Alliance
- Carnegie Mellon University
- Claude Worthington Benedum Foundation
- Consumer Energy Alliance
- Cynthia and George Mitchell Foundation
- International Association of Bridge, Structural, Ornamental & Reinforcing Iron Workers
- National Association of Manufacturers
- NorTech
- The Ohio State University
- Society of Chemical Manufacturers and Affiliates
- Texas A&M University Engineering
- U.S. Chamber of Commerce's Institute for 21st Century Energy

Regional discussion events held were:

- Opening discussion in the Marcellus region, hosted by Carnegie Mellon University on January 10, 2013
- Environmental discussion in the Marcellus region, hosted by Carnegie Mellon University on April 4, 2013
- Midwest regional discussion, hosted by Ohio State University on December 13, 2013
- Gulf regional discussion, hosted by the Houston Advanced Research Center and Texas A&M University on January 23, 2014
- Gulf regional discussion, hosted by Louisiana State University's Center for Energy Studies on May 9, 2014
- Western regional discussion, hosted by Colorado State University's Center for the New Energy Economy on June 5, 2014

Participants in the discussions represented a range of perspectives including:

- Policy makers and regulators from a wide range of governmental organizations
- Academic researchers, engineers, scientists and policy experts
- Industry scientists, engineers, entrepreneurs, innovators and business executives
- Environmental engineers and health and safety experts from non-governmental organizations (NGOs), academia, labor and industry
- Infrastructure and logistics experts
- Workforce development experts from academia, industry, state economic development agencies and labor

This report was prepared through six multi-stakeholder, ASMP-hosted discussions at partnering academic institutions. Cross-sector partners discussed topics deemed essential to expediting a manufacturing renaissance including workforce development and jobs creation, the manufacturing supply chain, federal and state policies, collaboration with agencies and local government, infrastructure, research and innovation, and the environment.

Executive Summary

The development of domestic shale resources is an economic driver, providing an abundant and affordable supply of energy and raw materials used in manufacturing. Energy prices in the United States today are significantly lower than those in other nations as a result of this domestic shale development. U.S. manufacturers, especially those that are energy-intensive, are benefitting from this energy advantage, and this shale development has enabled those companies and the nation to better compete in a global economy.

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Several recurring themes stood out during the discussions and are reflected in the report. Workforce development and jobs creation were identified as key components in a robust manufacturing economy. All stakeholders shared the view that a manufacturing renaissance cannot occur without a highly trained and motivated workforce. Strategic partnerships between community and business leaders, educational and training providers, and government at all levels have already demonstrated success in linking manufacturers and construction firms with existing vocational and technical programs at the high school level and at community colleges and universities. In addition, cooperative education, apprenticeships and supplemental

training opportunities were highlighted as ways to enhance classroom education. One of the main challenges identified, however, is building awareness of the range and benefits of careers that are available to encourage recruitment into the modern manufacturing workplace. A concerted effort amongst all stakeholders will be required to demonstrate the viability of these well-paying careers.

In order to support a U.S. manufacturing renaissance, efficient processes and financial resources should be considered when addressing regulatory, permitting and environmental measures. Today a patchwork of complex and often differing federal and state regulations, and limited resources at regulatory agencies, present a significant challenge to both governing authorities and industry. Although many factors influence a manufacturer's preference for state or federal regulation and their decisions of where to operate, all stakeholders support a clean, healthy environment and a safe workplace. Recommended strategies for consideration include the formation of a multi-stakeholder task force to address the challenges associated with the regulatory and permitting processes, new mechanisms for increased engagement with both elected officials and the public, and opportunities to streamline regulatory processes.



Infrastructure is another element viewed as critical to supporting the manufacturing renaissance. While the United States enjoys advanced infrastructure, compared to many other regions around the world, participants expressed that there may be certain limitations in terms of availability, age and overall integrity. While some infrastructure developments are underway, participants agreed that infrastructure funding should be made strategically and viewed as a long-term investment. To that end, relationships among industry, government and impacted communities must be established

or enhanced prior to undertaking infrastructure projects, and state and federal regulations must not inhibit development. This report presents several models and ideas which have been viewed as successful in meeting infrastructure challenges.

Empowering research and innovation also was identified as critical to driving the manufacturing renaissance. Participants recommended new and continued partnerships among industry, government and the academic community which have led to successful research and development initiatives. Additional

strategies recommended include sustained and predictable funding mechanisms for public and private research partnerships, patent protection considerations and technology transfer opportunities.

The challenges outlined in this report are not insurmountable. They will, however, require more targeted discussions at a national level among a broad array of interests. This report provides ideas, examples of best practices and suggestions that can help inform those discussions and provide a path forward toward an American manufacturing renaissance.

Introduction – The Emerging Manufacturing Renaissance

The United States has always relied on the manufacturing sector as the nation's economic backbone. Critical to global competitiveness, manufacturing added over \$2 trillion to the U.S. economy in 2013 and employs more than 12 million Americans.¹

Both the private and government sectors recognize the value of manufacturing investments in our nation and the role these investments play in a manufacturing renaissance. Recent indicators point to a resurgence in growth including an increase in energy and chemical exports, a rise in capital spending, an upsurge in the number of factory orders and the expansion of manufacturing jobs. In addition, manufacturers who moved operations offshore over the past two decades are taking a fresh look at re-shoring. An expanded manufacturing base has the potential to transform the U.S. economy in a way that few things can, with impacts comparable to the Internet revolution of the late 1990s.

The energy sector is a leader in the manufacturing renaissance. Oil and natural gas production has led to innovative technologies which have improved efficiency and productivity within the energy sector. With these advances comes a shift to new sources of energy and a better

understanding of ways to protect natural resources while creating sustainable solutions. This includes the recycling and reuse of water for energy production, and optimizing the value of other energy resources.

Advances in the energy sector provide clear economic, political and security benefits; not just for manufacturers, but for society as a whole. For the first time this century, the United States is producing more oil than it imports, decreasing reliance on foreign sources of oil. Less dependence on oil from unstable or unfriendly regions in the world will strengthen the nation's energy security.

The United States also is producing an abundant amount of natural gas and natural gas liquids from hydraulic fracturing which will provide an affordable supply of energy and raw materials for decades. This abundance of resources, along with our transportation and logistical infrastructure, educational system and environmental infrastructure, is expected to set the United States apart from other regions around the world.

