

Dow Pennsylvania

# **Advanced Manufacturing Plan**



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### Policies and Recommendations to Support and Grow Pennsylvania Manufacturing

The goal of the Pennsylvania Advanced Manufacturing Plan is to provide an overview of the issues that impact manufacturing in Pennsylvania and ideas to support and grow the manufacturing industry.

With approximately 15,000 manufacturing establishments and more than half a million high-wage careers, manufacturing currently is the second largest contributor to Pennsylvania's gross state product. Although the state has made great strides over the past several years, it is clear Pennsylvania needs a progrowth strategy that includes a strong talent base, competitive tax system, streamlined regulatory structure and high-quality transportation infrastructure to attract and retain manufacturers. With the right plan and a steely focus on growing the state's manufacturing base, Pennsylvania has the opportunity to build on its strengths and improve existing laws to spur job growth and encourage investments, such as public-private partnerships that advance new ideas to solve pressing policy challenges. Our Advanced Manufacturing Plan for Pennsylvania provides a window into what is possible when committed companies, communities and policymakers join efforts to build a sound foundation for manufacturers and create a brighter, more prosperous future for all Pennsylvanians.



### **Energy Policy** Overview

Advanced manufacturers such as Dow operate at the apex of energy and manufacturing, and need sound energy policy to remain globally competitive. As the global population grows and incomes rise, the demand and competition for energy will dramatically increase. The challenges presented by this growth in energy demand must be met head on, and states must play a critical role. With strategic investments and an eye to the future, we believe Pennsylvania can be a leader in developing a comprehensive energy policy that balances economic and environmental concerns, and moves the country toward a sustainable energy future. Pennsylvania's energy production is as diverse as it is robust. According to the Energy Information Administration (EIA), the state ranks among the nation's leaders across many sectors: total energy production (4th), natural gas production (2nd), coal production (4th), net electricity generation (2nd), and electricity generation from nuclear power (2nd). Pennsylvania's electricity generation is highly dependent on traditional sources. According to the Pennsylvania Public Utility Commission (PUC), roughly 40 percent of the state's electricity is generated from coal, 35 percent from nuclear, 19 percent from natural gas, and just 4 percent from alternative and renewable sources. Pennsylvania's energy costs have been declining over the past five years, with average wholesale electricity prices dropping more than 40 percent. However, current residential and industrial prices are still above the national average.

Pennsylvania is a national leader in energy production and ranks amongst the highest producing states across several sectors, including natural gas (2nd), coal (4th), and nuclear power (2nd). Affordable energy is a key to economic growth, and sound energy policy can strengthen the economy and increase and diversify supplies, all while minimizing the impact on the environment. At Dow, we believe the future of energy is connected to innovative technologies and materials from chemistry, and that energy policies at all levels of government should focus on four fundamental principles:

- 1. Conserve by aggressively pursuing energy efficiency
- 2. Optimize, increase and diversify domestic hydrocarbon resources
- 3. Accelerate the development of cost-effective clean energy alternatives
- 4. Transition to a sustainable energy future

Dow's efforts are critical to transition to a sustainable energy future, but we cannot do it alone. Fully transitioning to a sustainable energy future requires focused government action that optimizes today's resources while promoting innovation to develop the next generation of energy production and storage.





# **Energy Policy** Energy Efficiency

Energy is a key enabler of economic growth. However, we as a society waste far too much of it. As such, energy efficiency remains critical to meeting the U.S.'s growing energy demands. The cheapest, cleanest and most abundant energy is the energy we never use, and energy efficiency is generally the simplest and most affordable way to reduce energy demand and the emissions that result from burning fossil fuels.

The National Petroleum Council found that available energyefficiency technology applied to residential and commercial buildings would reduce energy use 15 to 20 percent, and yet our nation's building industry continues to lag behind other sectors in effective policies that drive significant energy savings. Dow has long been a leader in industrial energy efficiency. Since 1990, we have reduced our energy intensity by 40 percent, saving 5,200 trillion Btu, and as part of our 2015 Sustainability Goals we have pledged a further 25 percent reduction. If the U.S. implemented a similar economywide goal, the country would save the Btu equivalent of all of its oil imports from the Middle East. The state needs to take the lead in developing policy and investing in programs to encourage energy efficiency across all sectors of the economy, with particular focus on commercial and residential building construction. The building sector is the largest consumer of energy, and regularly updating and strengthening state building codes to encourage efficiency will help reduce Pennsylvania's demand for energy and accelerate the transition to a low-carbon economy.

