Industrial Innovation Initiative

a partnership between Great Plains Institute and World Resources Institute

From: Industrial Innovation Initiative (I^3)
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About I^3

The Industrial Innovation Initiative (I^3) is an ambitious coalition of leaders from industry, labor, and nonprofit organizations focused on strengthening and innovating American industry. The Initiative's insights are valued by stakeholders, policy makers, and agency officials because of our nonpartisan, consensus-based approach. Co-convened by the Great Plains Institute and World Resources Institute, the Initiative builds on years of stakeholder engagement to establish a consensus around key industrial policies and initiatives.

The Initiative focuses on policy development and implementation, technology demonstration and adoption, and demand-side market development at the federal, state, and regional levels. We value a competitive US economy, thriving livelihoods for American workers, a safe and healthy environment, and a stable climate.

Background

Thank you for the opportunity to respond to this Request for Information to share strategic feedback on the development of the National Strategic Plan for Advanced Manufacturing. The Industrial Innovation Initiative applauds the Trump Administration's stated commitment to revitalizing American manufacturing, creating new jobs, and growing the economy nationwide. We also applaud the Trump Administration's stated goals of accelerating research and development, strengthening domestic supply chains and manufacturing, spurring robust private sector investment, and advancing American companies in global markets to ensure the United States remains an unrivaled world leader in advanced technologies. These priorities align well with I^3's objectives, and we

look forward to working together to develop and implement effective, impactful American industrial policy.

I³'s response represents the collective knowledge of the nonpartisan, consensus-based Initiative. Members are also encouraged to submit individual responses to capture the priorities of their individual organizations in greater detail. We are grateful to be presented with this opportunity to shape the Office of Science and Technology Policy's overall strategy for advanced manufacturing.

1. a. Which emerging science and technology areas (e.g., artificial intelligence) will be key to the next generation of innovative advanced manufacturing technologies, and how will they impact advanced manufacturing?

I³ encourages the administration to take an expansive view of advanced manufacturing. Promoting advanced manufacturing means fostering cutting-edge technologies and advancing outcomes, such as more efficient production, that benefit companies, workers, and communities.

Technologies such as artificial intelligence (AI) and nanotechnology require large volumes of electricity. Food and beverage production and other industrial sectors that rely primarily on low- and medium-temperature heat will likely continue to electrify some of their processes over the next several years. Residential electricity demand is also rising because of the widespread adoption of residential heat pumps and electric and hybrid vehicles. The combined effect of all these trends will be a sustained increase in electricity demand.

There is a risk that demand for electricity will outpace supply of new generation, leading to electricity shortages that may thwart the growth of advanced manufacturing. To realize the full potential of artificial intelligence and other transformative technologies, the federal government can lead in promoting energy efficiency while enabling innovative, firm electricity production.

AI and energy efficiency improvements can reinforce each other. The industrial sector can deploy advanced sensors with AI technologies to manufacture products more efficiently and trim energy consumption without compromising quality or reducing production volumes. These technologies represent the next frontier in industrial energy efficiency. AI allows for real time monitoring of energy consumption, enabling manufacturers to adjust operations to maximize efficiency, while also helping manufacturers refine production schedules and improve equipment operation.

Skillful equipment management is critical to the success of almost every manufacturer. AI tools, such as Internet of Things sensors that measure variables related to machine health and advanced analytics, can alert manufacturers to potential equipment problems before they occur, preventing breakdowns. Rather than relying on rigid service schedules, AI-powered predictive maintenance gives manufacturers the information they need to operate and maintain high-value equipment effectively.

Simultaneously, clean firm power sources with electricity storage can be built rapidly to meet the increase in electricity demand. I^3 recognizes the Administration's commitment to meeting energy demand with baseload fossil energy. It is also true, however, that demand for turbines needed to build gas-fired power plants is high, blocking immediate availability of machinery. Renewables are the fastest energy source to build, and they can be paired with storage technology; there are a growing number of American battery companies that can all but eliminate intermittency issues from renewables. Additionally, next-generation geothermal and small modular nuclear companies are strong candidates to provide electricity for the Administration's intended industrial renaissance.