Shale Resources – Driving the Manufacturing Renaissance

The development of domestic shale resources is an economic driver, providing an abundant and affordable supply of energy and raw materials

Currently 215 chemical projects including new facilities and major expansions are being planned in the U.S. based on shale gas, representing a capital investment of \$135 bn.²

used in manufacturing. Shale development enables the nation to better compete in a global economy thereby impacting the balance of global trade.

Energy prices in the United States are significantly lower than those in other nations as a result of domestic shale development. American manufacturers enjoy natural gas prices around \$3 to \$4 per thousand cubic feet, while European producers pay \$8 to \$10.³ Prices in Asia have fluctuated between \$11 and \$20 per thousand cubic feet.⁴ Natural gas prices also significantly influence the cost of electricity.⁵ U.S. manufacturers, especially those which are energy-intensive, are benefitting from this energy advantage.



Shale Resources – Building Blocks for Finished Products

In addition to affordable and abundant natural gas – which is mostly methane – shale development also has created an abundance of hydrocarbons called natural gas liquids (NGLs) which serve as starting feedstocks and are converted into materials used in manufacturing. NGLs such as ethane, propane and butane are used in petrochemical manufacturing to produce advanced plastics, fibers, adhesives, coatings, cleaning agents and other materials needed throughout the manufacturing supply chain.

The pricing of raw materials used in petrochemical manufacturing is tied to other, similar commodities. Petrochemical production relies on naphtha (i.e., a mixture of different hydrocarbon molecules which are derived from the oil refining process), which is tied to the price of oil, and NGLs, which are closely linked to natural gas prices. Because raw materials can represent as much as 75 percent of the cost of producing petrochemicals, U.S. manufacturers’ access to domestically-produced natural resources can present a significant cost savings over importing the same materials as petrochemical feedstocks.

Europe primarily uses naphtha as a starting feedstock for petrochemical production and, since naphtha prices are tied to the price of Brent crude, Europe does not enjoy the same advantage as the United States. Companies in Asia use both ethane and naphtha as raw starting materials. In terms of competitiveness, however, Asia pays as much as three to four times more for natural gas and the associated NGLs than do U.S. companies and, as is the case in Europe, the price of Brent crude can place naphtha at a disadvantage as a raw starting feedstock.

Other Factors Contributing to a Manufacturing Renaissance

Another benefit of accelerated shale development and advances in the energy sector is the creation of new and the replacement of aging infrastructure. In addition, beneficial impacts downstream in areas such as the plastics industry (due to the availability of inexpensive raw materials) and the formation of new sub-sectors and new companies are bringing an increase in jobs accessible to Americans at all educational levels. More and more facilities are being built, restarted, or expanded in the United States as a result of the shale gas revolution.⁶

While greater energy production is contributing to a reversal of previous declines in manufacturing, a variety of other strengths available in the United States are spurring the manufacturing renaissance. Political stability, intellectual property protection, a strong academic base, and a free market make the nation more attractive for investment compared with other regions of the world. U.S. employers also are providing career pathways for skilled workers and training where needed.

These factors nurture a strong competitive position for the United States and North America. While industry benefits by creating advanced research and development (R&D), more patents and U.S.-owned innovations, greater supply chain and energy-saving efficiencies, regions and local communities benefit as well. The revitalization of states, cities and towns is underway and local communities able to host and support manufacturing operations are seeing higher-wage jobs. For employees, manufacturing investments mean new opportunities for the middle class and those in poverty, and improved well-being for individuals and families.

In the midst of this renaissance, manufacturers and investors are continually looking for investment opportunities, which can have an impact on our nation for decades to come. Manufacturers are seeking a globally competitive advantage that ensures an abundance of affordable raw materials and energy, a well-qualified and motivated workforce, a reasonable and predictable regulatory system that protects people and the environment, and the collective

strength of an entire nation rallying for a strong manufacturing sector. A concerted and collective effort will be required among government, industry, labor, NGOs and academia to fully realize an American manufacturing renaissance.

Several things must be done. First, conversations about the nature of manufacturing must occur on a national level and consider the entire supply chain. Secondly, government and industry must address fundamental questions related to federal and state activities, infrastructure development, research and innovation, workforce development, jobs creation and the environment. Lastly, these issues must be answered through an inclusive partnership that can host constructive dialogues guided toward expanding the U.S. manufacturing renaissance.

Workforce Development and Jobs Creation as a Backbone for the Manufacturing Renaissance

An available, high-quality workforce is the backbone of manufacturing and construction in the United States. Talent is the manufacturing sector's greatest asset and the ability to acquire and to develop a future talent pool is vital to keeping pace at the convergence of the manufacturing renaissance, growing global demand, and increasing foreign competition.

Even for manufacturers and unions with global reach, workforce development takes place at local and regional levels. Development efforts have led many potential employers to recognize a possible disconnect between their needs and the U.S. educational system. Secondary

education curricula are more focused on meeting specific standards and college preparation, and can leave out options which would develop the skills that are required by industry.

One contributing factor is a low level of awareness of the value which the manufacturing and construction sectors can provide on local, regional and national scales. Decision makers, elected officials, influencers and the public are largely unaware of the benefits possible through investments in manufacturing and infrastructure. Opinions and perceptions are often shaped by media that focus on environmental issues without a proper discussion or balance with regard to socio-economic benefits. Individuals may

not recognize the high-tech nature and safety culture of today's manufacturing and construction environment or that these sectors offer well-paying careers.

When corporations make decisions about where to establish new operations, critical factors include workforce availability, policies relevant to workforce development, and the various options for training new and prospective employees. The economic benefits of manufacturing and job creation are available to regions and local communities but require the formation of partnerships among corporations, worker representatives, government, academia and the public.



Texas A&M University gives a presentation on hydraulic fracturing at county fairs. Many industry partners participate in the annual Energy Day in Houston, sharing insights and public education in interactive ways.

The University of Miami of Ohio provides a two-week course for kindergarten through 8th grade teachers on how to make science fun on a shoestring budget.



Building Awareness of the Benefits of Manufacturing Careers

Manufacturing careers have been devalued over time due to the emphasis on other sectors, especially those related to services and knowledge, which are deemed more lucrative and less demanding.

