



Revitalizing American Manufacturing

*The Obama Administration's Progress in Establishing a
Foundation for Manufacturing Leadership*

National Economic Council
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EXECUTIVE SUMMARY

On Manufacturing Day 2016, the Administration takes stock of the progress that the U.S. manufacturing sector has made over the nearly eight years since President Obama took office. When President Obama took office, the auto industry—the heartbeat of the American manufacturing sector—was on the brink of collapse and the economy was on the verge of the next Great Depression. After saving the auto industry, the Obama Administration set out to methodically reinvest in the capabilities that manufacturing needs to succeed.

Since early 2010, U.S. manufacturing has added over 800,000 direct jobs, and companies from around the world again see the United States as the best place for new investment in the most leading-edge manufacturing across industries. Although the manufacturing sector has faced challenges over the last two years, many have incorrectly argued that U.S. manufacturing competitiveness is weak or that manufacturing will return to a path of decline similar to what we faced from 2000 to 2009. Despite these bumps in the road, the reality is that the foundation for manufacturing expansion is as strong as it has been in decades. To take advantage of that underlying strength, policy choices matter to ensure the U.S. continues to reinvigorate the capabilities that are required for a successful and innovative manufacturing sector.

A strong manufacturing sector is vital to a growing innovative economy

- Workers employed in manufacturing earn 20 percent higher than the median income and, even when holding all other factors equal, it is clear that workers in the manufacturing sector earn a pay premium.
- The manufacturing sector houses a great deal of innovative activity, with 75 percent of private sector research and development, 60 percent of all U.S. R&D employees, and the vast majority of patents issued, despite representing only 12 percent of the GDP.
- Manufacturing activity generates positive spillover benefits, because the know-how and capabilities gained in making things is a key ingredient in continued leadership in design, product development, and innovation.

U.S. manufacturing's recovery has been strong

- Since the Great Recession, manufacturing has grown at nearly twice the pace of the economy overall, marking the longest period where manufacturing has outpaced U.S. economic output in fifty years.
- Analysis by the President's Council of Economic Advisers suggests that cyclical factors do not fully explain manufacturing's job gains, as the job gains between 2010 and early 2014 are about 500,000 above and beyond what would be associated with the historical cyclical pattern.

Manufacturing has faced headwinds over the past two years but those headwinds are temporary and will likely subside

- The weak global economy, combined with the decline in energy-related capital expenditures, has been a drag on manufacturing given that the sector relies heavily on exports.
- Despite these headwinds, these last two challenging years are identical in manufacturing employment growth to the very best two year period from 2001 to 2009.

- After falling in the 2000s, U.S. manufacturing has stabilized its share of global exports, even in the face of these headwinds.

The Obama Administration’s actions have built a foundation for manufacturing that is stronger than it has been in decades, but optimism about manufacturing’s potential must be accompanied by the right policy choices. Examples of progress include:

- Creating manufacturing innovation institutes to boost U.S. competitiveness: The Administration’s signature initiative, Manufacturing USA, has now launched nine manufacturing innovation institutes to connect our research base to our production base, and is on the way to the President’s vision of 15 institutes by the end of the Administration.
- Reinvesting in manufacturing workforce skills: The Administration has invested to rebuild community college programs to provide the latest training to manufacturing workers, leading to credentials for hundreds of thousands of people, which is needed to keep the United States at the cutting edge. The Administration has reinvigorated apprenticeships, a proven vehicle for “learning while earning,” and we are seeing tens of thousands of new apprenticeships for the first time in years.
- Strengthening America’s competitiveness: Over the last eight years the Administration has taken a number of steps that make the U.S. more competitive for manufacturing investment, like making permanent the research and experimentation tax credit which largely benefits manufacturing firms, enabling small business to expense capital investment to strengthen our supply chains, investing in clean energy to capture this growing opportunity, and facilitating safe and responsible natural gas production to reinvigorate energy-intensive industries.
- Ensuring manufacturers are competing on a level playing field: The Administration has brought 23 enforcement cases at the World Trade Organization (WTO)—more than any other WTO member—and in every case that has been decided we have won. The Administration has worked with Congress to create new tools to enforce trade laws, like the “customs” legislation which will hold trading partners accountable.

I. MANUFACTURING SECTOR PERFORMANCE AND OUTLOOK

A strong U.S. manufacturing sector is vital to a growing, innovative economy

President Obama made revitalizing American manufacturing a central component of his economic agenda to establish the needed foundation for robust, broad-based economic growth. Manufacturing has long played an important role in supporting high-quality jobs, both in the manufacturing sector and more broadly across the economy. Critically, important know-how and capabilities can only be generated and supported by a strong base of production, which is key to enabling our country's innovation capacity.

Workers employed in the U.S. manufacturing sector earn 20 percent higher than the median income and, even when holding all other factors equal, it is clear that workers in the manufacturing sector earn a pay premium.¹ Since the beginning of 2010, U.S. manufacturing has directly added over 800,000 new jobs. However, to focus solely on the activities within the four walls of a factory is to ignore the important role that manufacturing plays across the economy. The sector supports millions of additional jobs through integrated supply chains and millions more in communities supported by the economic activity that manufacturing generates. A recent study by McKinsey Global Institute estimated that services suppliers and other jobs linked to manufacturing firms employ almost six million additional workers.² Those who have argued that manufacturing's impact on jobs is limited by ongoing technological change that allows us to produce more with fewer workers, fail to recognize these broader employment impacts from manufacturing activity. Manufacturing is increasingly supporting a broader set of high-quality business services jobs, like the software and application developers that are increasingly turning their focus to the technology embedded in, for example, new automobiles. In fact, it is reasonable to expect an increasing integration between these high-quality services jobs and manufacturing activity, as these industries become further intertwined.

A strong manufacturing sector is vital to America's economic progress because it is inextricably linked to our country's ability to innovate. Despite representing only 12 percent of U.S. GDP³, manufacturing accounts for roughly 75 percent of private sector research and development, 60 percent of all U.S. R&D employees, and the vast majority of patents issued.⁴ These investments in innovation and product design are reliant on the know-how and capabilities gained throughout the production process. Over the past seven years there has been an outpouring of new literature on manufacturing's role in the economy demonstrating the ways in which production activities and the learning inherent in the knowledge activities of research, development, and design are co-dependent.^{5,6} Companies are increasingly recognizing the

¹ Department of Commerce, *Economics Statistics Agency*, October 2015. www.esa.doc.gov/sites/default/files/the-pay-premium-for-manufacturing-workers-as-measured-by-federal-statistics.pdf.

² McKinsey Global Institute, *Manufacturing the Future*. 2013.

³ Bureau of Economic Analysis, Department of Commerce.

⁴ National Science Foundation National Center for Science and Engineering Statistics and U.S. Census Bureau, *Business R&D and Innovation Survey*, 2010.

⁵ Pisano, Gary and Willy Shih. "Restoring American Competitiveness." *Harvard Business Review*. July 2009.

⁶ MIT Taskforce on Production in the Innovation Economy. *A Preview of the MIT Production in the Innovation Economy Report*. February 2013.

benefits of co-locating production with design, whether that means engineers working on product development from the production floor or research centers migrating to factory sites.

Production activity has the power to enable higher productivity growth, which determines our economic potential. The economic evidence is clear that innovation spillovers are strongly connected to production activity, and that those spillovers decline with distance.⁷ For example, an economic study showed that when a manufacturing plant chooses to invest in a given location, the investment results not just in new production at the site of the plant, but actually increased productivity of other firms in the surrounding area.⁸ In other words, manufacturing location matters to a country's and a region's innovative capacity, and therefore its potential for ongoing productivity growth.

If the United States were to allow its industrial base to erode, America would lose its capability to produce things. This may enable a vicious cycle that makes the United States less attractive for new manufacturing and ultimately puts at risk our continuing capability to innovate and raise future living standards.

Since World War II, U.S. manufacturing performance had steady growth...

Many have mistakenly argued that U.S. manufacturing has been in steady decline for decades. The reality of U.S. manufacturing performance from 1945 to 2000 tells a dramatically different story. For decades, manufacturing production expanded at an average annual rate of 3.4 percent, roughly in line with real GDP growth. In 1966, the manufacturing sector directly employed 17.3 million workers. While there were ebbs and flows with recessions and recoveries with U.S. manufacturing employment peaking in 1979, and internal shifts between industries and regions within the country, in 2000 the manufacturing sector still directly employed 17.3 million workers.

In the mid to late 1990s, at a time of accelerating productivity growth, the manufacturing sector expanded production at its fastest sustained rate in decades, increasing to a pace of nearly 6 percent while adding over 700,000 new jobs.

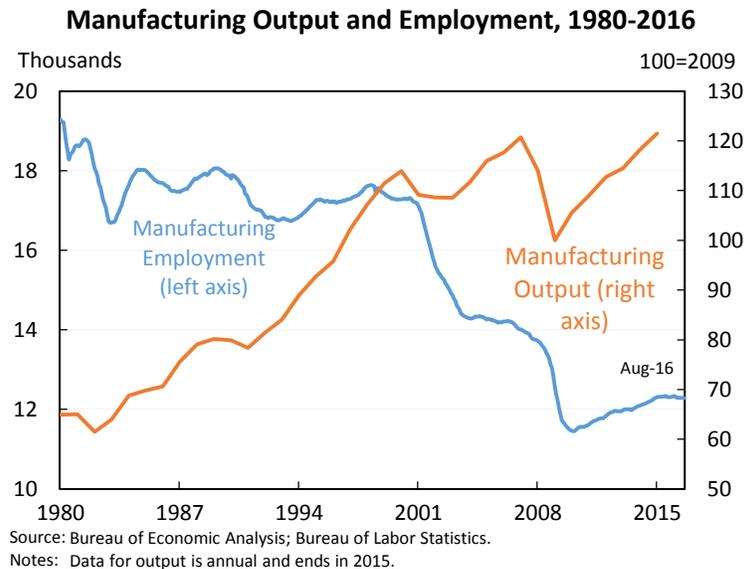
...Until the U.S. manufacturing sector faced an existential crisis beginning in 2001

However, beginning in 2001, the onset of the recession drove manufacturing production into a period of stagnation that would continue for the remainder of the decade. From 2000 to 2007, manufacturing production grew at only 1.3 percent per year, the worst peak-to-peak performance since World War II and significantly underperforming the overall economy for the first time. And combined with the Great Recession, from 2000 to 2009 the manufacturing sector shed 5.7 million jobs, or roughly one-third of all manufacturing workers, a higher share of jobs lost than

⁷ Keller, Wolfgang. "Geographic Localization of International Technology Diffusion," *American Economic Review*, 2002, v92 (1, Mar), 120-142.; Branstetter, Lee. "Are Knowledge Spillovers International or Intranational in Scope?" *Journal of International Economics* 53 (2001) 53-79. March 1999.