According to the American Council for an Energy-Efficient Economy's 2013 State Energy Efficiency Scorecard, Pennsylvania ranks 19th in the U.S. in energy efficiency.

#### **Building Codes**

Pennsylvania has been a national leader in energy-efficient building practices and was one of the first states to adopt the 2009 International Codes. Updated building codes do more than simply increase energy efficiency – they drive structural, electrical and mechanical improvements that enhance safety and make buildings perform more effectively across all sectors of the construction industry. Delays in adopting code updates will affect building safety and energy efficiency in Pennsylvania well into the future.

Every three years the International Code Council (ICC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) develop, approve and publish a series of model building codes for potential use by state governments.

These model codes are updated through a collaborative process of the nation's leading experts in energy efficiency, building design and product performance professionals, state and local governmental officials, product manufacturers, architects, and builders, including representatives from Pennsylvania. The updated codes reflect the latest advances in building products, science and construction practices that states can adopt and implement.

In Pennsylvania, the Uniform Construction Code Review and Advisory Council (RAC), a 19-member group appointed by the governor, is in charge of reviewing the latest ICC codes and recommending to the governor, the legislature and the Department of Labor and Industry what should be adopted. Homeowners whose homes were built under the 2012 International Energy Conservation Code (IECC) would experience a 26.8 percent reduction in energy costs as compared to homes built under the 2009 IECC, according to the U.S Department of Energy.

Recent legislative changes have made it more difficult to adopt updated energy-efficiency codes and building practices. Previously, new codes were automatically adopted and the RAC made recommendations on what should be excluded. In 2011, legislation was passed requiring a two-thirds super majority vote from the RAC in order to update statewide building and energy codes. This law places veto power in the hands of industry groups, who make up one-third of the RAC and hold firmly to the belief that new codes are too costly and burdensome and should not be adopted. The current RAC process discourages adopting new energy-saving technologies, which negatively affects economic growth, the economy and the environment.

In January 2012, the latest year for code renewal, the RAC did not meet the two-thirds majority required to update the 2009 International Energy Conservation Code (IECC) to the new 2012 standards, in either full or partial form. Many of the updates include non-energy building improvements such as mechanical, fuel, fire and plumbing standards, and the concern is that a two-thirds majority consensus will be very difficult to achieve in the future.

Outdated building and energy codes stand to leave Pennsylvania behind compared to other states that pursue and adopt modern, efficient and safe building code standards. The adoption of uniform and recommended standards by the ICC and ASHRAE is imperative to provide consumers and corporations with energy savings, improved safety and increased building performance for years to come.



According to a U.S. Department of Energy analysis, homes built in Pennsylvania to the 2012 IECC would save homeowners an average of \$8,632 over the first 30 years, compared to homes built to the 2009 IECC.

Updated building codes would also reduce energy consumption as residential homes built to the 2012 IECC would use 28.6 percent less energy than homes currently being built to the 2009 IECC. Lowering energy usage reduces the need for new generation sources and lowers energy costs for consumers.

Many of the innovative products needed to achieve greater energy efficiency are manufactured in Pennsylvania. Updated building codes that result in greater energy-efficiency measures being adopted will have a direct economic impact in the state.

#### Cogeneration

Advancing integrated cogeneration for the industrial sector is another key way to encourage energy efficiency. According to the EPA, the average efficiency of fossil-fueled power plants in the U.S. is 33 percent. By putting the wasted heat to use, combined heat and power (CHP) is estimated to offer thermal efficiency between 60 and 80 percent. As noted in Pennsylvania's State Energy Plan, there are currently 135 CHP installations in the state with a generating capacity of 3,276 MW.

#### Act 129

The Pennsylvania General Assembly enacted Act 129 in 2008, requiring the PUC to adopt energy-efficiency and conservation programs to reduce energy demand and consumption by each of the state's electric distribution companies (EDC). Act 129 required the state's seven largest EDCs to reduce electricity consumption by 1 percent by May 2011 and by 3 percent by May 2013, and to achieve a 4.5 percent reduction in peak demand by May 2013.