I^3 encourages the Department of Energy (DOE) to take several steps to increase energy efficiency and innovative firm power. First, DOE can promote the dissemination of Information Control Technology (ICT) through existing programs such as Better Plants. DOE-sponsored webinars and materials can be an effective way to promote and normalize cutting-edge technologies such as ICT. Spotlighting companies that are embracing ICT and AI to more effectively manage their assets, improve energy efficiency, and boost their bottom lines is one low-cost way that the government can demonstrate the utility of existing technologies. Clean firm power deployment can benefit from financing for capital expenditures such as the 48C Advanced Manufacturing tax credit. Additionally, these energy sources should be relevant in any permitting reform efforts.

1. b. What are the primary challenges and barriers that need to be addressed to ensure the successful integration and widespread adoption of emerging technology in manufacturing?

Investing in research and development is critical. Federal support for these activities has been crucial in the past and will be essential to expanding the technologies of tomorrow.

However, limiting the government's role to research and development will restrict the dissemination of critical technologies. Companies are generally reluctant to adopt new technologies based solely on lab results or small-scale projects. They require clear evidence that the technologies will work on a larger scale. Commercial-scale demonstration projects are the gold standard. To scale up new technologies in different

manufacturing sectors, the United States must demonstrate that these technologies can be successfully deployed. The federal government can de-risk new technologies by providing economic incentives for companies to build commercial-scale demonstration projects.

Research, development, and demonstration projects complement each other. We must research the technologies of tomorrow and deploy the ones that are mature enough to be implemented. These demonstration projects are critical because they can reveal deficiencies or breakthroughs that companies and researchers will need to incorporate in advance of widespread implementation. Demonstration projects in which the federal government and companies share the costs of implementation are critical to bolstering American manufacturing and remaining globally competitive.

As noted above, increasing the electricity supply will be crucial. Many advanced manufacturers, as well as data centers, are seeking renewable energy generation because it is quick and low-cost to build. Barriers to deploying electricity supply from any generation source will impact the ability of manufacturers to innovate and expand advanced manufacturing capabilities.

Streamlining the permitting process to accelerate the construction and transmission of new energy sources will also help ensure that advanced manufacturers have the power they need to expand their businesses. Shortening review windows for all forms of energy construction will reduce one of the major barriers to the growth of advanced manufacturing technologies, such as AI.

Ensuring faster interconnection to transmission for advanced manufacturing is vital for energy system planning and market readiness. The expected time for advanced manufacturers to bring large energy load demand to the grid is several years longer than data centers. New large load policies should simultaneously seek to bring parity to interconnection times among facilities while ensuring that different energy consumers are receiving fair and proportionate rates.

Providing clear, reliable guidance for developers of all forms of energy is critical. Unexpected cancellation or delay of grants may deter energy developers from embarking on future projects. Easing permitting requirements and making project development and implementation expectations more predictable will encourage energy development, supporting American advanced manufacturing.

5. b. What are the key challenges in translating research findings into commercially viable manufacturing processes and products, and how can they be overcome?

I^3 is encouraged that the Trump Administration is seeking direction regarding commercialization of advanced manufacturing processes and products. I^3 members are particularly interested in increasing the number of demonstration projects across industrial sectors. This can help inform and increase confidence among American manufacturers about technologies that, in many cases, are being deployed in other parts of the world but may not have reached full commercialization in the United States. Increasing the number of demonstration projects can increase the deployment of technologies that can enhance industrial efficiency, improve worker safety, and improve air quality.

Reliable, accessible data from demonstration projects is incredibly valuable, because it provides critical insights for manufacturers, such as the conditions under which advanced technologies can lower operational costs and what type of training may be required to upskill the existing workforce. This type of information gives manufacturers useful guidance as they make business decisions.

Disseminating the knowledge gained from publicly funded projects is also key. The overarching goal of investing public funds in specific demonstration projects is to obtain information that will be useful to scaling up innovative technologies. Sharing lessons broadly helps ensure that American industry can apply these insights, rather than only select companies. I^3 encourages federal agencies to maximize the regular dissemination of information about publicly funded projects through easily accessible channels.

The federal government should play a larger role in encouraging the recycling of materials such as steel, aluminum, and concrete. Maximizing the re-use of these products reduces American reliance on imports of these materials from other countries. This is particularly important for materials such as aluminum because domestic primary aluminum production has decreased significantly in recent decades. Increasing domestic production of primary aluminum will take time, largely due to the need to build additional electricity capacity to power aluminum smelters. In the near-term, the government can prioritize developing the most efficient ways to increase the reuse of existing supplies.