⁸ Greenstone, Michael; Hornbeck, Rick; Moretti, Enrico. *Identifying Agglomeration Spillovers: Evidence from Winners and Losers of Large Plant Openings*. April 2010.

during the Great Depression.⁹ Over this period, tens of thousands of factories closed their doors, including 40 percent of our largest factories, those employing over 1,000 workers.¹⁰ By the bottom of the Great Recession, factories sat empty and much of our capacity was under-utilized, with vacancy rates nearly doubling from 5.1 percent in 2000 to nearly 10 percent in 2009.¹¹



There has been much debate over the causes of this decade of decline for U.S. manufacturing. Some economists^{12,13} have pointed to the impact on U.S. manufacturing of globalization in this period, and particularly the impact of China’s entry into global markets. While additional research will be required to determine whether it was a failure of trade enforcement in some cases, an inappropriate lack of focus on the policies that enable a competitive and flexible manufacturing sector that can adjust to new challenges, or a combination of rapid shifts in global manufacturing markets combined with constraints on job mobility in the United States, but what is abundantly clear is that we were unprepared for these new challenges.

The auto industry’s failure could have imperiled the future of U.S. manufacturing

When President Obama took office, the heartbeat of American manufacturing—the U.S. auto industry—was on the brink of collapse. By December 2008, access to credit for car loans dried up and auto sales plunged 40 percent. Auto manufacturers and suppliers dramatically curtailed

⁹ Atkinson, Robert; Stewart, Luke; Andes, Scott; Ezell, Stephen. *Worse Than the Great Depression: What Experts Are Missing About American Manufacturing Decline*. March 2012.

¹⁰ Bureau of Labor Statistics, Quarterly Census of Employment and Wages.

¹¹ Tolliver, Jason; Mace, Andy; Bailey, Bethany; Morris, John. *The U.S. Manufacturing Renaissance: Driving a Resurgence in Industrial Real Estate*. Spring 2016.

¹² Pierce, Justin R; Schott, Peter K. “The Surprisingly Swift Decline of U.S. Manufacturing.” *Yale School of Management and National Bureau of Economic Research*, February 2015.

¹³ Autor, David H.; Dorn, David; Hanson, Gordon H., “The China Syndrome: Local Labor Market Effects of Import Competition in the United States.” *The American Economic Review*, Volume 103, Number 6, October 2013, pp. 2121-2168(48).

production, and in 2008 the industry shed over 400,000 jobs, a year in which the manufacturing sector overall lost 900,000 jobs.¹⁴ It is within this context, unprecedented job losses for manufacturing workers, the offshoring of thousands of American factories, and an auto industry facing collapse, that many argued that the U.S. manufacturing sector was no longer globally competitive and that we should allow our industrial base to continue its decline.

At the time that President Obama took office, GM and Chrysler were on the brink of failure. The President's decision to support GM and Chrysler was, of course, about more than these two iconic American companies and the tens of thousands of workers they employed. Consistent with the positive manufacturing spillovers mentioned above, estimates at the time from the Bush Administration suggested that the failure of GM and Chrysler could have led to the loss of more than one million jobs, because the failure of those two firms would have had a cascading effect across the industry, through the supply base, and in communities around the country. The end result would have eroded our industrial capabilities, potentially to the point that they would have been impossible to resuscitate. At the time, Ford's CEO Alan Mulally came to Washington D.C. to argue in favor of the U.S. government intervening to prevent the failure of GM and Chrysler, stating that "we believed... that if GM and Chrysler would have gone into free fall bankruptcy, they would have taken the supply base down and taken the industry down plus maybe turned the U.S. recession into a depression." Even though Ford did not require direct support, Mulally made clear that if GM and Chrysler failed, Ford would fail as well.

Automakers, like other manufacturers, rely on a network of shared suppliers. These suppliers not only make up the majority of the value-added in a vehicle, but they are often critical to new innovation and competitiveness across a given industry. The failure of GM and Chrysler would not only have potentially had dramatic near-term consequences, including the potential failure of Ford and a deeper recession, but it could have done irreparable harm to the fabric of U.S. supply chains that is critical to our future economic activity and innovation. In this instance, the policy decision by the Obama Administration both supported near-term economic recovery and ensured the potential for a reliable foundation upon which manufacturing activity rests. As an example of the type of recovery that occurred, auto sales in the U.S. reached a record level of 17.4 million units in 2015, the strongest in history.

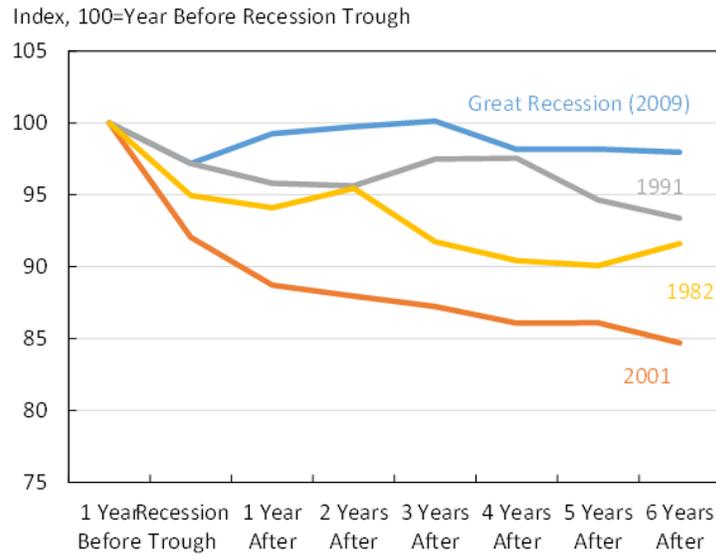
U.S. manufacturing has had a robust recovery emerging from the Great Recession

Manufacturing output has increased by almost 30 percent since the end of the recession, growing at roughly twice the pace of the economy overall from the third quarter of 2009 when the economy began to expand through the first quarter of 2016, marking the longest period where manufacturing has outpaced U.S. economic output in fifty years.¹⁵ Starting in 2009 manufacturing output has increased as a share of US value-added, contrary to the pattern seen in all U.S. recessions since 1982.

¹⁴ Bureau of Labor Statistics, Department of Labor, *Employment, Hours, and Earnings from the Current Employment Statistics Survey*, 2008.

¹⁵ Bureau of Economic Analysis, Department of Commerce, *NIPA Tables*.

Manufacturing Output Rebound by Recession



Note: Index of the share of manufacturing value added to total output
 Source: United Nations National Accounts Data

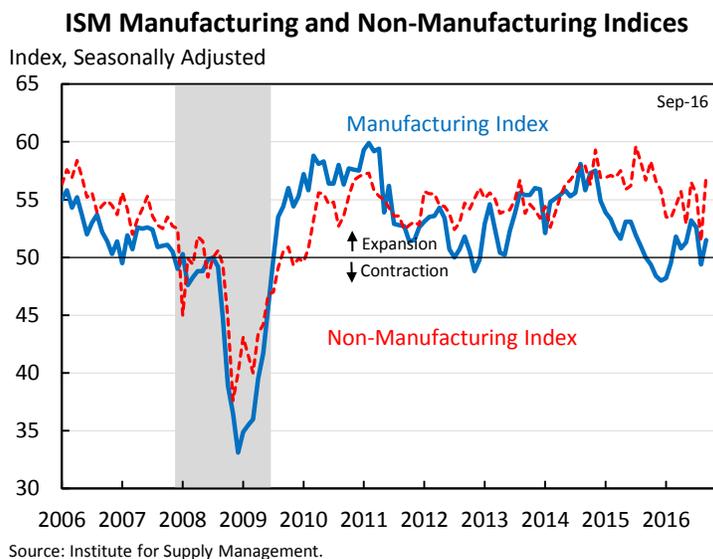
Since February 2010, U.S. manufacturing has added over 800,000 new jobs. U.S. manufacturing's recovery and job growth since the Great Recession is a marked departure from last decade, when the sector struggled to recover and never added back any of the jobs lost in the 2001 recession. The auto industry overall, including sales and distribution, has added over 671,000 jobs since GM and Chrysler emerged from bankruptcy in mid-2009, the industry's strongest growth on record.¹⁶

In addition to a dramatic break from last decade's decline, analysis by the President's Council of Economic Advisers suggests that cyclical factors do not fully explain manufacturing's job gains, as the job gains between 2010 and early 2014 are about 500,000 above and beyond what would be associated with the historical cyclical pattern.