According to the FY 2012-2013 PUC Annual Report, all but one EDC met the consumption reduction requirements in 2011. The PUC undertook phase two of its implementation plan in FY 2012-2013 by setting new required incremental reductions in consumption and participating EDCs began implementing the new reduction plans in 2013.

#### The Solution

- Enhance policies to increase the use of CHP and waste heat recovery in the industrial sector.
- Regularly update and strengthen state building codes to ensure large-scale energy savings through efficiency in new building construction. Additionally, policies should promote efficiency upgrades in existing buildings and homes.
- Develop a process for automatic adoption of noncontroversial building code updates. Any code update not receiving public comment calling for modification or rejection should be considered non-controversial, and therefore "deemed adopted." Such a process would give the RAC flexibility to focus its limited time and resources on code updates about which there are legitimate concerns from stakeholders.
- Strengthen the code adoption process by ensuring that the adoption of new codes does not weaken energy-efficiency codes, and that energy-efficiency experts have representation on the RAC.
- Encourage energy efficiency as a strategy to reduce greenhouse gas emissions.
- Collaborate with stakeholders to establish innovative and effective energy-efficiency financing mechanisms for residential and consumer buildings.



# **Energy Policy** Optimizing Hydrocarbons

As we seek to transition to a low-carbon, sustainable economy, hydrocarbon resources will continue to play a significant role in meeting growing energy demands until cleaner energy technologies can be brought online at scale.

Hydrocarbons provide critical feedstock for the manufacturing of products and solutions that drive economic growth and innovation. These resources enable many of the products that advanced manufacturers such as Dow make to help move us closer to a low-carbon, sustainable future, including photovoltaics, wind turbine blades and energy-saving insulation.

#### Natural Gas

Advancements in the recovery of unconventional shale gas are powering a manufacturing resurgence in the U.S., resulting in billions of dollars of new investment and thousands of jobs. These abundant supplies of unconventional natural gas will be an important resource for the U.S. over the coming decades, and Dow supports environmentally responsible methods of bringing these resources to market. According to the EIA, Pennsylvania produced 3.3 trillion cubic feet of unconventional gas in 2013, a 62 percent increase from 2012, making it the second largest gas-producing state in the country. In fact, natural gas production has increased in Pennsylvania every year since 2005. Pennsylvania's annual natural gas production increased 62 percent from 2012 to 2013 and has increased every year since 2005. Pennsylvania is now the second largest natural gas producing state in the U.S.

Pennsylvania has more than 32 trillion cubic feet of proven natural gas reserves, according to the EIA, most coming from the Marcellus Shale. Continued development of the Marcellus Shale also resulted in Pennsylvania having the largest net increase in natural gas proven reserves of any state in 2012. In addition to the Marcellus Shale, the Pennsylvania Department of Environmental Protection's 2013 Oil and Gas Annual Report notes there is increased interest in the exploration and production of the Utica Shale, and to a lesser extent, the Rhinestreet, Huron and Devonian shale formations.

Low natural gas prices are benefiting consumers. The Pennsylvania PUC found in 2012 that average natural gas costs dropped 50 percent from 2007 to 2012, saving residential customers \$85 a month in energy costs. As a result of the production boom and associated cost reduction, new power generation capacity in the state is expected to favor natural gas, mainly at the expense of coal. Fully optimizing the state's natural gas resources is important as Pennsylvania currently depends on natural gas for 19 percent of electricity-generating needs and 38 percent of home-heating needs.

As a result of continued development of the Marcellus Shale, Pennsylvania had the largest net increase in natural gas proven reserves of any state in 2012.

Natural gas prices have been historically low over the past few years, making gas more competitive with coal for power generation. As more generation is shifted to natural gas, it is critical to avoid any measure that drives increased demand for natural gas without assuring ample supply is available. Fluctuations in natural gas prices can have significant negative impacts on manufacturing. When prices are high and volatile, manufacturing suffers. With a once-in-a-generation opportunity to fuel a manufacturing rebirth, it is critical to avoid any missteps that would derail growth, including bans or restrictions on hydraulic fracturing, incentivizing fuel switching, subsidies that accelerate demand for natural gas vehicles, regulations that force rapid conversion of coal-fired power plants to natural gas, and policies that prioritize exports over domestic competitiveness.