One goal is to replace the current view by recognizing that technology plays a much larger role in manufacturing than ever before. The modern manufacturing era presents a broad range of jobs and a higher than perceived standard of living and opportunities for workers at any level of education. With this comes benefits that are not always understood by students, young adults, or even influencers such as teachers, counselors and parents.

Creating general awareness of science, technology, engineering and mathematics (STEM) disciplines and fields will facilitate an understanding of the modern manufacturing and construction sectors. Targeted curricula and experiential learning can show how manufacturing and construction jobs require and use STEM knowledge and skills. This can lead to an awareness of the training required for specific jobs and promising careers.

Strategies for fostering positive attitudes and providing clear understanding of manufacturing career opportunities include:

- Working with community leadership, schools and influencers to guide large-scale community engagement and focused engagement with different stakeholder groups
- Engaging students and families where manufacturers are located, to include engagement with youth-focused organizations and the use of social media in addition to traditional outreach

The Houston Advanced Research Center through its Environmentally Friendly Drilling program has developed a virtual oil rig website and a virtual hydraulic fracturing website which are formatted like video games to give visitors a unique way to understand energy development and to provide information regarding best practices available for hydraulic fracturing.

The state of Ohio has launched OhioMeansJobs K-12. OhioMeansJobs K-12 is a no-cost, online career development tool that enables teachers, parents and students to explore career interests, research career options, and evaluate education and training programs in a child-friendly way.

- Providing a look at manufacturing, construction and their opportunities through field days, teacher visits and other experiential learning and demonstration opportunities
- Providing information about manufacturing-related careers in Advanced Placement and STEM curricula
- Empowering employees in manufacturing and construction to serve as peer-to-peer counselors and messengers in the classroom to convey the benefits of manufacturing and construction careers
- Having constructive discussions within the manufacturing and construction sectors about changes that need to be made to encourage positive views of industry

Strategic Partnerships to Build Community Value

Partnerships between community leaders, educational providers, and government at all levels can maximize the potential for success when developing manufacturing facilities. The value of partnering is most clearly demonstrated in the established links between manufacturers and construction firms with existing vocational programs at the high school level, community colleges, universities and the eventual hiring of local citizens into manufacturing jobs.

Because faculty and schools support a diversity of education and training objectives, the burden of imparting specific manufacturing and construction knowledge and skills development may rest with industry and the unions. More companies and unions are realizing this and forming effective local and regional strategies that can be adapted to other places. There also are good examples of industry needs influencing educational curricula through partnerships and other relationships.

Colorado is one of many states that have recognized the value of community colleges as a training platform where academia, industry and government can unite to provide training in specific skills that are needed, link students to jobs and show career pathways.

Sustained engagement and intellectual support rather than just brief intersections and infusions of funding are vital to build a strong and lasting pipeline of prospective hires. Strategies being considered and implemented across the United States include:

- Forming certification and degree-granting programs which also require internships and other experiential enrichment activities
- Partnering with schools to talk with teachers, counselors and students, and hosting STEM events, career days and other educational programs to build awareness and expose young people to the manufacturing and construction sectors
- Providing salary premiums and private funding endowments for teachers who demonstrate STEM skills and have relevant degrees and work experience

- Supporting community-based organizations that seek to share STEM in the classroom and through community events and outreach
- Using a “check the box” option on state tax forms to earmark funding for education
- Identifying ways for non-U.S. students to stay in the United States and succeed

IowaWorks is the Iowa state government’s partnership with industry to help with all stages of the human resources cycle – from recruitment to training to retention. Iowa uses the “WorkKeys” tool to assess employees’ skills and match workers with appropriate jobs.



Recruitment into the Modern Manufacturing Workplace

Today's manufacturing and construction sectors offer something for everyone at all levels of education from those with high school diplomas to those with PhDs. Increased awareness of pathways to manufacturing and construction careers can start as early as the middle school level and incorporate information about regional and local opportunities.

A critical target for recruitment efforts are young adults between the ages of 19 and 21. This is an age range in which career options are being considered and desired career paths are being identified. For some, it also signals the end of required education and a chance to be involved in a range of career training activities.

Targeted recruitment efforts by companies have proven successful when properly planned, resourced and sustained. U.S. military veterans can be one of the best potential employee segments in the manufacturing sector due to their backgrounds, training, discipline and attitude. Employers must be prepared to accept the necessary transition period and deal with the highly trained and conditioned military mindset to enable effective entry of service members into the workplace culture.

Employers also should focus recruitment efforts to appropriately and strategically engage minorities and women who are historically under-represented in the manufacturing environment and STEM-related careers. Value can be found in presenting opportunities in modern manufacturing and construction to inner-city and rural youth for whom the attainment of a four-year degree may be more economically challenging.

Strategies to enable recruitment include:

- Emphasizing potential career paths, job security, safety and compensation, and the number of jobs available in specific fields for certain skill sets
- Clarifying pathways and opportunities for advancement after entry into the manufacturing and construction sectors to encourage interest and seed retention
- Noting the distinction between the ease of entry into some manufacturing and construction careers and the income opportunities through certification and apprenticeship programs versus the time and costs that must be invested in other career fields
- Empowering employees in manufacturing and construction jobs as recruiters to high school-aged youth, peer-to-peer counselors and messengers within their communities
- Utilizing extracurricular groups such as 4-H, the Boy Scouts and Girls Scouts which can serve as vital partners to the manufacturing and construction sectors, ensuring that children and young adults can make informed decisions about future career options

National Guard, Reserve, retired and transitioning military service members are recruited into the construction industry through the national, non-profit Helmets to Hardhats. Free training provided by industry through federally-approved apprenticeship programs educates service members on the construction industry and unique specializations.



Training Strategies to Build the Modern Manufacturing Workforce

While students are exposed to a consistent base of basic STEM requirements taught in the classroom, additional training experiences should be tailored to align with employer needs. Critical competencies include basic electrical, instrumentation and computer literacy, modern manufacturing technologies, an understanding of digital control systems, basic understanding of environmental health and safety practices, interpersonal skills and the ability to adapt to change.

One private sector partner teamed with Habitat for Humanity in New Mexico to create a building trades' apprenticeship program for 700 at-risk students. Keys to its success were engaged stakeholders, trained instructors, available jobs, and media interest.

Regardless of the sector, U.S. employers recognize a potential disconnect between the knowledge and skills required of new employees in today's marketplace and what is being taught in schools. With greater emphasis on achieving state-based and federal learning standards, new graduates are entering the workplace a step behind employers' needs.