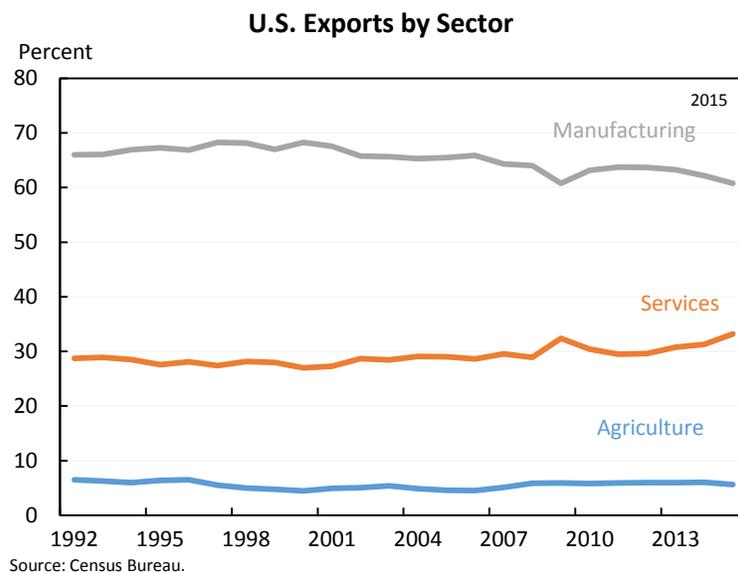
U.S. manufacturing has faced headwinds over the past two years, but those headwinds are temporary and will likely subside

Following the strong manufacturing recovery in the wake of the Great Recession, the past two years have seen lackluster growth in the sector. Manufacturing employment growth has stalled and industrial production growth has been slower than at any other point since 2009, largely due to a number of temporary factors. A number of data series, like the ISM Purchasing Managers survey, reveal the slowing of growth in the manufacturing sector since late 2014 and the divergence of the sector's performance from non-manufacturing industries. Notwithstanding the modest improvement in early 2016, it is clear that manufacturing is facing a spell of headwinds.

¹⁶ Council of Economic Advisors, September 2016.



Two headwinds have dragged down recent manufacturing performance: (1) the weak global economy and (2) the decline in energy-related capital expenditure. Factors that drive export demand—global economic output and U.S. terms of trade—are particularly important to manufacturing as it is a far more trade-exposed sector than other parts of the economy. While manufacturing represents roughly 12 percent of value added in the economy, manufactured exports have maintained a share of above 60 percent of U.S. exports. This implies a much greater sensitivity to the global economy than sectors like construction or health care. Real exports rebounded swiftly after the crisis, helping the manufacturing sector. But, recently, real exports of goods and services have fallen slightly — 1.1 percent over the past four quarters.



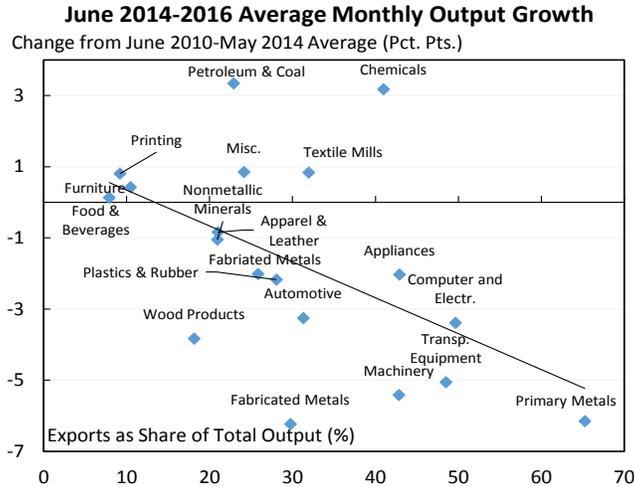
The challenges for U.S. exports principally come from the direct and indirect effects of slower foreign GDP growth. Real exports tend to track nearly perfectly with foreign real GDP growth (weighted by U.S. export shares). Global growth has slowed notably since 2012, and U.S. real

export growth has slowed along with it. At the same time, as the figure below shows, U.S. exports have slowed even more in the last two years, based on part on the relative strength of U.S. economic output and terms of trade.

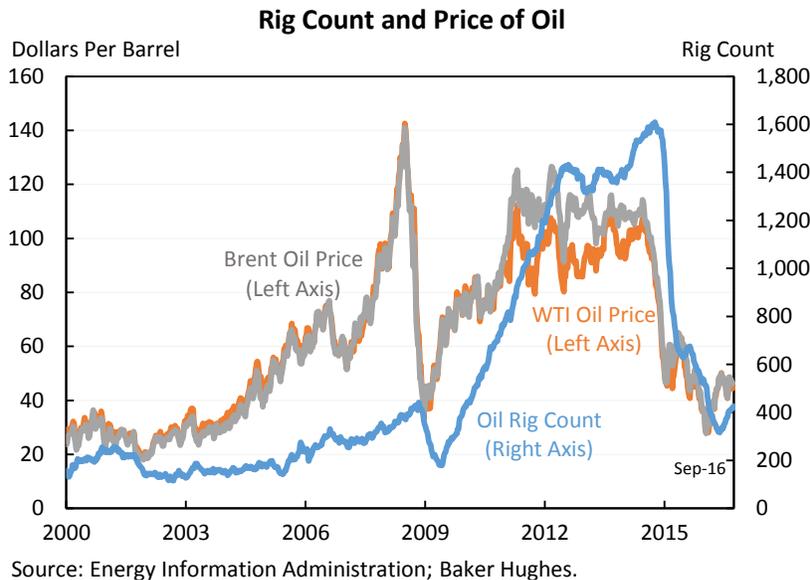


Producers of tradable goods are sensitive not only to a drop in direct exports abroad, but also through exports of downstream firms that use their goods as inputs into their own production processes. The most export-exposed sectors by this combined measure are primary metals, with the highest total (direct and indirect) export share of nearly 70 percent, as well as computers and electronics and transportation equipment, with total export shares of about 50 percent. Even some services industries, like air and rail transportation, are highly exposed to export demand fluctuations.

Consistent with these broad export pressures, U.S. manufacturing industries with higher (direct plus indirect) export shares have experienced slower average monthly output growth. Primary metals, with the highest total export share, experienced the greatest slowdown since June 2014 relative to its June 2010-May 2014 average. Transportation equipment, fabricated metals, and machinery, with export shares ranging from 20 to 50 percent, also have seen slower output growth.



The second headwind is the impact on some manufacturing sectors from the drop in energy prices. The sharp decline in crude oil prices in 2014 to 2016 due in part to a global supply glut as well as slowing demand based on slower global growth, prompted U.S. energy producers to reduce their capital investment in drilling. When Brent crude and WTI prices fell to lows in the \$25-50 per barrel range compared to over \$98 per barrel during the third quarter of 2014, the oil rig count dropped sharply, diving below 425 after peaking at over 1,600 in October 2014. The rapid decline in prices and rig count slowed structures investment and consequently spilled over into industries such as steel that sell materials to drillers.



Despite the aforementioned headwinds, the last two years are comparable to the best two years from 2001 to 2009, even amongst its periods of modest production growth in the middle of the decade. In fact, the best two-year pre-recession performance for manufacturing jobs was identical to the recent challenging two-year period, where manufacturing employment has been roughly stagnant.

Despite these temporary headwinds, the foundation for U.S. manufacturing is as strong as it has been in decades

While the headwinds have slowed the expansion of U.S. manufacturing, the underlying performance of the sector has been strong. One clear piece of evidence regarding the continued resilience of the U.S. manufacturing industry is that the United States has stabilized and begun to modestly expand its market share in global manufacturing exports. The U.S. share of world manufacturing exports fell precipitously in the first half of the 2000s, a contributing factor in the weak production growth from 2000 to 2007.

Overall, global manufacturing exports declined precipitously in the Great Recession. But as the United States emerged from the recession, the U.S. was able to stabilize its share of global exports. The U.S. remains the third largest exporter of manufactured goods in the world—demonstrating the competitiveness of U.S. manufactured goods on world markets.

U.S. Manufactured Goods Exports as a Percentage of World Manufactured Goods Exports



Notes: Data for 2015 are preliminary CEA estimates based on scaled World Bank WDI data. Manufactured exports are defined by SITC sections 5, 6, 7, and 8 (which includes iron and steel, chemicals, machinery and transport vehicles, and textiles), but excludes division 68 (non-ferrous metals) and group 891 (arms and ammunition). This differs from the census definition of manufacturing, which is based on NAICS codes 31-33. Source: World Trade Organization; IMF International Financial Statistics; Eurostat Comext; World Bank.

Over the past several years, surveys of global manufacturing executives have continued to demonstrate growing competitiveness in the U.S. as a location for manufacturing production. The Boston Consulting Group has found that U.S. manufacturing executives have increasingly answered that they are actively moving or actively considering moving production from China to the United States, with the most recent survey showing that 53 percent of executives are either moving production or actively considering moving production back to the United States.¹⁷ Deloitte and the Council on Competitiveness found in a recent survey that global manufacturing executives stated that the U.S. is currently the 2nd most competitive location for manufacturing production, and that they believe that by 2020 the U.S. will overtake China and be the single

¹⁷ Boston Consulting Group, Perspectives, *Reshoring of Manufacturing to the U.S. Gains Momentum*, December 2015.

most competitive country for manufacturing due to the continued shifts towards more advanced manufacturing processes and a growing need for talent.¹⁸

The strong foundation for manufacturing expansion and growing optimism from manufacturing firms about the U.S. as a location for production rests on several important factors: the changing cost and supply chain dynamics of global manufacturing production, the increasing convergence of a range of manufacturing production technologies, and the increasing policy emphasis on supporting a robust manufacturing base.