#### Liquefied Natural Gas (LNG)

Abundant supplies and low domestic prices have led producers to look for opportunities to liquefy natural gas and export it to overseas markets where prices are considerably higher. Dow believes in a balanced approach to LNG exports that supports overall exports and domestic investment, while maintaining a robust supply of stably priced gas for domestic use. Supply imbalance, which occurs when demand exceeds available supply, drives up prices and forces manufacturers to scale back production. Although production may resume when the imbalance has been corrected, the price volatility ultimately leads to job loss in the manufacturing sector and harm to the overall economy.



To grow its economy and create jobs, Pennsylvania should use its abundant natural gas supplies to further develop its manufacturing sector instead of exporting it as LNG. There is an advantage to the economy to use abundant natural gas supplies to export value-added products rather than exporting the gas overseas to be burned for fuel. According to a 2013 analysis by Charles River Associates, the \$90 billion of gas-intensive manufacturing investments will contribute twice as much GDP, more than eight times the amount of permanent jobs, and more than four times the amount of construction jobs relative to exports at the same level of gas consumption.

#### Coal

There is no doubt that coal will continue to play a major role in meeting growing energy demands until cleaner energy technologies can be brought online at scale. Pennsylvania was the fourth largest coal-producing state in the country in 2012 and is the only state to still produce anthracite coal, which has a higher heat value than other kinds of coal.

Coal accounted for 40 percent of the state's fuel mix in 2012, but by 2015, announced and expected coal-fired power plant retirements in the state will reduce generation capacity by 4,820 MW and could decrease further due to new EPA regulations. While the proportion of power generated from coal is declining, coal remains the largest energy source for electricity generation. Exploring sustainable uses of coal will grow more important in the coming years because of its large share of generation and its importance to the Pennsylvania economy.

#### The Solution

- Enhance policies to ensure continued affordable access to the vast source of natural gas located in the Marcellus Shale, and encourage further development of other shale plays, including the Utica Shale.
- Develop clear, science-based policies to resolve environmental, regulatory and other uncertainties in public opinion around use of the hydraulic fracturing process.
- Promote the development of a robust natural gas pipeline infrastructure to effectively transport abundant natural gas supplies to higher-demand regions.
- Avoid adopting policies that artificially accelerate natural gas demand ahead of supply.
- Encourage and accelerate the adoption of available water treatment technologies, especially those for fracturing water recycling and reuse



### **Energy Policy** Renewables

A core component of any plan to transition to a clean energy future is to reprioritize government support and policy to accelerate the development of effective and more sustainable energy sources and next-generation energy storage capabilities. Dow believes that any comprehensive energy plan must recognize the critical role renewable energy sources will play in a more sustainable energy future. According to the National Renewable Energy Laboratory, renewable electricity generation from currently available technology, when combined with a more flexible electric system, is capable of supplying 80 percent of total U.S. electricity in 2050.

According to the EIA, Pennsylvania ranks 17th in the country in net renewable electricity generation. The state ranks 9th in the nation for total solar capacity. Its total installed wind capacity is 15th best in the nation, and new capacity wind installations ranked 9th in 2012, according to the American Wind Energy Association. Additionally, wind could provide up to 6.4 percent of Pennsylvania's current electricity demand, according to the National Renewable Energy Laboratory. Pennsylvania currently ranks in the top 10 in the nation for total solar capacity but is the only major state to see its solar residential market shrink year-over-year. Various financial incentives led to a quick build-out of Pennsylvania's solar capacity, but a lack of funding and a steady decline in the price of State Renewable Energy Credits slowed development. The Pennsylvania Sunshine Program, which provided \$100 million in rebates to help fund solar projects for homeowners and businesses, exhausted all of its available funds in November 2013 and is now unable to provide additional rebates. Property owners and business owners have become reluctant to adopt solar technology because of the lack of financial incentives.

Pennsylvania is one of 31 states to adopt a form of a renewable portfolio standard (RPS), which is known in Pennsylvania as the Alternative Energy Portfolio Standard. Under the state's Alternative Energy Portfolio Standards, a percentage of all electricity sold at retail must be generated from alternative energy sources. The standard is implemented on a 15-year scale and calls for 18 percent of electricity to be generated from renewable sources by 2021.