More firms are recognizing this divide and the need to ensure that both common and technology-specific knowledge and skills are being developed. Apprenticeships, job shadowing, cooperative work arrangements and placement programs are needed that link students and adults with R&D centers, engineering departments, laboratories, construction sites and manufacturing floors.

The Iron Workers Apprenticeship Program is an example of an "earn while you learn" effort that links learners with experienced workers. In this program, employees with little to no knowledge gain on-the-job and classroom instruction designed to qualify them as journeymen in all segments of iron work.

At a minimum, manufacturers should support STEM learning to seed interest in and build knowledge of basic scientific and engineering concepts. The benefit to employers is acquiring talent with some aptitude for STEM-related jobs and basic knowledge of relevant concepts. Because STEM fields also emphasize discovery and innovation, those individuals can adopt this mode of thinking with carry-over to their careers.

Training is a two-way street as students must be able to understand the potential value of the commitment they are making. Employers that are intent on investing in human capital development can provide training opportunities that are practical and affordable to attract and retain students and adults. Incentives can be incorporated into training programs to draw in potential employees and more effectively compete with other sectors that are eager to develop and acquire new talent.

Strategies that can support the formation of an equally-rewarding employer/employee partnership include:

- Establishing support mechanisms for trainees such as earning a salary while training, housing subsidies, tuition assistance programs and student loan programs
- Creating mechanisms for transferable certification among various industry sectors
- Forming grant support for learning providers to cover training costs
- Establishing ways for students to learn in manufacturing and construction environments and not just the classroom
- Tailoring coursework for high school students aiming for manufacturing and construction jobs, and ways to earn college credit while in high school
- Reviving industrial arts and other related classes for students in high school and ensure that females are involved as both teachers and students
- Infusing manufacturing and construction representatives and industry ambassadors into the classroom to offer first-hand experience
- Exposing educators through immersion activities and industry events to convey manufacturing needs and opportunities, and the breadth of the manufacturing supply chain
- Reforming liability standards to permit the hiring of students under 18 years of age
- Companies should study and modify successful regional and local strategies from their sector and other manufacturing sectors. This includes examining education efforts such as high-tech high schools that integrate technical learning with academic education to expand students' relevant skills and knowledge

Efficient Permitting to Support the Renaissance

In identifying a region, state or local site for investment, industry can encounter a range of environmental issues. Examples of these environmental issues include potential air emissions; water and soil contamination; waste disposal; greenhouse gas emissions; chemical use; water consumption; ecological impact; methane migration; seismicity; and venting and flaring. Much of this focus is on the “upstream” part of the process where hydraulic fracturing takes place, but some of these issues also are of concern during the midstream processes that involve pipelines and storage, and downstream manufacturing parts of the process. Groups concerned about environmental issues would like more information, some of which is provided as part of the permitting and regulatory process. They also would like assurance that government officials have sufficient resources to review permits as well as to monitor and enforce regulations.

From an industry perspective, permitting is one of the most pressing issues manufacturers encounter throughout the manufacturing supply chain. It affects natural resource development, infrastructure development, the construction of facilities, and just about any other area which impacts manufacturing.

Industry faces a patchwork of differing federal and state government regulations which can be time-consuming and confusing. The existing processes for establishing new sites, new infrastructure, and acquiring needed permits can be fraught with uncertainty and unpredictability.

The burden is not industry’s alone – government staff must manage budgets, staffing shortages, emerging technologies and other resources. This can make efficient permitting and working with industry partners a challenge.

Public and community reaction also can influence a company’s choice to operate in a particular location. Perceptions about industry can create credibility gaps, whether true or not. This is evidenced in public opinion based on both fact and perceptions about industry interaction with the natural environment, resource use, safety and protection.



Permitting Process Uncertainty and Delays Can Hamper U.S. Productivity

Current permitting processes are characterized by high levels of uncertainty and unpredictability. The sheer multitude of state and federal government agencies involved in the permitting process makes the process overly complex and confusing. From the U.S. Environmental Protection Agency (EPA) to the Army Corps of Engineers and on, manufacturers struggle with knowing which agency to talk to and when.⁷ Providing a single point of contact for the manufacturing sector could help guide industry in navigating this process.

Delays in permitting can occur due to the amount of permitting required, untimely permit response and approval, and current review procedures that sometimes lack the flexibility and expediency needed to achieve effectiveness. The latter can be due to frequent changes to the rules around permitting, as well as a lack of clear and consistent regulations.

Managing permitting processes can be challenging for agencies as well as the private sector when there is insufficient expertise to address new technologies. Manufacturing inputs, modifications, and outputs change and new industry segments emerge. For example, the implications for power generation of switching material content can expedite permitting by some federal agencies, but not by all when these federal agencies lack understanding of this change. By comparison, state agencies can be faster with regulatory action than federal agencies and more responsive due to the unique circumstances within each state.

Other reasons for delays can include agencies working beyond their boundaries when assessing applications and making decisions, inter-agency wrangling and friction between agencies, poor communication between agencies, and the use of permits as a tool to force an agency agenda or will upon another entity. At the federal level, the review and application of a single permit can take more than two years.

Agencies should consider allowing companies to help offset the cost of expedited permit reviews, on a voluntary basis, to help reduce the public sector burden in cases where an expedited review is desired by a particular company.

Companies often do not know what to expect when beginning the permitting process. They may encounter different answers and levels of cooperation within a single agency. Resulting hang-ups with permitting can impact private sector budgets, the creation of infrastructure, transportation choices, and the acquisition of raw materials for manufacturing. For manufacturers, this can expand timelines for projects from just a few months to years. By that time, delays and red tape may have caused investors to seek other investment opportunities.

The Metro Denver Economic Development Corporation brings together economic development agencies, companies, utilities, and state and federal regulators to discuss issues including project planning and public land development before the permitting process starts. This has reduced process timelines and strengthened organizational connections. Similar approaches are used in California, Idaho, Oregon and Washington.

In some states, a three-month project can extend out to three years due to permitting process delays. A copper mine project in Arizona is still waiting for a permit seven years after purchasing the needed mining equipment.

Companies operating in Louisiana are allowed to provide funding to agencies to facilitate a faster permit review process and help to defray costs associated with permit reviews. Another facilitative tool is a roadmap of the process in Louisiana which gives clarity and understanding.