First, U.S. direct manufacturing production costs compare favorably to other advanced economies, particularly due to the high productivity of American workers and the low energy costs as a result of abundant natural gas. According to The Boston Consulting Group, the U.S. relative costs of production in 2014 were within 5 percent of those of China and substantially less than countries like Japan, Canada, Brazil, France, and Germany. In addition, companies increasingly recognize the need to take a ‘total cost’ approach when evaluating manufacturing location decisions. For example, proximity to customers, the ability to manage product development and production across disparate locations, and the risks of lengthy supply chains leading to costly disruptions all must be factored into location decisions, advantaging the United States. The U.S. Department of Commerce developed the Access Costs Everywhere (ACE) tool that helps companies understand the interaction of these costs.¹⁹

Second, there is an ongoing convergence of manufacturing technologies that has the potential to dramatically change both the products we use and how we produce them. Digital manufacturing enables the connection of different parts of the manufacturing life-cycle through data and modeling, allowing for digital design and digital production runs, reducing cycle time and cost. Additive manufacturing, or 3D printing, allows for producing products in layers of materials rather than subtracting from a block of material via machining or assembling several components together, reducing waste and allowing for prototypes to be constructed in some cases at a dramatically lower cost. And other emerging technologies—like advanced robotics, artificial intelligence, and the internet of things—all offer the promise of advancing the possibilities in manufacturing. The common connection is that these are all areas where the United States is a global leader, in part due to the inherent and growing connection between software and hardware. The United States has a large lead in novel software development, and our ability to integrate these new technologies into physical products and manufacturing processes will create opportunities for the future of manufacturing and facilitate the potential for enhanced U.S. leadership.

Third, the Obama Administration’s focused policy effort, first to rescue the auto industry and then to ensure a strong foundation for manufacturing growth, has played a key element in enabling manufacturing strength. This focus has influenced policy at the state and local levels, which play an important role investing in the assets and capabilities that facilitate a strong local production base. While the combination of changing cost dynamics and evolving technologies influence manufacturing competitiveness, policy choices will continue to play a key role.

¹⁸ 2016 Global Manufacturing Competitiveness Index.

www2.deloitte.com/global/en/pages/manufacturing/articles/global-manufacturing-competitiveness-index.html

¹⁹ Access Costs Everywhere. <http://acetool.commerce.gov/>.

II. OBAMA MANUFACTURING POLICY AGENDA

As the economy emerged from the Great Recession, President Obama directed his team to establish the policies needed to enable a stronger foundation for U.S. manufacturing expansion, recognizing the important connection between a strong manufacturing sector and a strong, innovative economy. The experience with the auto industry—where the failure of two companies imperiled the health of the broader U.S. manufacturing sector for years to come—demonstrated the interconnected nature of the manufacturing sector and the need for a comprehensive approach. The manufacturing sector in the United States is diverse, but its continued strength relies on a broad set of underlying capabilities that make it more attractive for firms to invest and manufacture in the United States. Following the challenges that manufacturing faced from 2000 to 2009, there had been significant underinvestment in manufacturing capabilities and policy was required to rebuild and regrow what some have referred to as the ‘industrial commons’.

The Administration also recognized the need to use a broad set of policy tools to tackle these challenges. While manufacturing activity is inherently local, the Federal government plays a key role in investing in and establishing the conditions for capabilities to thrive. For example, the Federal government can serve as a catalyst, as demonstrated by the President’s Manufacturing USA initiative to create public-private manufacturing innovation institutes, or as a convener, as demonstrated by efforts like Manufacturing Day and the Supply Chain Innovation initiative; both of which have focused local and private efforts on supporting manufacturing capabilities. The effort to develop a robust policy agenda included calling on the President’s Council of Advisors of Science and Technology (PCAST) to make recommendations and launch a new partnership with business and academia called the Advanced Manufacturing Partnership. The strong external participation from business, academia, and labor strengthened these efforts and will ensure that they are lasting.

In total, the steps taken by the Obama Administration have helped to create a foundation for U.S. manufacturing leadership. As the United States moves forward, it is critical to reinforce that foundation and build on this progress through smart policy choices. Policy will determine if we are making the needed investments in technologies and know-how that power innovation or in workforce skills to ensure that our workers continue to be the most productive in the world. This Administration’s approach has repositioned the role of the Federal government in appropriately supporting manufacturing expansion through coherent innovation policy, ensuring U.S. leadership in new technologies and approaches. However, more work is needed to continue to implement where progress is underway and to kick-start action where progress has been stalled.

The Administration’s emphasis on revitalizing American manufacturing has helped to change the conversation around manufacturing’s importance. Whereas prior to and during the Great Recession, many argued that manufacturing’s decline was inevitable and perhaps beneficial, there is now broader recognition of important role a strong manufacturing sector plays in a growing, innovative economy. Given the progress made since 2010, it is critical to continue the momentum. To be clear, there is no silver bullet to ensuring strong growth across U.S. manufacturing. Manufacturing in the United States is diverse. That is why a comprehensive effort is required to ensure the right policies with the right solutions are made so that our manufacturing sector continues to grow and innovate.

A Framework for Manufacturing Policy

In January 2010, the President charged the President’s Council of Advisors on Science and Technology (PCAST) with examining U.S. manufacturing, and in June 2011, led by the efforts of PCAST members, Shirley Ann Jackson and Eric Schmidt, the Council released its report *Ensuring American Leadership in Advanced Manufacturing*. In response, the President soon after created the Advanced Manufacturing Partnership Steering Committee (AMP), a working group of 19 manufacturing leaders in industry, academia, and labor and chaired by Andrew Liveris, Susan Hockfield, and Rafael Reif, organized under PCAST, as part of his continuing effort to maintain the competitive edge on emerging technologies and to invest in the future of our manufacturing sector and the White House Office of Manufacturing Policy, co-chaired by the National Economic Council and the Department of Commerce. The policies fueled by these efforts have been a big contributor to the progress made over the past five years. Building on the success of AMP, the President created the Advanced Manufacturing Partnership Steering Committee ‘2.0’ in 2013, chaired by Andrew Liveris and Rafael Reif. The AMP 2.0 working group, was again organized under PCAST auspices. AMP 2.0 met with industry, academia, labor, government, and the public to address the challenge of expanding advanced manufacturing across the United States. The central approach of both AMP and AMP 2.0 has been to strengthen U.S. manufacturing by (1) enabling innovation, (2) securing the talent pipeline, and (3) improving the business climate.

Through these efforts, the Administration has been able to develop a holistic policy approach to strengthening U.S. manufacturing by focusing not on the cultivation of specific industries or firms, but on investing in the strong foundation—the capabilities, assets, and business environment—critical for manufacturers to flourish in the United States. This policy approach has four pillars to encourage U.S. manufacturing production, investment, and competitiveness:

1. Spurring innovation through next-generation technologies to ensure that the powerful new technologies of tomorrow are developed and manufactured in the United States.
2. Strengthening skills, communities, and supply chains to attract investment to equip the manufacturing workforce and manufacturing firms with the skills needed for today’s increasingly technology-oriented manufacturing opportunities, and to ensure communities large and small across the United States are well-positioned to compete for manufacturing investment.
3. Making the United States more competitive for production to create the best business environment in the world to enable capital investment.
4. Expanding market access and leveling the playing field to expand market access opportunities for U.S. manufacturers of all sizes at home and abroad, and to enforce trade rules and protect American workers and firms from unfair practices.

Pillar 1: Spurring Innovation Through Next-Generation Technologies

Innovation is America’s central advantage. Without a combination of process and product innovation, where making spurs learning in real-time, we risk losing important capabilities that underpin our ability to innovate. For many technologies, the capabilities gained in production are intertwined with new learning and the knowledge activities of research, development, and design. To avoid losing the competitive edge in our ability to innovate, a key component of the manufacturing policy for this Administration has been to foster an ecosystem in which we invest in research and development to keep our manufacturing sector at the forefront of manufacturing innovation. The Federal government has an important role to play by investing in pre-competitive research and development, establishing the institutions that enable collaboration between firms and academia in order to fully harness our innovation advantage, and creating the right incentives for firms to expand investment in innovation activities in the manufacturing sector.

Manufacturing USA

The Administration’s most significant action taken to support manufacturing innovation was the creation of the National Network for Manufacturing Innovation, now known as Manufacturing USA, in 2012. Manufacturing USA brings together industry, academia, and government to co-invest in the development of world-leading manufacturing technologies and capabilities. Each Manufacturing USA institute focuses on a technology area critical to future competitiveness—such as 3D printing, integrated photonics, or smart sensors. In the four years since its establishment, Manufacturing USA has grown from one institute with 65 members to a network of nine institutes and over 1,300 members. Across the Manufacturing USA institutes, the Federal government has committed over \$600 million, which has been matched by over \$1.3 billion in non-Federal investment. A full list of the Manufacturing USA institutes can be found in the Appendix.

Together, the Manufacturing USA institutes are already enhancing U.S. competitiveness in advanced manufacturing—from helping Youngstown, OH attract over \$90 million in new manufacturing investments to its region and train 14,000 workers in the fundamentals of 3D printing for businesses, to supporting companies like X-FAB in Lubbock, TX upgrade to cost-competitive, next-generation semiconductors and sustain hundreds of jobs. These public-private partnerships (PPP) are bringing value to their memberships and regions by providing:

- Technological Pre-eminence: By accelerating the transition from design to Made in USA, the institutes are leading the development of emerging manufacturing technologies—for example, America Makes, the National Additive Manufacturing Innovation Institute in Youngstown, OH enabled one of its founding members, Oxford Performance Materials, Inc., to become the first company to receive clearance from the U.S. Food & Drug Administration (FDA) to manufacture 3D-printed polymer implants for use in surgical procedures in the United States.
- Collaborative Constituencies: The institutes align industry priorities by combining the efforts of manufacturers across geographies and supply chains—for example, the American Institute for Manufacturing Integrated Photonics (AIM Photonics), the Integrated Photonics institute in Rochester, NY, has members on both coasts to involve the entire supply chain for

integrated photonics, from microprocessing training and circuit design centers in Massachusetts; to wafer foundry, packaging, and assembly centers in New York; to integrated photonic device manufacturers in California.