To meet the requirements, 8 percent of the energy must come from Tier 1 resources (solar thermal, wind, hydropower, geothermal, methane, fuel cells, biomass, and coal mine methane), including a 0.5 percent solar requirement, and 10 percent must come from Tier II (by-products of pulping, wood manufacturing, waste coal, distributed generation systems, demand-side management, large-scale hydropower, municipal solid waste and integrated combined coal gasification) resources. The alternative energy standard is implemented through a tradable credit system, under which obligated entities submit certificates of compliance that they either earned directly or purchased from another provider.

As of 2014, hydro plants power the most electricity out of all renewable sources in Pennsylvania. However, most of the state's hydroelectric facilities are older, and some have been in operation for more than 50 years. Overall, Pennsylvania currently generates 2.3 million megawatt hours of energy from hydro sources with wind following at 1.9 million megawatt hours.

Policies to advance clean energy development in Pennsylvania should focus on boosting research and development while preventing energy prices from rising too high. Advanced manufacturers are the ones that will be developing the next generation of clean energy technology. Innovation is already making alternative and renewable energy solutions more efficient and affordable. Fully transitioning to a sustainable energy future will take further collaboration between policymakers and innovative advanced manufacturers. Advancing renewable energy sources is critical for energy security, economic growth and environmental sustainability throughout the country. Pennsylvania has the capacity to accelerate the development of effective renewable sources of energy and, in doing so, could set itself apart as a leader in advanced manufacturing.

#### The Solution

- Explore innovative financing structures to encourage greater adoption of renewable technology.
- Utilize public-private partnerships to enhance research and development opportunities.
- Incentivize greater adoption of renewable technology through a reformed Pennsylvania Sunshine Program or a similar initiative.



### **Innovation and Research & Development (R&D)**

#### Overview

Innovative ideas from world-class research and development centers are the backbone of a strong advanced manufacturing industry and produce substantial economic benefits for the region and nation. Pennsylvania is home to many manufacturing research centers, and its university system contributes to a strong and vibrant research environment. When manufacturers and universities create research partnerships, the impact is even more evident. In 2011, Dow announced that it would partner with 11 of the nation's leading universities, investing a total of \$25 million over 10 years to strengthen research capabilities in traditional scientific fields and re-energize the manufacturing industry. The company currently partners with two institutions in Pennsylvania – Pennsylvania State University and Carnegie Mellon University. At Penn State for example, Dow awarded more than \$1 million in research grants to investigate flexible and printed electronics, along with \$200,000 for chemical linguistic analysis.

#### Partnerships

Public-private partnerships provide a promising avenue to promote science, technology, engineering and math (STEM) education and solve commercial and manufacturing challenges. The regional manufacturing industry and the State of Pennsylvania should work to create policies that enable these partnerships to flourish. One of the state's successes in this area has been its Discovered in PA, Developed in PA (D2PA) program, aimed at supporting innovative and job-creating ideas, the commercialization of new technologies and enhancing Pennsylvania's global competitiveness. In its two-and-a-half-year existence, the program has taken significant strides to promote STEM education and strengthen the state's natural gas and manufacturing industries.

Two successful examples of grants provided by the D2PA program illustrate how the program is being used to further Pennsylvania's advanced manufacturing renaissance:

- Carnegie Mellon's Institute for Complex Engineering Systems received a sizeable grant for the Research for Advanced Manufacturing in Pennsylvania program, or RAMP, to help researchers at the Oakland campus and at Lehigh University connect with the state's manufacturing industry through grants of \$25,000 to \$60,000 and 12- to 18-month partnerships.
- Innovation Works received a grant that will fund the next round of the Technology Commercialization Initiative, which it recently took over, to help early-stage companies and university-based projects build prototypes to land investment.

Discovered in PA, Developed in PA had a budget of nearly \$9 million in the fiscal year, that ended June 30, 2014.

#### **Regional Impacts**

The state's manufacturing profile tends to vary by region, with no one manufacturing sector representing more than a small percentage of Pennsylvania's overall manufacturing output. This indicates a highly diversified sector that can attract investment and spur innovation across a spectrum of industries, including energy, pharmaceuticals, chemicals, coal, steel, heavy equipment manufacturing and others. Shell is considering building an ethane cracker plant 30 miles northwest of Pittsburgh that could employ several hundred people and create up to 10,000 construction jobs. In order to retain the significant economic benefits for the area, Governor Corbett approved a \$1.7 billion tax break for the project.

The manufacturing industry in western Pennsylvania is primarily focused on the natural gas trapped in the Marcellus and Utica shale formations, and recent breakthroughs in extraction technology have led a number of large producers and refiners to invest in the area and take advantage of low prices.