Recycled concrete has been shown to be even stronger than newly manufactured concrete. Investing federal funds and research dollars into developing more efficient ways to remove impurities from concrete will promote the reuse of this valuable material. The federal government can provide financial incentives to demonstrate advanced recycling methods for steel, aluminum, and concrete.

6. a. What are the main challenges in attracting, training, and retaining a skilled workforce for advanced manufacturing, and how can they be addressed?

Required Skill Set: There is often a mismatch between the skills that employers need and those that employees possess. Many educational programs do not keep pace with the rapid technological advancements in manufacturing.

Lack of Interest: Many young people find industrial work less appealing than alternative employment options, leading to a lack of interest among potential candidates.

Funding and Resources: Limited funding for training programs and apprenticeships can hinder the development of a skilled workforce. Many companies lack the resources to invest in extensive training. Supporting union-affiliated training and apprenticeship programs, which have a strong track record of training workers in a variety of trades, is one proven way to ensure an adequate supply of highly skilled workers.

Employee Retention: Undesirable work shifts, work hours, long distances to travel, and access to alternative job opportunities all contribute to high employee turnover rates in today's workforce.

Training for the Jobs of Today and Tomorrow: As new industries and sectors of the economy deploy AI, employers will require fewer workers to perform certain tasks. Training these displaced workers will be one piece of the workforce puzzle. Another piece is ensuring that training programs prepare workers for durable jobs that cannot easily be replaced by AI.

Of course, predicting the future is difficult. The notion that AI could potentially displace large numbers of coders would have seemed fantastical only a few years ago. Therefore, it is essential that government work closely with industry, educational institutions, and unions to identify flexible training models that enable workers to pivot to adjacent areas of study or training if AI is poised to shrink employment opportunities in a particular area of training. Ensuring that workers have flexible skillsets that can be used in a variety of positions is essential.

While new technologies threaten to eliminate some job categories, fields such as construction and some types of manufacturing are likely to face shortages of workers. Consistent government support for training programs that target high-growth fields will be essential to avoid mismatches between employer needs and employee skills.

6. b. How can Federal agencies and federally-funded R&D centers develop, align, and strengthen all levels of advanced manufacturing training, certification, registered apprenticeships, and credentialing programs?

To address these challenges, I^3 recommends implementing several strategies:

1. **Enhanced Collaboration**: Create partnerships between industry, high school vocational programs, trade schools, and trade union apprenticeships. This approach will help ensure that training programs are relevant and are teaching skills that reflect industry's changing needs.
2. **Awareness Campaigns:** Launch initiatives to promote the benefits of industrial manufacturing careers, targeting schools and communities through outreach programs.
3. **Increased Funding:** Increase federal, state, and employer funding for trade school grants, for training programs like apprenticeship programs, labor management training partnerships, and workforce development initiatives.
4. **National Labs:** The ecosystem of national labs is one of America's greatest assets in the global technology race. The government via the national labs can convene and collaborate with the private sector to unify stakeholders invested in research, development, and deployment. By continuing to issue lab calls, national labs support new innovations and help bring potentially game-changing technologies to market.
5. **Industrial Training and Assessment Centers (ITACs):** Located within a variety of schools and colleges, ITACs create a pipeline for students to enter in-demand industries and manufacturing sectors. The Administration's continued support for ITACs will help students develop robust and flexible skills to turn them into some of the most valuable workers in the US.
6. **Integrated Training Models:** Create integrated training models that combine classroom learning with hands-on experience, such as apprenticeships and internships, to provide real-world skills.
7. **Technology-Enhanced Learning:** Utilize technology, such as virtual reality and online platforms, to enhance training delivery and accessibility, making it easier and cheaper for individuals to participate.

7. a. In what ways can the Federal government assist in the development of advanced manufacturing clusters and technology hubs nationwide, beyond funding needs?

The government can help reform the federal permitting process to expedite approval of projects that advance important energy and societal goals. One promising approach is to

provide categorical exclusions from some permitting requirements for projects that provide clean, baseload energy, such as geothermal, and are being sited on parcels with a likely low impact on habitat and local communities. Accelerating projects that are likely to pose minimal environmental risk is a prudent approach to permitting reform.