Ultimately, a lack of dependability and predictability within permitting processes can force industry to make decisions about whether to operate in the United States or overseas. This ultimately impacts local and regional economies and results in missed opportunities in terms of new jobs, economic development and new infrastructure.

Strategies to enable a clearer, efficient and more effective permitting process include:

- Setting up a task force of agencies, compliance experts from industry, and environmental experts to examine review and approval processes, identify redundancies and propose ways to streamline regulatory permitting processes, and strike a balance between environmental protection and the interests of the manufacturing sector
- Creating forums that link agencies with industry to build recognition of ways that regulations impact the ability to create the infrastructure needed for a manufacturing renaissance, and to determine what regulatory agencies need to do to prepare for the manufacturing renaissance
- Developing relationships between industry and government prior to permit submission to enable efficiency and reduce potential confusion
- Channeling voluntary resources from industry to help offset increased public expenses associated with expedited permit processing
- Retaining former government employees who are hired as temporary contractors and empowered to conduct application reviews on a project-by-project basis
- Building greater transparency into agencies by educating industry on processes, agency contacts, and the progress of permit application reviews
- Simplifying permitting by appointing one agency and one office as the lead point of contact
- Finding ways to effectively manage applications held up by the use of Resident Rules of Rights, the Endangered Species Act, and “sue and settle” provisions in some environmental laws
- Considering ways to equitably review overall regional production capacity in light of permit applications or in instances where other entities have applied for permits in the same area
- Implementing National Environmental Policy Act reform and streamlining the review process
- Building agency understanding of industry requirements and timelines
- Using revenue from royalties from natural resources to support regulatory processes
- Setting reasonable time limits for application receipt and decision-making to enable agencies to make decisions within a specific time period
- Establishing an online permitting process and database, and a process that allows for greater expediency based on positive reputations and past history



Upgrading Regulatory Processes to Support the Renaissance

A highlight of the American manufacturing renaissance is growing domestic production of energy resources including shale development. The result is lower environmental impacts by manufacturers and electricity generation facilities. This is helping to achieve carbon dioxide emission levels that reached their lowest point in 2012 when compared to the past two decades; and, the United States is meeting or exceeding international targets for reduction of greenhouse gases.⁸ There are some concerns, however, that methane emissions may increase as a result of shale gas-related activities. This is a concern that requires the completion of several ongoing studies.

Much of the reduction in carbon dioxide can be attributed to the switch from coal to natural gas in the electricity generation sector, along with energy efficiency measures and innovative engineering practices.

Some federal regulations were written decades ago and do not account for current technological advances. Currently, there is no easy or reliable method for governments to ensure that policy and permit standards are updated, sound and reasonable, and can be adapted to technological changes. One challenge in the regulatory process is that regulations and standards need to be brought up-to-date with industry innovations and current environmental community concerns.

Partnering and communication are key components to regulatory process upgrades. Engagement among stakeholders can foster greater consistency, better communication and information-sharing, and system improvements which help industry and the communities in which they operate. Coalition actions and collaboration can enable the navigation of regulatory hurdles, especially for manufacturers that work across state lines or require different environmental approaches for different parts of the supply chain.

Strategies that can help upgrade regulatory and permit processes include:

- Revising standards to match changes in energy use and sources, as well as innovative practices to ensure that they keep pace with manufacturers and industry standards
- Enlisting third-party entities such as academia and consultative groups to analyze industry advances and give direction on the policy changes required
- Creating research partnerships and consortia as a means to achieve breakthroughs in policies
- Developing product-specific policies to address unique needs along the supply chain rather than general policies
- Building diverse coalitions of government partners, manufacturers, suppliers and supply chain partners to advocate for legislative and regulatory enhancements

Public Engagement to Build Relationships and Resolve Concerns

As agents of the public, elected officials are tasked with accepting public opinion. Public and media outcry over real and perceived crises can tip discussions and delay processes important to manufacturing operations. This has been demonstrated around environmental protection issues, resource use, the transportation of raw materials and finished goods, and the creation and sustainment of manufacturing sites.

More than ever before, citizens are able to access both fact and conjecture through the media and online resources. Manufacturers must be prepared and responsive in addressing concerns, stereotypes and perceptions associated with their specific industry segment.

Concerns with new or expanded manufacturing include raw material production, energy use, and potential environmental impacts. Hydraulic fracturing, water use and disposal, urban drilling, air and noise pollution, greenhouse gas release, carbon dioxide and methane production, aging and abandoned infrastructure, and basic health and safety precautions are other issues.

Engagement by manufacturers should address a community’s potential exposure to environmental and noise impacts, traffic and zoning ordinances, safety and security of residential areas, and other appropriate issues to meet the challenges of specific facility locations and environmental concerns. There also should be honest discussions to address neighborhood concern about the co-location of industrial activities near residential areas.

A cornerstone of effective engagement is science-based education and response. Concepts such as “clean,” “air quality,” or “standards,” can appear vague if not put into the appropriate context. Citizens may not realize that flipping a light switch draws on the energy produced by a power plant just down the street. Knowledge gaps should be addressed with a science- and fact-based response.

Public communication can emphasize manufacturing’s value to local and regional economies. Modern manufacturing is clean, safe work with many environmental safeguards, which people may not be aware of if they haven’t been to a modern manufacturing facility. This understanding can be corrected by inviting the public to manufacturing facilities and events. The application of high-tech, modern manufacturing standards is ensuring greater environmental protection and puts the safety of the public and workers at the forefront of operations.

Influential and trusted partners can play key roles in enabling public understanding. Community leaders, regulators, the media, community advisory panels, chambers of commerce, faith-based organizations, and universities and extension services can serve as trusted resources. These messengers can help to overcome the stigma which can be associated with industry-led communication campaigns.