Pennsylvania is also well positioned to capitalize on the first of many National Network for Manufacturing Innovation (NNMI) "America Makes" institutes in Youngstown, Ohio, which is a partnership of nearly 100 companies, non-profits and academic institutions focused on the transformative manufacturing technology of additive manufacturing (or 3-D printing). This partnership should be optimized and leveraged to foster manufacturing growth outside of natural gas-related activities.





Dow and The Advanced Manufacturing Partnership The Advanced Manufacturing Partnership was created in 2010 by the White House and the U.S. Department of Commerce to identify and tackle the most pressing challenges facing the American manufacturing sector. The group is comprised of university and college presidents, CEOs from the nation's most successful manufacturing firms and federal government policymakers. It is co-chaired by Andrew Liveris, president and CEO of The Dow Chemical Company, and Dr. Rafael Reif, president of Massachusetts Institute of Technology. One of its central recommendations was the creation of the National Network for Manufacturing Innovation (NNMI) to accelerate the commercialization of transformative technologies in advanced manufacturing through regional hubs – public-private partnerships called Institutes for Manufacturing Innovation (IMIs). Over the span of 10 years, President Obama has proposed building out NNMI to encompass 45 IMIs.

The central and eastern regions of Pennsylvania provide the natural resources and intellectual capital to support industries such as coal and steel, whose extraction and processing requires cutting-edge technologies, and advanced manufacturing sectors such as pharmaceuticals, chemicals and information technology services. Pennsylvania is the fourth leading coal-producing state, mining 68 million tons in 2013. The Pennsylvania mining industry constitutes a major source of employment and tax revenue. Last year, it created 49,100 direct and indirect jobs with a total payroll in excess of \$2.2 billion. About 75 percent of Pennsylvania's annual bituminous coal production goes to the electricity utility sector, making its production vitally important for a competitive U.S. manufacturing sector, as well as the local manufacturing base. As environmental standards have tightened on the use of coal, technological innovation in production methods and on the consumption side have followed. Additionally, the combination of coal and natural gas resources provided by Pennsylvania companies is fueling the U.S. manufacturing renaissance by providing competitively priced energy to energy-intensive industries like steel and chemicals, and low-cost raw materials to companies like Dow.

In spite of the reputation of a declining U.S. steel industry, it is still responsible for generating more than \$9.35 billion in business revenue per year for Pennsylvania.



York, Pennsylvania, has long been known as the manufacturing epicenter of the East Coast, if not the United States. Huge companies keep plants in York to produce everything from potato chips to Harley-Davidson motorcycles. Companies such as Boeing, Honeywell and ExxonMobile are frequent customers of a York-based manufacturer that uses steel to produce baskets that are used for everything from ultrasonic cleaning to waste disposal. Pharmaceuticals and chemicals are a key growth and innovation industry predominantly in the southeastern region of Pennsylvania. In fact, the state's institutions, medical facilities, universities and companies have attracted more than \$2 billion in federal research funds. The biotechnology industry has also taken root in the area, with hundreds of start-up companies vying for a piece of a booming sector.

Manufacturers' 2010 Pennsylvania R&D expenditures totaled about \$2,953.6 million. This is an aggregate growth rate of 131.5 percent over 2001 Pennsylvania R&D expenditures of \$1,275.9 million. Between 2001 and 2010, the Pennsylvania R&D expenditures for state taxpayers grew at a compound annual growth rate of 9.8 percent.

#### Access to Capital

Manufacturers need access to capital across all stages of the business lifecycle to achieve and sustain a healthy financial position. Access to capital is critical to ensure stability and flexibility that meet ever-changing market demands. Accessing capital is a complex business growth strategy for companies and requires detailed analysis to match the most appropriate type of capital to individual business needs.

#### The Solution

- Expand programs aimed at fostering in-state innovation in manufacturing.
- Support a pro-growth tax policy that attracts large-scale investment in advanced manufacturing projects. These projects not only create direct manufacturing careers, but also support product and technology innovation and job growth in the nearby service sector.
- Provide clear policy enablers to encourage the manufacturing industry to collaborate with academic institutions. This could include funding for additional IMIs or similar shared facilities, or provisions to protect intellectual property when it is jointly created.
- Leverage nearby IMIs and other organizations such as Manufacturing Extension Partnerships (MEPs) that promote advanced manufacturing with partnership opportunities and information-sharing.
- Provide greater access to information, tools and training tailored to the unique needs of manufacturers on the types of capital available, access and uses. Some of this information is available to Pennsylvania manufacturers already, and more will be available through federal programs as a result of the work of the Advanced Manufacturing Partnership.