Another important role that the government can play is reducing risk for geothermal developers. The need for clean, firm power is escalating, and geothermal can play a role in providing this power. But the next-generation geothermal industry is still in a relatively early stage of development. A significant increase in production of geothermal energy will require government support for exploration and partial financial coverage for unsuccessful wells.

The Administration has considered making federal land available for housing construction. I^3 encourages a similar approach for the siting of manufacturing clusters and technology hubs. Although most federal property is likely too remote to be suitable for hosting these facilities, some parcels may be a good fit, especially those that have been recently developed or already host industrial-scale activity. By providing favorable lease or sale terms, the federal government can lower land acquisition costs for advanced manufacturing clusters.

The US has already proven how technology hubs can spur enormous private sector investment interest with the Hydrogen Hubs Program. Before the seven final hubs were selected, 79 entities representing regions across the country and billions of dollars submitted applications. Continuing to invest in this hub program, as well as the Direct Air Capture Hub program, will sharpen the ability of the US to pick winning manufacturing clusters.

7. b. Is there a need for new or expanded advanced manufacturing clusters or technology hubs for the competitiveness of US manufacturers, and if so, in what sectors or technologies?

Advanced manufacturing clusters can promote more efficient use of energy, enhancing both advanced manufacturing firms and innovative energy production and delivery systems. Locating advanced manufacturing clusters on sites with easily accessible geothermal resources will promote the utilization of geothermal for industrial heat, provide manufacturing firms access to a reliable energy source, and minimize the need to develop other energy resources to power these facilities. The federal government can play a "matchmaking" role by helping energy developers identify potential manufacturing partners. This approach can simultaneously accelerate the deployment of promising

energy sources such as geothermal and promote the development of advanced manufacturing hubs.

A similar logic applies to data center construction. Data centers produce large volumes of heat that could be used by industrial manufacturers to heat a range of industrial processes. Providing heat to manufacturers reduces energy costs for data centers and could significantly lower energy costs for manufacturers.

One of the greatest barriers to productive reuse of data center heat is the geographical mismatch between the location of data centers and industrial facilities. Advanced manufacturing clusters provide an opportunity to design an energy ecosystem that can benefit data centers and advanced manufacturers. Co-location minimizes the need for expensive infrastructure to transfer heat from data centers to manufacturers. Such projects could enhance the competitiveness of manufacturers, increase AI computing power, and promote industrial energy efficiency.

9. a. What are the biggest obstacles faced by small and medium-sized manufacturing companies in adopting advanced technologies to increase efficiency and productivity?

Electric technologies such as industrial heat pumps (IHPs) and thermal batteries have the potential to increase efficiency and productivity at small- and medium-sized manufacturing companies. Industrial heat pumps can be more efficient than conventional boilers but have not penetrated the US market.

One barrier is capital costs. Small and medium-sized manufacturers operate on thin margins, making it virtually impossible to opt for more expensive electrified technologies. The relatively high cost of electricity is an obstacle for American manufacturers of industrial heat pumps, because it is difficult to achieve the economies of scale required to produce less expensive units.

One potential solution is for manufacturers of IHPs and thermal batteries to provide heat-as-a-service to manufacturers. Such arrangements eliminate the need for manufacturers to make large capital investments and relieve manufacturers of the burden of operating unfamiliar equipment.

Another barrier is high electricity rates. Manufacturers often pay significantly less to generate heat with natural gas than with electricity. This difference, known as the spark gap, generally exceeds the efficiency advantages of electrified technologies. Generating heat with electrified technologies would significantly increase operating costs for most manufacturers, preventing adoption.

One way to address this challenge is for utilities and states to develop innovative time-of-use electric rate structures. These variable rate structures would enable manufacturers to use electricity from the grid when supplies are plentiful, and other energy sources when supplies are constrained. Manufacturers could use electricity to power industrial heat pumps at certain times of day and then switch over to gas boilers to generate heat when electricity prices rise. Another option is for manufacturers to generate heat using thermal batteries by charging the batteries when prices are low and discharging heat from the batteries when prices rise. By embracing these electrified technologies, manufacturers can also enhance grid stability. By using electricity during times of low demand, manufacturers enable the promotion of more efficient use of generation capacity. By disconnecting from the electric grid when demand is high, manufacturers can help grid operators manage loads.