Strategies for effective public engagement include:

- Forming clear messages for consistent use with any stakeholder group and across all media vehicles
- Establishing processes for fact-checking and response to misinformation and misperception
- Respecting and addressing all community concerns and issues rather than talking around them
- Forming partnerships with trusted community resources to help carry the message
- Encouraging and educating local citizens to engage with the community rather than solely depending on industry and NGO entities
- Hosting community events and public forums, and participating in community-based science forums such as Houston Energy Day and manufacturing events
- Inviting teachers to facility tours
- Evaluating public understanding of science-based issues and levels of awareness of the value of manufacturing as it pertains to regional and local economies, jobs creation and infrastructure development
- Capitalizing on ways that the government and academia can clearly communicate research and other technical matters to enhance public understanding
- Learning how industry sectors have overcome negative perceptions or fostered positive perceptions
- Engaging trade associations and other industry groups to interact with the communities in which they operate



Engagement with Elected Officials and Public Servants as Influencers

In addressing public concerns about the convergence of manufacturing, the environment and public safety, manufacturers should engage public leaders to ensure understanding and encourage support of economic development.

One step is to help local governments and communities recognize the value that they can derive from a manufacturing renaissance. Officials, opinion leaders, decision makers and educators such as local university extension leaders can all help to generate community support once they are aware of what will be required to launch and sustain manufacturing in their own community.

Engagement with officials and leaders can help build trust when public concerns are raised and local voices are needed. Additional voices in the mix can integrate manufacturing into the public discourse and enhance its reputation as a viable economic engine. Engagement also can benefit companies by identifying ways to incentivize companies and fostering pathways to mutually address local regulatory challenges.

Strategies important to engaging leaders include:

- Explaining the manufacturing process and how each specific operation contributes to overall success, especially in areas not accustomed to shale development and upstream, midstream and downstream nodes
- Clearly and fairly identifying both the advantages and disadvantages of modern manufacturing, so that communities can make their own relative value judgments
- Developing effective partnerships and fostering non-traditional relationships to ensure that diverse views are heard, equitably discussed and understood
- Identifying ways to manage the accountability of agencies which implement legislation and policies at federal, regional and local levels

Federal and State Government Process Improvements Are Vital to the Manufacturing Renaissance

Industry decisions about where to build infrastructure can be based on where it operates along the manufacturing supply chain, local, state and federal tax policies, the regulatory environment and the availability of a trained workforce. Upstream oil and gas producers usually prefer environmental regulations at the state level due to unique geologies within each state. There may be many different permits involved and several different authorities taking part in reviews and regulatory decisions. The federal government may still try to regulate, however, in instances when states cannot regulate due to resource or other constraints. Also, in some cases, states choose to relinquish regulatory authority to the federal government.

Preference for state or federal regulation among midstream and downstream manufacturers can differ from the upstream sector. Midstream and downstream activities often cross state lines and a patchwork of different state regulations can be confusing and unnecessarily burdensome. Federal agencies may exert a perspective of complete control even over land that is state-owned and administered.

The ease or difficulty with which a manufacturer can move materials across state lines from the material source to a demand center, as well as the amount of regulatory compliance required for operations that span several states, are other factors that can influence decisions about where to operate. A company operating across several states typically prefers federal regulations to avoid a patchwork of different state laws.

Other factors that inform companies' decisions about where to operate include access to affordable raw materials or feedstocks, energy sources, resources such as water, labor, export capabilities, the best ways to supply a customer base, ways to achieve a supply and demand balance, and the stability of electrical costs.

The challenges described are not insurmountable and a concerted effort among affected stakeholders could enable a clearer and more streamlined system. It also could build trust. Some in the shale production industry note that state departments of natural resources have worked with industry which has led to greater efficiencies and helped agencies understand innovative measures being undertaken by manufacturers.

The State of Louisiana's Department of Environmental Quality (DEQ) familiarizes corporations with regulatory requirements through compliance education, self-certification options, and performance measurement tools. DEQ regulators provide best practice guidance and apply pre- and post-inspections and statistical methods to increase compliance, limit costs associated with permitting and inspection, and create lasting improvements.

Colorado State University's WaterWatch Program is a public-private partnership that enables water contamination and air methane monitoring through new technologies that help industry stay compliant and provide a way to implement policy and oversight. This approach is being used at the Eagle Ford rock formation in South Texas and similar technology is used by Oak Ridge National Laboratory.

Manufacturers acknowledge that the United States can compete more ably with other nations if the time and financial costs associated with regulatory, permitting and environmental uncertainties can be reduced. It is also in the best interest of local, state and federal governments to collectively design improvements to the regulatory process.

Strategies that can guide local, state and federal government partners include:

- Educating agencies on manufacturers' needs, the manufacturing environment, and emerging manufacturing areas by working with industry groups and other affected parties to design targeted educational programs and materials
- Enlisting academia to act as a regulatory interface between different stakeholders
- Viewing the regulatory process from a systemic standpoint in order to identify improvements
- Forming coalitions of states and an interstate board to expedite regulatory processes
- Committing more resources to increase the efficiency of regulatory frameworks
- Improving the knowledge of agencies and manufacturers, leading to more innovative practices, flexible regulatory enforcement and updates to existing laws to keep pace with technological changes
- Building a roadmap that spans states, showing nodes on a supply chain and the interface of different regulations to attract new industry and maintain environmental stewardship
- Dedicating attention to cross-agency engagement for greater efficiency and knowledge-sharing
- Setting common sense requirements
- Establishing a regulatory roadmap that identifies agencies responsible for specific parts of the regulatory process
- Publishing descriptions of federal offices with regulatory responsibilities
- Identifying appropriate points of contact at agencies who can advocate for both private sector and public interests
- Reducing the number and consolidating state and federal agency processes
- Identifying expected timelines for various regulatory processes
- Conducting a more transparent public comment process to include requests for comment period extensions
- Conducting a review and adoption of effective state-based models to guide dispute resolution and land holder issues
- Educating agencies on industry basics, especially if that agency is new to that industry
- Partnering by large manufacturers with smaller businesses to help guide them through the regulatory process

The States First initiative facilitates ongoing multi-state communication and the creation of regulatory solutions for states that produce oil and gas. This consortium helps regulators keep pace with technological changes and increases awareness of innovative regulatory processes from state to state. States First is led by governors, regulators, and policy leaders in partnership with the Interstate Oil and Gas Compact Commission and the Ground Water Protection Council.

Tax Credits and Incentives Can Drive Industry Decisions

Tax credits and incentives can factor into manufacturers' decisions to set up shop in specific locations and expand existing operations. Current federal government tax policy is unclear as are guidelines around the Federal R&D tax credit. In fact, the U.S. has some of the highest effective corporate tax rates among developed economies. Clearer guidance and tax policy could enable manufacturers to leverage associated tax incentives. Competitive tax rates are another factor that can guide industry decisions. While there is not universal agreement on any particular strategy or policy, participants generally agreed that tax policy at both the federal and state levels can influence decisions on where to locate facilities.