- **Leveraged Investments**: For companies, institute membership allows access to unique equipment and capabilities that are too costly for any one company to undertake—for example, Advanced Functional Fabrics of America (AFFOA), the Revolutionary Fibers and Textiles institute in Cambridge, MA, is standing up a distributed, on-demand foundry to rapidly identify domestic manufacturing pathways within its membership to accelerate the design-to-product process.
- **Customized Training**: Institutes act as “teaching factories,” providing specialized curriculum for the relevant technology—for example, PowerAmerica, the institute focused on power electronics in Raleigh, NC, created the first Master of Science concentration in wide bandgap power electronics, in its first year engaging 225 freshman engineering students to create a talent pipeline. New courses introduced at Power America-affiliated universities have doubled the capacity of graduate students learning about power electronics, impacting more than 200 graduate students per year.
- **Business Opportunities**: By developing national expertise across their supply chains, the institutes are creating new reasons for companies to locate jobs and investment in their regions and the United States—for example, Leisure Pools, a carbon fiber pool manufacturer originally from Australia, has relocated its facilities to be near the Institute for Advanced Composites Manufacturing Innovation (IACMI) in Knoxville, TN, as Leisure Pool retools to become an advanced manufacturer of carbon fiber and composite materials and adds up to 1,000 jobs in Knoxville over the next decade.
- **Innovation Ecosystems**: The institutes are creating trusted environments, knitting together technical expertise across supply chains to craft new business opportunities—for example, the Digital Manufacturing and Design Innovation Institute (DMDII) in Chicago, IL is providing space within its facilities for start-ups developing their business, facilitating relationships between young companies and its large industrial members through collaborative projects.
- **Rejuvenated Neighborhoods and Networked Expertise**: By anchoring regional manufacturing competitiveness, the institutes are breathing new life into the manufacturing regions where they are located—for example, Lightweight Innovations for Tomorrow (LIFT), the lightweight and modern metals manufacturing institute in Detroit, MI, has transformed a former factory that was abandoned during the wave of offshoring in the early 2000s, rejuvenating one of Detroit, MI’s oldest neighborhoods. IACMI has co-located with LIFT to stand up a composite materials production line, convening the smartest minds across the Manufacturing USA Network to accelerate vehicle lightweighting.

Manufacturing USA bridges the gap between research and product development and serve as a regional hubs to accelerate additional technologies. The Federal government’s seed funding serves as a catalyst to establish each institute, and that funding is leveraged – approximately every dollar provided by the Federal government is matched by two dollars from industry. With this unique pre-competitive, collaborative model, each institute acts as a “teaching factory” that allows for education and training of students and workers at all levels, while enabling shared assets to help companies – most importantly small manufacturers access the cutting-edge capabilities and equipment to design, test, and pilot new products and manufacturing processes.

The early successes are promising. From accelerating the transition from design to *Made in the USA* through 3D printing and digital manufacturing techniques to repurposing existing factories to house the next generation of American semiconductor foundries, the manufacturing innovation institutes are advancing U.S. leadership in emerging manufacturing technologies that make the U.S. more competitive in advanced manufacturing. With over 250 research projects teed-up, underway, and completed—each taking a comprehensive approach in bringing together leading technologies from industry and their public partners with preeminent academic researchers—the institutes are already generating technology breakthroughs with even more just around the corner. Each project is situated at the intersection of research and development helping transition groundbreaking technology from the lab out onto the factory floor. Some key success stories include:

Federal Investment in Manufacturing Research and Development

The Administration has set an explicit focus on supporting the entire pipeline of manufacturing innovation, from increasing research and development investments—up 40 percent in the President’s FY2017 Budget compared to 2011—to coordinating activities across 13 Federal agencies. PCAST also has recommended particular focus on the manufacture of nanotechnology, recommending research investment and coordination that will unlock the potential of these technologies. Despite a period of difficult budgets, the Administration’s commitment to manufacturing R&D was able to deliver substantial expansions of key programs supporting a broad set of foundational technologies.

The National Science and Technology Council Subcommittee on Advanced Manufacturing (SAM) serves as a forum for information-sharing, coordination, and consensus-building across 13 Federal agencies regarding Federal policy, programs, and budget guidance for advanced manufacturing. Originally chartered in 2012, the subcommittee seeks to identify (i) gaps in the Federal advanced manufacturing research and development portfolio and policies, (ii) programs and policies that support technology commercialization, methods of improving business climate, and (iii) opportunities for public-private collaboration.

To foster a shared technological vision across the public and private sectors, in April 2016 the SAM released *Advanced Manufacturing: A Snapshot of Priority Technology Areas Across the Federal Government*, a report detailing common priorities for research and development in advanced manufacturing technologies and initiatives to strengthen manufacturing education and workforce development. Recognizing these areas is a critical step toward identifying smart, strategic investments that build on our strengths—revving the engines of American ingenuity and honing the skills of the world’s most productive workforce. Among the shared technology priorities identified in this report are:

- Advanced materials manufacturing: designer materials that are “born ready” for specific next-generation products, approaching atomic precision at kilogram scales;
- Bio-manufacturing for regenerative medicine: repairing and replacing cells, tissues, and organs that might one day lead to 3D-printed organs; and
- Continuous manufacturing for pharmaceuticals: uninterrupted production enabling greater quality, yield, and flexibility toward personalized medicine.

Maker Movement

In June 2014, the President launched the Nation of Makers initiative, a multi-stakeholder effort to ensure students, entrepreneurs, and Americans of all backgrounds have access to a new class of technologies. In recent years, a growing number of Americans have gained access to technologies such as 3D printers, laser cutters, easy-to-use design software, and desktop machine tools. This, in combination with freely available information about how to use, modify, and build upon these technologies and the availability of crowd funding platforms, is enabling more Americans to design and build almost anything. These new tools are giving students the types of hands-on STEM learning experiences that spark interest in science and technology careers. They are also fostering a “maker mindset”—dispositions and skills such as curiosity, collaborative problem-solving, and creative confidence that are vital to the modern innovation economy.

Through the Nation of Makers initiative, the Administration, led by the Office of Science and Technology Policy, hosted the first of its kind maker faire at the White House in 2014, which brought together over 100 makers from more than 25 states, and included more than 30 exhibits. In June 2015, the Administration proclaimed June 12-18, 2015 as a National Week of Making, during which 21 Federal agencies committed a suite of services for people interested in engineering and manufacturing. More than 150 colleges and universities, over 125 libraries, and more than 90 mayors pledged to take steps to help advance making in the United States. This past year the Administration again proclaimed June 17-23, 2016 as the National Week of Making. This year, eight Federal agencies announced new grants, education initiatives, training, knowledge networks, and other supports to help create more makers and assist more entrepreneurs to take prototypes to scale with new ventures – in addition to more than 100 commitments made to support makers across the United States.

Pillar 2: Strengthening Skills, Communities, and Supply Chains to Attract Investment

Manufacturing production relies on the skills of a talented workforce, the capabilities of robust supply chains, and the assets within our regions and communities. In a recent survey, manufacturing executives identify workforce talent as the single most important determinant of global competitiveness.²⁰ The Administration has made investments to rebuild our manufacturing workforce training programs after years of neglect, create new efforts like our focus on apprenticeships, reinvigorate the critical Manufacturing Extension Partnership to support tens of thousands of small and medium manufacturers, and launch the new Investing in Manufacturing Communities Partnership to spur communities around the country to leverage their own strengths and capabilities to enable a stronger American manufacturing sector.

Manufacturing Workforce Training

From 2000 to 2009, as the manufacturing sector shed jobs, it appeared that there was little need to invest in new workforce capabilities in our community colleges and technical schools. As a result, our workforce training system was ill-equipped for the expansion of manufacturing jobs

²⁰ Deloitte LLP and U.S. Council on Competitiveness. *2016 Global Manufacturing Competitiveness Index*.

since 2010. The Administration has taken a number of steps to reinvest in our manufacturing workforce training capabilities, increase our focus on portable credentials for manufacturing workers, and increase our focus on apprenticeships, which are underutilized in the United States. These actions will continue to be of critical importance given the changing dynamic within the manufacturing sector, requiring higher levels of formal education and training.

First, to enhance workforce training capabilities and capacity, the Administration awarded nearly \$2 billion in Trade Adjustment Assistance Community College Career Training (TAACCCT) grants help community colleges expand and improve programs that prepare workers for careers in high-paying, high-skill occupations. TAACCCT grantees are leveraging curriculum that has been developed through strong partnerships between community colleges, the workforce system, employers, and industry groups to transform the way they design and deliver courses through accelerated learning strategies.

Second, the Administration has focused on apprenticeships, as they tend to lead to good paying jobs and provide a strong return on investment for employers—87% of apprentices are employed after completing their programs, with an average starting wage above \$50,000.²¹ The return on investment for employers is also impressive: for example, international studies suggest that for every dollar spent on apprenticeship, employers may get an average of \$1.47 back in increased productivity, reduced waste, and greater front-line innovation.²²

To capitalize on the workforce benefits of apprenticeships, the Administration has allocated \$265 million towards expanding apprenticeships in the United States. These investments have been made through a \$90 million investment into ApprenticeshipUSA and through \$175 million in grants. The funding will be distributed through grants to states, regional industry partnerships, and public-private partnerships that are working to expand high-quality apprenticeships. The PPP grantees are well on their way to creating and filling more than 34,000 new apprentices in high-growth and high-tech industries including health care, IT, and advanced manufacturing over the next five years.

We are already seeing a number of successes in the number of new apprenticeships being created and in the high number of credentials earned from TAACCCT graduates:

- Nearly 300,000 participants have enrolled in in-demand education and training programs at community colleges in all 50 states through the TAACCCT program, with a total of 160,000 credentials to date.
- We've seen a 31% increase in active apprenticeships since the President's Call to Action in 2014, with an estimated 20,000 additional new apprentices in the manufacturing industry.

²¹ U.S. Department of Labor. *American Apprenticeship Grants*. 2015. <https://www.doleta.gov/OA/aag.cfm>.

²² Ibid.

Manufacturing Extension Partnership (MEP)

More than 230,000 small manufacturers form the backbone of America's supply chains and employ an increasing share of U.S. manufacturing's overall workforce.²³ Dense networks of these small manufacturers are vital to taking a product from concept to market. The Hollings Manufacturing Extension Partnership (MEP) enables the ability of American small manufacturers to increase their capability with the latest technologies, which is important to U.S. competitiveness for jobs and investment in manufacturing.