Widespread implementation of time-of-use rates and expanding use of demand response mechanisms will give grid operators far more flexibility. This flexibility will enable grids to accommodate increasing demand for electricity from data centers and other users, including manufacturers.

9. b. How can Federal agencies assist these companies in adopting advanced technologies and participating in the establishment of robust and resilient domestic manufacturing supply chains?

One approach that federal agencies can take is to offer rebates for purchases of certain types of equipment that support advanced manufacturing practices and products. Rebates will reduce the capital costs of advanced technologies by lowering the effective cost of acquiring this technology. Rebates can also indirectly reduce costs by increasing production capacity for companies producing advanced manufacturing equipment.

The federal government can also help reduce operational costs through its influence over wholesale energy markets. The Federal Energy Regulatory Commission can promote time-of-use (TOU) rates by encouraging demand response programs in wholesale markets. This can encourage broader adoption of TOU rates by utilities. Making TOU rates available to industrial customers has the potential to increase uptake of energy-efficient technologies that can help stabilize the grid.

In certain circumstances, more direct federal involvement is warranted. The public-private partnership that the Defense Department struck with MP Materials in July is a prime example. Ensuring that American companies have access to critical minerals is an important government function. This partnership indicates the seriousness of the government's commitment to ensuring domestic production of rare earth minerals, which

will serve as a signal to private investors. Striking the right balance between protecting taxpayers and encouraging ample production of critical minerals and other materials is essential. I[3] encourages the government to intensively study the implementation of this partnership. Applying lessons from the MP Materials deal will ensure that the federal government deploys its limited resources effectively.

11. The current 2022-2026 National Strategy for Advanced Manufacturing has three top-level goals, each with objectives and priorities:

1. Develop and implement advanced manufacturing technologies
2. Grow the advanced manufacturing workforce
3. Build resilience into manufacturing supply chains and ecosystems.

a. Are these goals appropriate for the next 4-5 years? Why or why not?

1. The development of this plan will take time to create, given the number of parties involved.
2. Vocational schools will need to be inserted into the school curriculum, which will take significant time to implement.
3. Trade schools would need to adjust their programs to meet industry-specific needs in real time, making necessary adjustments for new industry training needs and equipment.
4. The legislation required to support these goals will take considerable time to develop and enact.
5. Employer buy-in will vary by industry, the cost of implementing these changes, and the anticipated return on investment.
6. Union apprenticeship programs can make an immediate impact. The trade unions have developed working apprenticeship programs that have effectively trained highly qualified workers who built this nation.

b. What emerging needs or opportunities might require the addition of new top-level goals, and why?

Emerging needs and opportunities that may require the addition of new top-level goals include:

1. Digital Transformation: The rise of Industry 4.0 and digital manufacturing necessitates a goal centered on digital skills and technologies, ensuring the workforce is equipped to handle data analytics, and smart manufacturing systems. It is imperative that the labor force required to maintain these systems be properly trained. Existing workforce training programs generally lack this digital component.

2. Global Competitiveness: A goal aimed at enhancing global competitiveness could focus on international collaboration, trade policies, and strategies to position US manufacturing favorably in the global market.
3. Cybersecurity in Manufacturing: With increasing reliance on digital technologies, a focus on cybersecurity measures within manufacturing processes is essential to protect sensitive data and maintain operational integrity.

These additional goals would help address the evolving landscape of advanced manufacturing and ensure that the US remains a leader in the sector.

12. Is there any additional information related to advanced manufacturing in the United States, not requested above, that you believe should be considered? If so, describe.

There are opportunities in virtually every major industrial sector to expand capacity to recycle products and materials to increase domestic production and security.

As one example, waste oils and fats have been critical feedstocks for sustainable aviation fuel (SAF). Because supplies of waste oils and fats are limited, significantly increasing production of SAF will require the use of alternative feedstocks. New SAF production techniques that utilize biogas from landfills, dairies, and wastewater plants productively use energy assets that would otherwise be vented or flared. Many landfills reuse only a small portion of the methane produced. Tapping biogas resources from thousands of landfills and wastewater plants to power other key sectors is only one example of the enormous potential of material reuse.