During the discussions that informed this report, several ideas were brought forth regarding tax policy; however, there was not clear consensus on any one particular strategy or policy. When it comes to tax policy there are diverging views even among different industry sectors and event participants.

Strategies for fostering a more industry-friendly environment can include:

- Proposing and presenting tax credits to industry more carefully
- Responding to industry interest in knowing more about tax policy, credits and incentives
- Using strategies such as the Master Limited Partnership to draw business to access capital with tax incentives
- Simplifying the tax code
- Offering credits for smart energy use

JobsOhio is a private, non-profit corporation designed to drive job creation and new capital investment in Ohio. JobsOhio's programs complement state-administered assistance programs, including tax credits, infrastructure grants, and fixed-asset financing. Long-term planning is driven by projected levels of job creation, commitments to infrastructure creation, and potential return on investment.





Building Infrastructure to Support the Manufacturing Renaissance

Manufacturing's growth in the United States is facing challenges with the supporting infrastructure, which has limitations in terms of availability, age, and overall integrity. In addition, our nation's extraction, manufacturing and transportation infrastructure suffer from capacity and physical limits. It will be further burdened as manufacturing grows, our population increases, and the demand for U.S. goods and services continues to climb. Areas that will need to be addressed include:

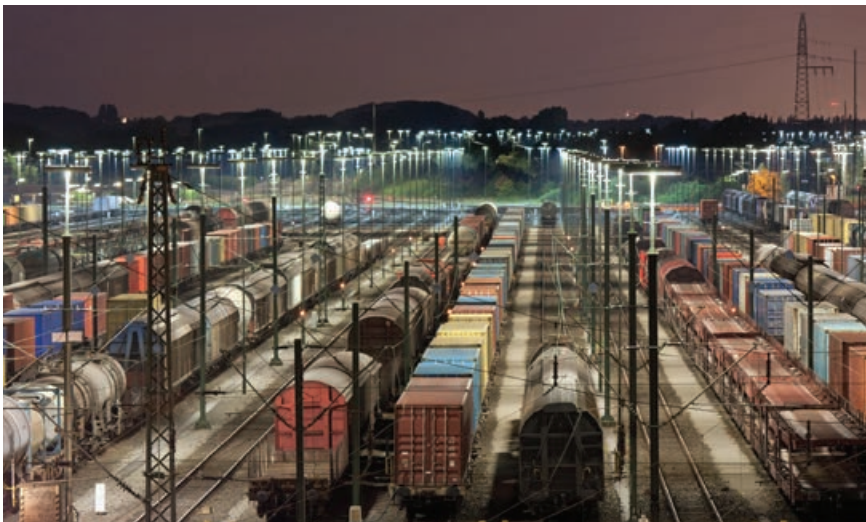
- Natural resource extraction infrastructure
- New and existing pipelines
- Electricity generation and distribution
- Raw material processing
- Downstream materials production
- Water treatment and distribution
- Transportation and storage

Additional infrastructure such as housing, hospitals, schools and community centers also are essential to sustaining the U.S. economy, environment, safety, and the well-being of citizens.

Developing new and repairing or replacing existing infrastructure requires a significant amount of public and private resources. While some infrastructure developments such as the range of new pipeline investments are underway, creating and replacing infrastructure involves more than simply building something new. It may require clean-up, permitting and other regulatory requirements. Proper installation and engineering controls also need to be considered.

Determining who has regulatory jurisdiction over particular types of infrastructure is an issue central to infrastructure creation and repair. With every project comes the need to identify parties to address issues and responsibilities at the local, state and federal levels. Public and private partners must understand the extent to which each entity is involved, the identification of funding mechanisms for public and private projects, and the permitting needed to proceed.

From a policy standpoint, the federal government has not, as yet, sufficiently supported public infrastructure development, such as highways, bridges and ports. Funding exists but investments in infrastructure and associated long-term costs can be viewed by some agencies as an obstacle to project completion, given that projects may take multiple years to complete and funding remains uncertain. Even when infrastructure spending is written into federal bills, most bills only operate on a two-year cycle. Disjointed and confusing funding mechanisms can shorten the life of policies that require Congressional action every two years. In the current policy world, strategic planning is difficult.





Decisions about infrastructure and funding should be made strategically with the good of local communities, regions and the nation in mind. Getting power to industrial facilities, the use of smart grids, energy efficiency measures, and the implementation of advanced energy storage technologies can make a significant positive impact on the overall energy landscape. This type

of investment can generate long-term value that could be as beneficial to society as the manufacturing renaissance itself.

Too often, regulatory barriers and insufficient agency personnel and resources inhibit forward motion. Industry may identify an implementation approach and plan the needed infrastructure only to return to the drawing board when government agencies express disagreement.

Strategies for building public infrastructure to support the manufacturing renaissance include:

- Viewing the funding of infrastructure as an investment in the future and not just a budget line item
- Forming a multi-stakeholder task force to rationalize permitting processes related to infrastructure that includes industry, state and federal agencies, NGOs and other relevant players
- Establishing relationships among industry, government and impacted communities prior to undertaking infrastructure projects such as new roads
- Learning from models within the government such as the Federal Highway Administration's Planning and Environmental Linkage process and the Federal Energy Regulatory Commission pre-filing process that strengthens regulatory transparency and certainty
- Establishing approaches for long-term community planning for economic sustainability
- Targeting funding mechanisms that link tax revenue generated by businesses to needed infrastructure

Empowering Research and Innovation to Drive the Manufacturing Renaissance

The growth of manufacturing in the United States is dependent on future research. Areas in which research and development investment are needed include advanced materials, energy and water efficiency and use, manufacturing techniques and equipment, potential uses of carbon dioxide and catalysis – e.g., gas to liquids (GTL) – and oxidative coupling of methane. Specific to shale development, R&D focus should continue on geological surveys; sensors and mapping; water use, including waterless hydraulic fracturing; and new technologies such as laser-assisted identification of potential shale plays. Other areas of exploration should include managed pressure drilling, corrosion and stress resistant pipeline coatings, and sophisticated software that provides a real-time view of what is taking place thousands of feet below.