MEP is a network of centers that provide technology and engineering expertise to tens of thousands of small- and medium-sized manufacturers in all 50 states and Puerto Rico. MEP creates new linkages between suppliers and provides small manufacturers with insight into technologies that can revolutionize their business. Since 1988, MEP has worked with 86,620 manufacturers, leading to \$96.4 billion in sales and \$15.7 billion in cost savings, and it has helped create and retain more than 797,994 jobs.

Through its budgets, the Administration has continued to call for a modest increase of federal investment in MEP. The program will continue to be important as we work to connect small and medium manufacturers with the emerging process and product technologies that have the potential to transform manufacturing.

Investing in Manufacturing Communities Partnership (IMCP)

Manufacturing, by definition, is a local activity. Production happens in a place. The assets and capabilities of a given community form the foundation for manufacturing production and investment. If we are going to take full advantage of the opportunity in the years ahead, our regions and communities must develop local plans for strengthening manufacturing. That is why President Obama launched the Investing in Manufacturing Communities Partnership (IMCP) in 2012, with the goal of encouraging local communities to develop comprehensive economic development strategies focused on manufacturing competitiveness by aligning local and Federal investments against local strategies.

IMCP works to enhance the way we leverage Federal economic development funds to encourage American communities to focus not on attracting individual investments one at a time, but on transforming themselves into globally competitive manufacturing ecosystems. Communities apply for an IMCP 'designation' by demonstrating their comprehensive manufacturing strategies, and if designated, a community receives (i) preferential access to Federal economic development funding along with a Federal liaison to navigate Federal opportunities and (ii) the ability to brand and promote their community as a designated Manufacturing Community to help attract additional private investment and partnerships. The IMCP program acts as an incentive for communities to invest in high-return capabilities, rather than low-return giveaways that do little to enhance our overall competitiveness.

²³ Economics and Statistics Administration analysis using data from the Census Bureau's Business Dynamics Statistics (BDS).

To bolster the competitiveness of each community, twelve Federal agencies, with more than \$1 billion in economic development funds, work with the communities to support and invest in public-private partnerships that bolster regional manufacturing. The first 12 communities were designated in 2014, and there are now currently 24 communities that have been designated through this effort. Each community focuses on a particular aspect of manufacturing such as chemical manufacturing, aerospace, or shipbuilding industries. The best practices of high-performing communities serve as a model for others around the country looking to take steps to expand manufacturing investment and production.

IMCP Community Snapshot: AMP Socal

The University of Southern California and the Advanced Manufacturing Partnership for Southern California (AMP Socal), one of the current 24 IMCP communities, built partnerships between industry, government, and academia focused on strengthening the aerospace and defense sector. Conceived as a four-county collaborative with 86 partners, AMP Socal has grown into a 10-county Southern California partnership with a growing list of collaborators. To further develop manufacturing skills, this IMCP community focuses on three pathways: (i) a model-based Engineering and Design pathway program that has already placed 16 trainees in jobs; (ii) an Additive Manufacturing Certificate Program, and (iii) a managed career pipeline strategy. 4000+ jobs have been created as a result of partnerships developed through AMP Socal and \$65 million in funding from both Federal and non-Federal sources have been matched by \$53 million from local sources to enhance the manufacturing competitiveness of this region. Further strengthening manufacturing in this IMCP community, the MEP Center leads a Growth Acceleration Strategy to provide technical assistance to small and medium sized companies to enhance their current capabilities and future potential by removing operational and technological barriers to growth. They credit this program with retaining 192 jobs over the first 18 months of the designation. Adding to the manufacturing ecosystem in this community is the Smart Manufacturing Innovation Institute, awarded this past June, which brings together a consortium of nearly 200 partners from across academia, industry, and non-profits—to spur advances in smart sensors and digital process controls that can radically improve the efficiency of U.S. advanced manufacturing.

Supply Chain Innovation

Small manufacturers that form the backbone of America’s supply chains play an increasingly important role in creating and retaining manufacturing jobs and investment in the United States. To support small manufacturers, this Administration implemented a Supply Chain Innovation Initiative designed to strengthen small manufacturers through the sharing and implementation of best practices. Because small manufacturers play an increasing role in the overall manufacturing sector as members of tightly interdependent supply chains, their ability to keep up with and even lead advances in technology is critical to the competitiveness of U.S. manufacturing overall.

One example of an action taken to strengthen supply chain innovation is the SupplierPay Initiative, which helps address the difficulties small businesses face in accessing affordable working capital. Reducing the time it takes for smaller suppliers to get paid or lowering their short-term borrowing costs enables them to devote more of their resources to investing in their business, hiring, and growing. The Administration's focus on reinvesting in America's small manufacturers is an example of how public-private sector efforts can strengthen the foundation of these key elements of the U.S. economy.

Manufacturing Day

Manufacturing Day is an annual, nationwide celebration of manufacturing that provides an opportunity for manufacturers to open their doors to show the public the face of modern manufacturing. First celebrated in 2012, the Administration has supported Manufacturing Day as a way to showcase the work manufacturers do on a daily basis and to educate students and community members on how integral manufacturing is to the local, national and global economy. These experiences matter—after participating in Manufacturing Day events, a recent study found that 81 percent of students and 91 percent of educators were more convinced that manufacturing provides careers that are interesting and rewarding, helping to inspire the next generation of manufacturers.²⁴ Given that 80% of manufacturing jobs are currently held by workers between the ages of 45 – 65, it is critical that we begin to recruit the next generation of manufacturers now.²⁵

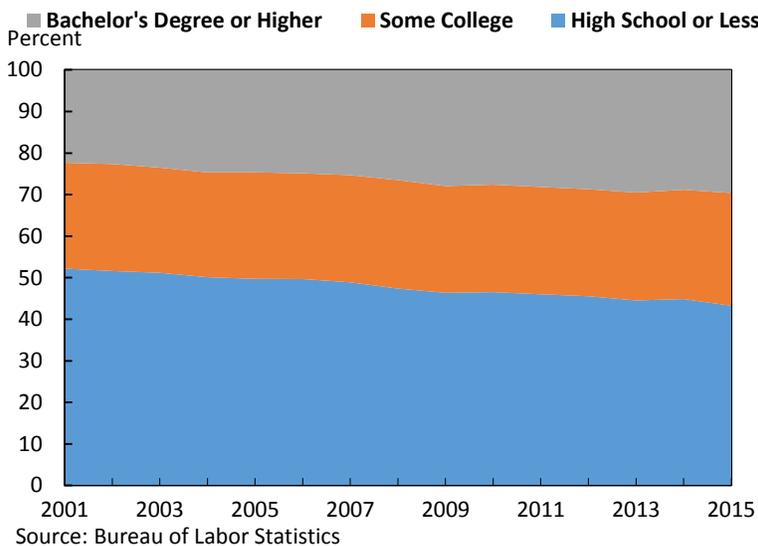
Manufacturing Day focuses on changing America's perception of the manufacturing sector, demonstrating what a career in modern manufacturing can look like for the next generation of America's workforce. Changing how the nation views the manufacturing sector is especially important given the high-tech nature of many of today's manufacturing careers. A high school diploma and a strong work ethic are no longer a guaranteed ticket to a middle-class career working on an assembly line. Over the past 15 years, the percentage of manufacturing employees with only a high school degree has dropped from 53% to 44% while the share with college or advanced degrees has jumped 8 points, a trend that is expected to continue.²⁶

²⁴ Deloitte and Manufacturing Institute perception survey; <https://www.mfgday.com/news/manufacturing-day-offers-insightful-onsite-experiences>.

²⁵ National Institute of Standards and Technology, *Making it in America*, March 2015.

²⁶ Bureau of Labor Statistics, Department of Labor.

Educational Attainment Among Manufacturing Sector Workers



In 2015, Manufacturing Day inspired factories, colleges, and cities to hold more than 2,600 manufacturing showcases across all 50 states, attracting more than 400,000 participants. 2015 marked the greatest number of events and highest participation rates yet, and we're aiming to beat those records this year for Manufacturing Day 2016.

[Pillar 3: Making the United States More Competitive for Production](#)

To attract investment and production, we must ensure that we are taking full advantage of our distinct capabilities while also ensuring that our business environment is properly recognizing the role that manufacturing plays. This Administration has focused efforts in four areas to ensure the United States remains the best place in the world to invest, grow, and hire: (i) reforming our broken business tax system to encourage investment at home, (ii) investing in infrastructure to lower the costs of moving goods, information, energy, and people, (iii) initiating regulatory reform to ensure that regulations that no longer serve their purpose are cleaned up, and (iv) ensuring safe and responsible production to take advantage of our domestic energy resources.

[Business Tax Reform](#)

Today, the U.S. corporate income tax combines a high statutory corporate tax rate with a tax base narrowed by loopholes and other tax preferences that creates an unfair playing field and distorts investment decisions. These factors disadvantage certain companies, including some manufacturing firms, relative to their domestic and international competitors, undercutting innovation and job creation.

The Administration has taken several important steps to support American manufacturers and boost innovation. For example, the December 2015 tax and budget agreement made permanent the research and experimentation tax credit for the first time since it was initially enacted in

1981, providing certainty to companies investing in innovation. Roughly 70 percent of this credit is utilized by manufacturing firms. In addition, the President has signed more than a dozen tax cuts for small businesses into law, including a significant, permanent increase in expensing for small businesses.

In 2012, the Administration put forward a comprehensive business tax reform framework that would strengthen U.S. manufacturing and innovation. The President's framework makes the tax code more competitive by lowering the corporate rate to 28 percent, broadening the tax base, eliminating dozens of inefficient loopholes and subsidies.^[i] The framework includes several critical policies to strengthen U.S. manufacturing, including expanding the domestic production activities deduction for manufacturing, effectively reducing the top tax rate on manufacturing to 25 percent. The framework also modernizes the international tax system to encourage domestic investment and increase the global competitiveness of U.S. firms, and it simplifies and expands the now-permanent research and experimentation tax credit to further encourage innovation.