# Tax Policy

#### Overview

With a gross domestic product of more than \$600 billion annually, Pennsylvania represents the 20th largest economy in the world, according to the Pennsylvania Department of Community and Economic Development. Despite having a large economy built on a proud manufacturing legacy and diverse natural resources, its uncompetitive tax structure is among the most pressing challenges in the state, constricting job creation and stunting manufacturing growth.

To aggressively compete for manufacturing jobs and improve the state's economic future, the state must take concrete steps if it is to lead the nation in policies that attract investment, spur innovation and create a more prosperous Pennsylvania for generations to come.

#### The Need

Although Pennsylvania's overall business tax climate ranks as 24th best in the nation, according to the Tax Foundation, some specific business tax provisions rank the state near the worst in the country. Pennsylvania must specifically reduce its second-highest-in-the-nation corporate tax rate, fully eliminate the Capital Stock and Franchise Tax, maintain or increase its R&D tax credit, and improve Net Operating Loss rules that are important to chemicals, coatings and plastics industries.

#### **Corporate Tax Rate**

According to the Tax Foundation, Pennsylvania lags behind other states in creating a competitive tax environment for advanced manufacturing to thrive. Pennsylvania's corporate income tax system consists of a flat rate of 9.99 percent, which ranks as the second highest marginal tax rate in the country, while imposing the highest corporate rate in the nation because of unique taxable base adjustments. To make matters more complicated, the state's tax revenues are overly dependent on corporate taxes, which can create inconsistent and volatile revenue streams, forcing the state to revise tax policies and making it more difficult for businesses to plan.

#### Net Operating Loss Carryforward (NOL)

While NOL provisions are important to emerging innovation companies, they are just as important to the state's existing manufacturers. Many states and the IRS allow companies to deduct 100 percent of NOLs in the following profitable year, which allows corporations to even out tax liabilities related to swings in profits and losses.

Many states allow companies to carry NOLs three years back and 20 years forward. Pennsylvania does not permit a carryback of losses, and while it provides for a 20-year carryforward, Pennsylvania is only one of four states that limit annual utilization of NOLs. Pennsylvania presently limits the use of NOLs to the greater of \$4 million or 25 percent of taxable liability per year, with limits of \$5 million and 30 percent expected in the near future. In either case, the NOL rules are simply uncompetitive.



#### Capital Stock and Franchise Tax (CSFT)

To improve the competitiveness of manufacturers in Pennsylvania, efforts to fully eliminate the CSFT must stay on track. Many states base their corporate tax rate on assets or income, but Pennsylvania taxes both. With 20 other states levying a similar tax, Pennsylvania ranks in the upper 50 percent for the burden it imposes on business activity. As long as the CSFT remains in effect, it will continue to make Pennsylvania uncompetitive for manufacturers and future investment, according to the Tax Foundation.

#### **R&D Tax Credit**

The R&D tax credit is important to many innovation companies and is key to an advanced manufacturing future in the state. The R&D tax credit has become an increasingly provisional element of the state's tax structure, which harms a manufacturer's ability to predict policy and creates uncertainty when attempting to grow and bring jobs to the state. If Pennsylvania does not have a competitive R&D incentive, the state risks the loss of existing high-value R&D jobs as well as future jobs. Other states understand the important effect incentives have for attracting and maintaining R&D jobs. Pennsylvania should follow suit.

#### The Solution

- Reduce the corporate tax rate to increase the state's competitiveness and ability to attract advanced manufacturing.
- Consider broadening the tax base to include pass-through entities such as partnerships, limited liability corporations and S corporations.
- Follow Pennsylvania's neighbors and eliminate caps on NOL utilization.
- Continue the phase out of the uncompetitive CSFT and avoid new tax policies on manufacturers that would seek to replace the revenue by a different name. Alternatively, require taxpayers to pay the higher of the franchise tax or income tax as a means to stabilize revenues.
- Maintain and make permanent an R&D tax credit that manufacturers can count on when planning to locate or expand operations in Pennsylvania.