Another area in need of further investigation is flaring. The oil and gas industries are impacted by emerging regulations related to the flaring of associated gas during the production of oil wells across the country. Operators are often faced with the need to install and utilize equipment aimed at the reduction of natural gas flaring. For most

operators, evaluating these technologies and selecting the correct one for a particular region can be daunting. Research focused on developing and demonstrating technologies specifically designed to utilize gas that is a byproduct of oil production, and even reduce or eliminate the need to flare emissions, is essential.

As oil and gas producers make the reuse of water a priority, as demonstrated by increased recycling of water used in hydraulic fracturing and reusing water that was originally used in mining operations, research should be considered on the use,

reuse and recycling of water especially as some Western U.S. states have been suffering through drought conditions. Areas of research should include the influence of permitting on water storage, the stewardship of water as a resource, and the establishment of appropriate pricing mechanisms or markets for water. Research conducted in Texas has already led to regulatory requirements that have driven manufacturers to establish water holding tanks, recycling systems and wastewater handling. Some companies also purchase wastewater from cities and build their own distribution systems and transport lines.

Green Completion and research efforts have driven manufacturers to establish water holding tanks, recycling systems and wastewater handling. Some companies also purchase wastewater from cities and build their own distribution systems and transport lines.

The U.S. Energy Policy Act of 2005 established a public-private partnership to identify industry research needs, encourage innovation development, and to drive commercialization. Funding for the partnership was generated from industry and concluded with the adoption of the 2014 federal budget.

Effective R&D environments involve the creation of entities committed to research and the growth of R&D hubs or clusters without regard for jurisdictional boundaries. Critical components of this environment include access to raw materials, leadership, cooperation from a macro-economic perspective, strong protection of intellectual property (IP), an educational infrastructure and entrepreneurial spirit that attracts and nurtures local and re-located talent, policies that support the involvement of non-U.S. citizens invited to support innovation, and long-term, secure funding. One significant challenge, however, is the proprietary nature of innovation, which must be addressed when considering research hubs or clusters.

These components have been shown to work effectively when centered near industrial hubs, known as supply chain management clusters. Examples of other clusters include places such as Silicon Valley, the nexus of state-based, multi-university partnerships, around national and government laboratories, near raw materials, and in proximity to areas that allow for agricultural and environmental innovation.

The value of these clustered arrangements is recognition and playing on strong reputations in innovation to attract talent and partners. These settings also create the potential for unique, valued industry and academic consortia and enhanced opportunities for students and faculty.

Research and development processes can differ depending on the industry or research focus, but generally the goal should be to develop innovations, commercialize techniques and products for greater use or to develop basic knowledge for use by innovators and entrepreneurs. Classified technology and other IP that is publicly funded should be evaluated and, where appropriate, redirected for use in the private sector and to academia for publication. Efforts around information-sharing and technology transfer become crucial to maximize the value of the investment.



The Research Partnership to Secure Energy for America is an industry and academic consortium that advances research in the extraction of hydrocarbons, primarily through deep water and unconventional gas development. The Partnership consists of more than 100 members representative of the natural gas and oil sectors. It strives to identify safe and environmentally sensitive technology and methods, fulfilling stewardship while furthering economic progress.

Federally-sponsored public and private partnerships include the Defense Advanced Research Projects Agency (DARPA), Defense Threat Reduction Agency (DTRA), Small Business Innovation Research and Small Business Technology programs, and the Department of Energy's Advanced Research Projects Agency (E-ARPA).

Successful research initiatives have included industry, academic and government partnerships that allow universities to direct the research and develop a R&D workforce. In this type of project, industry and government act as an advisory body. Examples of effective partnerships include the German National Education system, the Fraunhofer Society, the Research Partnership to Secure Energy for America (now operated through the National Energy Technology Laboratory), the Environmentally Friendly Drilling Systems program managed by the Houston Advanced Research Center and the National Science Foundation's interdisciplinary and multi-institution Engineering Research Center Program. All of these efforts have been successful due to long-term funding and will be dependent upon securing continual backing.

Government and industry innovation in Germany is furthered by the Fraunhofer Society, an applied research organization comprised of 67 institutions and research units with direct engagement with industry and the public sector. The Society develops, implements and optimizes processes, products and equipment until ready for market. Research is focused on efforts that can direct benefit to government, business and society.

Innovative efforts also are sustained when funding streams are predictable and funding allotments are provided at the levels promised. Long-term projects can get undercut when funding once promised goes away or ends earlier than expected. At risk is the loss of initial R&D efforts, faculty and student talent, partnerships, and reputations. Too often those initial efforts are repeated later, under a different project, which results in a waste of time and resources.

Existing patent policy and a lack of strong IP rights in the manufacturing sector can stifle innovation and R&D. The persistence of patent wars in which a single party obtains a general patent then trolls for infringement lawsuits can impede innovation in specific areas of application.

Strategies for strengthening R&D in the United States include:

- Establishing government funding for nascent research efforts to attract venture capital funding
- Creating a reward system within the government to encourage public and private sector innovation and partnerships
- Developing sustainable innovation hubs, industrial clusters and collaborative economic zones

- Tightening patent policy to alleviate monopolistic behavior, mandating reviews for patent specificity and strengthening penalties to discourage infringement
- Establishing and maintaining R&D tax credits
- Forming royalty and other fee arrangements to provide funding for public and private research partnerships that share results
- Pooling resources from across agencies to support cross-agency research endeavors
- Creating industry and academic partnerships that share resulting IP, especially around basic research outcomes
- Supporting programs that emphasize information sharing and technology transfer
- Sharing of information by consortia members prior to basic R&D funding in a precompetitive space
- Convening technical workshops and other events by trade associations to enable technology transfer
- Writing funding for government R&D into statutory language versus relying solely on the Congressional appropriations process
- Emphasizing the value of collaboration over competition, while still honoring the need for individual achievement and success



Conclusion

The benefits of a manufacturing renaissance in the United States are considerable. A well-thought-out path forward will lead our nation to greater economic prosperity while driving innovation and protecting our environment and resources.

The thoughtful discussions of this diverse group have produced ideas to advance the interests of all participants in this new era of manufacturing. By considering the current and potential problems and identifying solutions and opportunities, this report can help all participants in the manufacturing renaissance build the foundation that will ensure a future of prosperity.

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