[U.S. Infrastructure](#)

A quality infrastructure system helps manufacturers move goods to market quickly and keep costs down in order to stay ahead of global competition. Our infrastructure system used to be a source of distinct advantage, but without additional investment, it risks becoming a liability. Recognizing that a well-maintained and well-connected transportation infrastructure is critical to the success of manufacturing and many other industries, this Administration has taken steps to start rebuilding our infrastructure to bring it back to the world class position it once occupied.

While manufacturers have access to more than 4 million miles of public roads, more than 95,000 miles of freight railroad, and 5,100 public use airports²⁷, our transportation system is aging and poses a risk to future competitiveness for manufacturers. A World Economic Forum survey recently ranked the U.S. as 28th in the world in the quality of our infrastructure. And we continue to underinvest: in 2014, public spending on transportation and water infrastructure was only about 2.4 percent of GDP. Meanwhile, countries around the world are building for the future and investing higher levels of their GDP in infrastructure.

The Administration has made some progress, including recent meaningful steps to increase long-term investment in infrastructure. The Fixing America's Surface Transportation (FAST) Act signed into law this past December authorizes \$305 billion over fiscal years 2016 through 2020 for highway, highway and motor vehicle safety, public transportation, motor carrier safety, hazardous materials safety, rail, and research, technology, and statistics programs. While this is a step in the right direction, it is still only a modest increase over current levels of infrastructure investing.

Going forward, more and smarter investment needs to happen in our infrastructure system. The President has put forth a number of proposals – including the 21st Century Clean Transportation Plan – in order to meaningfully increase investments in our transportation and infrastructure.

^[i] Joint Report, The White House, Department of the Treasury, *The President's Framework for Business Tax Reform: An Update*, April 2016.

²⁷ Department of Transportation, Bureau of Transportation Statistics, 2016.

The Energy Opportunity

First, for the roughly one-fifth of U.S. manufacturing that is energy-intensive, low-cost reliable energy is important to continued competitiveness. U.S.-based manufacturers currently enjoy a competitive advantage from affordable natural gas. Once poised to be a major natural gas importer, the United States is now the number one natural gas producer in the world. The surge in American natural gas production has lowered energy costs for manufacturers and driven job growth, with U.S. natural gas costs one-half that of Europe and one-third that of Asia. Recent analysis estimates that industrial sector consumers of natural gas were better off by about \$22 billion between 2007 and 2013 due to abundant, inexpensive shale gas.²⁸ That is an important part of why companies have announced tens of billions in new capital commitments in energy-intensive manufacturing facilities that will come on line in the years ahead.

Second, the Administration has sustained and strengthened an environment that drives innovation across the energy space, with a focus on clean energy, an important and growing sector for U.S. manufacturing leadership. We've provided tax credits and loan guarantees that have supported wind and solar energy. We have financed more than \$8 billion in projects supporting 35,000 jobs to upgrade state-of-the-art assembly and manufacturing plants which have helped accelerate fuel-efficient vehicles production. As part of the American Reinvestment and Recovery Act, the Administration funded a carbon fiber testing facility that has played a significant role in advancing energy efficient materials manufacturing in the U.S. by cutting the cost of carbon fiber in half and reducing energy consumption in the manufacturing process by 60 percent. Also, through the establishment of Manufacturing USA the Administration supported the development of key technologies lightweight metals and flexible electronics that can help manufacturers save time and money while creating new industries centered on the most advanced manufacturing capabilities. We've also invested in producing existing energy sources responsibly – such as by investing in technologies that reduce emissions from coal-fired power. As a result of this full suite of investments, we have seen technology breakthroughs that have continued to keep energy costs down.

Regulatory Reform

An effective regulatory environment is one that carefully enables innovation and international competitiveness while protecting public safety, health, and the environment.

In an effort to create a more cost-effective, evidence-based regulatory system for the 21st century, in 2011 the Administration launched an unprecedented, government-wide review of existing regulations. As part of this “regulatory lookback,” agencies across the Federal government have completed over 800 retrospective review initiatives, achieving an estimated \$37 billion in cost savings and removing more than 70 notable regulatory provisions from the books.

The Federal government will need to continue to evaluate regulations based on their costs and benefits to continue to create an attractive and effective regulatory environment for businesses and manufacturers.

²⁸ Hausman, Catherine; Kellogg, Ryan. *Welfare and Distributional Implications of Shale Gas*. Brookings Papers of Economic Activity. March 2015.

Pillar 4: Opening Markets and Leveling the Playing Field

The Obama Administration has recognized that, for U.S. manufacturing to continue to compete globally, it is critical to ensure that trade agreements are enforced, that manufacturers of all sizes are able to access new markets at home and abroad, and that the United States continues to attract foreign direct investment. To set U.S. manufacturers up for success, this Administration has advocated for free and fair trade agreements to facilitate the movement of goods and services globally, we've brought multiple actions to the World Trade Organization to ensure our trading partners are playing by the rules, and we've catalyzed the flow of foreign direct investment into the U.S. through the SelectUSA program established just five years ago.

The Trans-Pacific Partnership (TPP)

Well-negotiated trade agreements are critical to protecting American jobs and manufacturers as well as helping expand our exports around the world. Manufacturing exports support more than 6 million jobs across the U.S. economy—and manufactured exports reached an all-time high of \$1.2 trillion in 2014, up by more than half since 2009. The competitiveness of American manufacturing is amplified by eliminating trade barriers. Securing trade agreements like the Trans-Pacific Partnership (TPP) that promote free and fair trade by eliminating tariffs, cutting red tape and streamlining customs gives American manufacturers access to rapidly growing global markets. Aiming to expand the global reach for U.S. manufacturers, TPP supports manufacturing jobs across the United States by creating a more competitive market environment in the Asia-Pacific region where U.S. manufacturing exports have historically been disadvantaged.

Exports have been a critical part of the recovery in manufacturing, and a strong manufacturing base is pivotal to continued growth, competitiveness and innovation across the U.S. economy. TPP covers nearly 40% of the world economy, opens markets for manufacturers, and eliminates 18,000 tariffs, including tariffs on all U.S. manufactured goods. TPP establishes rules to prevent other countries part of the trade agreement from maintaining, expanding, or creating new trade barriers to American manufacturers as they eliminate tariffs. TPP expands trade for knowledge-intensive industries, including advanced manufacturing, which plays to our strengths and ensures that in an age of global supply chains, U.S. products have the upper hand. TPP eliminates all foreign taxes in the form of tariffs on U.S. manufactured goods exported to TPP countries, including rates as high as 70 percent on automobiles in Vietnam. Beyond the advantages to U.S. exports and economic growth, expanded trade relationships deepens partnerships with allies and help ensure stability and national security.²⁹

Trade Enforcement

While trade opens up access to global markets to manufacturers, it's also critical that all countries play by the rules. To ensure fair, global competition for U.S. manufacturers, this Administration has made a strong trade enforcement regime a priority.

²⁹ Office of the United States Trade Representative, *Trans-Pacific Partnership Benefits for Manufacturing Fact Sheet*.

Since 2009, the Obama Administration has brought 23 enforcement cases at the World Trade Organization (WTO)—more than any other WTO member—achieving removal of barriers and increased export opportunities worth billions of dollars to American workers and firms. In February of this year, President Obama signed the Trade Facilitation and Trade Enforcement Act—or “customs” legislation—to add to and strengthen our ability to hold trading partners accountable. This legislation increases staffing at the Department of Commerce focused on enforcement, helps prevent foreign competitors from gaming the process in AD (antidumping) and CVD (countervailing duty) cases, and provides enhanced capabilities for CBP to better enforce and prevent evasion of these orders. Commerce and the U.S. Customs and Border Protection (CBP) are currently enforcing 350+ AD/CVD orders that address dumped goods or unfairly subsidized imports from foreign companies. Of these orders, 170 AD/CVD orders involve imports of foreign steel, representing nearly half of all cases.

Trade Enforcement: China and the Auto Industry

In 2014 the Obama Administration won a major trade enforcement case against China on behalf of U.S. auto manufacturers and the more than 900,000 American automotive industry manufacturing workers around the country, from Michigan to Ohio to California. In that case, the WTO agreed with the United States that China’s imposition of antidumping duties and countervailing duties on American-made cars and sport-utility vehicles (SUVs) breached numerous international trade rules. In 2013, the United States exported over \$60 billion of autos, with about 15 percent of the total, going to China. China is now the second largest export market for U.S. autos, after Canada. China’s unjustified duties, which ranged up to 21.5 percent, affected an estimated \$5.1 billion worth of U.S. auto exports in 2013, and were applied to well-known models such as the Jeep Grand Cherokee, Buick Enclave, Cadillac Escalade, and many others.

SelectUSA

President Obama established SelectUSA in 2011 as the first-ever government-wide Federal program to promote and facilitate job-creating business investment into the United States. Foreign direct investment (FDI) strengthens our economy by supporting good-paying jobs for millions of American workers, expanding our exports, and funding R&D. Attracting over \$348 billion in FDI in 2015, more than doubling from 2014, the United States is the top destination for foreign investment flows in the world.³⁰ SelectUSA provides services to international companies of all sizes and U.S. economic development organizations (EDOs), working across the Federal government. Since 2011, SelectUSA has helped facilitate more than \$22.8 billion of investments into the United States, supporting thousands of jobs and spurring economic growth.

³⁰ Bureau of Economic Analysis, *Foreign Direct Investment in the United States Balance of Payments and Direct Investment Position Data*. United Nations Conference on Trade and Development (UNCTAD), *Global Investment Trends Monitor No. 22*. January 2016.

The U.S. manufacturing sector continues to benefit greatly from FDI; nearly 70% of new FDI in 2015 and over one-third of jobs at U.S. majority-owned affiliates of foreign entities in 2014 were in manufacturing industries.³¹ Manufacturing employment at U.S. affiliates was 2.4 million in 2014, over 20% of all U.S. manufacturing employment.³² Reflecting growth across the manufacturing sector, new foreign investment in manufacturing totaled \$243 billion in 2015. As in 2014, manufacturing accounted for more than half of total new investment expenditures.³³ Recognizing the innovation occurring across U.S. manufacturing, over 70% of all foreign investment in R&D is concentrated in the manufacturing sector.³⁴

In 2016, the annual SelectUSA Investment Summit attracted the participation of over 2,500 participants from 70 markets around the world and every corner of the United States. Companies that participated in the second SelectUSA Summit in March 2015 have since announced at least \$5.5 billion worth of investments in the United States associated with over 9,480 jobs.

To highlight a few of the success stories coming out of the SelectUSA program:

- The 2015 SelectUSA Investment Summit catalyzed collaboration between Columbus 2020, a regional economic development group in Ohio, and the Sofidel Group. In July, 2016, Italy-based Sofidel Group broke ground on a new manufacturing facility in Circleville, Ohio. The 1.4 million square-foot facility is expected to create more than 300 jobs and the \$259 million commitment represents the largest private-sector investment in Circleville in decades.
- SATA, a family-owned manufacturer from Italy, recently announced that it would invest \$114 million in a machining operation that will create 300 jobs in the Brownsville region over a 10-year period. SelectUSA worked with the Brownsville Economic Development Council for the last two years to advocate for this investment. Additionally, due in part to foreign direct investment, the local unemployment rate has fallen from 12.2 percent to 6.7 percent.
- This past April, AB Group Packaging, based in Ireland, cut the ribbon on their first U.S. plant in Delaware. The company met local economic development officials at the 2015 SelectUSA Investment Summit. They plan to hire 87 workers to make shopping bags and tissue here in the United States for retailers like Nike, Vodafone, and Tommy Hilfiger.

³¹ Bureau of Economic Analysis, *New Foreign Direct Investment in the United States, 2014 and 2015*, July 2016. *Activities of U.S. Affiliates of Foreign Multinational Enterprises*.

³² Bureau of Economic Analysis, *Activities of U.S. Affiliates of Foreign Multinational Enterprises*.

³³ Bureau of Economic Analysis, *New Foreign Direct Investment in the United States, 2014 and 2015*, July 2016.

³⁴ Bureau of Economic Analysis, *Activities of U.S. Affiliates of Foreign Multinational Enterprises*.

APPENDIX

Appendix I: List of Manufacturing USA Innovation Institutes

- In Youngstown, OH, **America Makes**, the National Additive Manufacturing Innovation Institute – the first Manufacturing USA institute – is accelerating the adoption of 3D printing/additive manufacturing by developing and transitioning this suite of technologies to industry use, and by engaging in innovative partnerships to rapidly educate and train both the current and future additive manufacturing workforce.
- In Chicago, IL the **Digital Manufacturing and Design Innovation Institute (DMDII)** is pioneering technologies at the intersection of the digital universe and the factory floor connecting different parts of the manufacturing life cycle through data, to then utilize that information to enable manufacturers to make smarter, more informed and more competitive business decisions.
- In Detroit, MI, **Lightweight Innovations for Tomorrow (LIFT)** is developing advanced lightweight metals and related manufacturing technologies for industries where the U.S. has a traditional manufacturing advantage, such as the aerospace and automotive industries, that will enable the lighter, stronger, safer vehicles and airplanes of tomorrow.
- In Raleigh, NC, **PowerAmerica** is investing in the technologies and techniques to convert idle, existing U.S. silicon foundries over to the production of a new generation of advanced semiconductor materials that can shrink an electric vehicle recharging station from the size of a refrigerator down to a microwave, and increase power generation from, wind and other forms of clean energy.
- In Knoxville, TN, the **Institute for Advanced Composites Manufacturing Innovation (IACMI)** is pushing advanced composites down the cost curve to enable lightweight vehicles with record-breaking fuel economy, lighter, longer and stronger wind turbine blades to harness greater wind power, and high-pressure tanks for natural gas-fueled cars.
- In Rochester, NY the **American Institute for Manufacturing Integrated Photonics (AIM)** is taking the region’s more than 120 years of pioneering optical technologies into a new era by transiting out of the lab and into the marketplace innovations in photonics that can lead to faster computers, greater Internet capacity, improved night vision systems, and needle-less diagnostic tests for diseases like diabetes.
- In San Jose, CA, **NextFlex** is advancing next-generation flexible hybrid electronics manufacturing, and fostering U.S. leadership in manufacturing technologies from smart bandages to self-monitoring weapons systems to wearable devices.
- In Cambridge, MA, **Advanced Functional Fabrics of America (AFFOA)** is spearheading a fabric revolution through innovative fabrics and textiles that protect firefighters from the hottest flames, replicate the sensing capabilities of a smart watch

into a lightweight fabric, and have the ability to detect when a wounded soldier needs treatment.

- In Los Angeles, CA, the **Smart Manufacturing Innovation Institute**—the newest institute announced by the President in June 2016—will spur advances in smart sensors, smart products, and smart digital process controls that can work together to radically improve the efficiency of U.S. advanced manufacturing.

Forthcoming institutes include:

- ***Robotics in Manufacturing Environments Manufacturing Innovation Institute.*** In collaboration with the Department of Defense, this institute will focus on building U.S. leadership in smart collaborative robotics. Human collaboration with robots has the potential to change a broad swath of manufacturing sectors, from defense and space to automotive and health, enabling the reliable and efficient production of high-quality, customized products.
- ***Advanced Tissue Biofabrication Manufacturing Innovation Institute.*** In collaboration with the Department of Defense, the Institute will focus on next-generation manufacturing techniques for repairing and replacing cells and tissues. The Institute will focus on solving the cross-cutting manufacturing challenges that stand in the way of producing new synthetic tissues and organs. We expect collaborations across multiple disciplines; from 3D bio-printing, cell science, and process design, automated pharmaceutical screening methods to the supply chain expertise needed to rapidly produce and transport these live-saving materials.
- ***Modular Chemical Process Intensification (MCPI) Institute.*** In collaboration with the Department of Energy, the Institute will fundamentally redesign the process used for manufacturing chemicals, refining fuels, and producing other high-value products by combining many complex processing stages into one simple and streamlined step. Process intensification breakthroughs can dramatically shrink the footprint of equipment needed on a factory floor or eliminate waste by using the raw input materials more efficiently.
- ***Reducing Embodied Energy and Decreasing Emissions (REMADE) in Materials Manufacturing Institute.*** In collaboration with the Department of Energy, the Institute will focus on reducing the total lifetime use of energy in manufactured materials by developing new cradle-to-cradle technologies for the reuse, recycling, and remanufacturing of manmade materials. U.S. manufacturing consumes nearly a third of the nation's total energy use annually, with much of that energy embodied in the physical products made in manufacturing. New technologies to better repurpose these materials could save U.S. manufacturers and the nation up to 1.6 quadrillion BTU of energy annually, equivalent to 280 million barrels of oil, or a month's worth of that nation's oil imports.

- ***Industry-proposed Institutes Competition.*** Leveraging authorities from legislation passed with broad bipartisan support in Congress, the Department of Commerce has launched the first “open topic” institute competition. This competition is open to any topic proposed by industry not already addressed by a manufacturing innovation institute. At least one institute will be awarded using FY2016 funds, and one or more will be awarded subject to the availability of additional funds. The open topic competition design allows industry to propose technology areas seen as critical by leading manufacturers to the competitiveness of U.S. manufacturing.

Appendix II: Investing in Manufacturing Communities Partnership – 24 Designated Communities

➤ **First Round Designated Communities**

- Southwest Alabama, led by the University of South Alabama
- Southern California, led by the University of Southern California Center for Economic Development
- Northwest Georgia, led by the Northwest Georgia Regional Commission
- The Chicago metro region, led by the Cook County Bureau of Economic Development
- South Kansas, led by Wichita State University
- Greater Portland region in Maine, led by the Great Portland Council of Governments
- Southeastern Michigan, led by the Wayne County Economic Development Growth Engine
- The New York Finger Lakes region, led by the City of Rochester
- Southwestern Ohio Aerospace Region, led by the City of Cincinnati
- The Tennessee Valley, led by the University of Tennessee
- The Washington Puget Sound region, led by the Washington Department of Commerce
- The Milwaukee 7 region, led by the Redevelopment Authority of the City of Milwaukee

➤ **Second Round Designated Communities**

- The Greater Pittsburgh Metals Manufacturing Community led by Catalyst Connection in Pittsburgh, PA
- The Alamo Manufacturing Partnership, led by the University of Texas at San Antonio in the San Antonio, TX metro area
- The Louisiana Chemical Corridor led by Louisiana State University, stretching from New Orleans, LA to Baton Rouge, LA
- The Madison Regional Economic Partnership (MadREP) in the Madison, WI region
- The Made in the Mid-South Manufacturing Alliance led by the Greater Memphis Chamber spanning nine counties in surrounding Memphis, TN
- The Greater Peoria Economic Development Council leading a five county region in central Illinois
- The Minnesota Medical Manufacturing Partnership led by GREATER MSP in Minneapolis, MN
- The South Central Idaho region led by the Region IV Development Association in Twin Falls, ID
- The Utah Advanced Materials and Manufacturing Initiative led by the University of Utah in the Wasatch Front region
- The Pacific Northwest Partnership Region, led by Business Oregon in Oregon and Southwest Washington

- The Connecticut Advanced Manufacturing Communities Region, a four county area centered on Hartford, Connecticut, is led by the State of Connecticut Department of Economic and Community Development
- The Central Valley AgPlus Food and Beverage Manufacturing Consortium led by California State University in Fresno and the Sacramento Community