### **Regulatory Reform**

Today, U.S. manufacturing facilities are required to comply with a large amount of data collection, reporting and other regulatory requirements. In many cases, these regulations are vital and have contributed significantly to making our nation's workplaces the safest and our environment among the cleanest in the world. However, regulations not grounded in science or lacking a convincing analysis of benefits versus costs are altogether different. For example, some environmental regulations do little to improve or protect our air, water and sensitive lands, but still impose severe economic burdens on manufacturers. Where this is the case, the cost of compliance can be a major hindrance to the expansion of manufacturing, and penalties for the slightest infraction, even where there is no intent of harm, can be significant. We seek a proper balance that maximizes the effectiveness of both regulation and innovation. We recognize that effective and smart regulations are vital to protecting our environments. At the same time, success in the marketplace and profitability provide companies the capacity to hire outstanding workers and invest in innovative solutions. Regulations must therefore provide more flexibility for operations and reduce the burden of compliance, while continuing to protect people and the environment. Of equal importance, regulations must not create ambiguity and uncertainty. In Pennsylvania, the recent State Supreme Court ruling on Act 13 has raised serious concerns about the economic impact to development projects throughout the state. The court's decision and expansive interpretation of the Environmental Rights Amendment undermines the legislature's position as the authority for balancing the state's environmental and economic interests. By countering this position, the court has effectively created a system in which development projects could be subjected to different environmental or natural resource management rules and regulations in every local jurisdiction in the state, creating much ambiguity and uncertainty for these projects.

Regulations must also be streamlined to align with relevant existing rules on the state and federal level. In Pennsylvania, a recently proposed rule from the Department of Environmental Protection (DEP) to amend Additional RACT Requirements for Major Sources of NOx and VOCs (25 Pa. Code Chapters 121 and 129) could benefit from several modifications to take into account industry experience with implementation time frames and benefits already achieved from the implementation of established federal regulatory programs.



#### The Solution

As part of its long-standing commitment to Responsible Care®, Dow strives to protect the health and safety of employees, communities and the environment. Dow believes that well-conceived, science-based and effectively implemented regulations are important tools for protecting our work spaces and environment. Done right, they also ensure American industry retains the capacity to operate and innovate, thereby bolstering the economy and the nation's workforce.

Below are some recommendations aimed toward a smarter and more effective regulatory environment that fosters efficiency, productivity and job growth.

- Ensure that regulations/statutes orient toward performance standards rather than prescriptive, rigid requirements, thereby allowing industry to be creative and develop the most efficient method of meeting the intent of the regulation.
- Agencies should work more collaboratively with industry in the regulatory development phase to ensure that better, more implementable standards are developed.
- Where applicable, different agencies need to harmonize and simplify rules, especially where there is overlap in jurisdiction.
- Enhance benefits to self-reporting and implementation of management systems.
- Increased regulation must be based on a transparent and reproducible cost-benefit analysis that demonstrates net benefit to human health and/or the environment.
- Any new requirements should be benchmarked against other states to ensure that Pennsylvania remains competitive for businesses.

The Competitive Enterprise Institute estimates that Americans paid a grand total of \$1.863 trillion in federal compliance costs for 2013. If the costs of regulation are completely passed through to consumers, each household pays nearly \$15,000 a year in hidden regulatory costs. That constitutes nearly a quarter of the average household income before taxes and is higher than any other expense outside of housing.



# **Transportation Infrastructure**

#### **Overview**

The efficient, safe and secure movement of people and goods is a key driver of economic growth. Yet there are consistent and significant barriers to the transportation infrastructure system, both nationally and at the state level.

Maintaining Pennsylvania's diverse transportation infrastructure is a significant challenge to the state. The Pennsylvania highway system is comprised of 40,000 state miles of roads, ranking it as fifth largest in the nation for state-owned highways. Truck traffic in Pennsylvania is almost twice the national average and the state's severe winters can cause significant damage to roads and bridges. The state also maintains one of the busiest inland ports in the nation in Pittsburgh, and 260 miles of inland waterways that require dredging, lock maintenance and continued investment to remain competitive. In November 2013, Governor Corbett signed Act 89 into law, which will advance plans for a \$40 million to \$60 million rehabilitation project to begin in 2015 and will provide \$2.3 billion annually for infrastructure. To fund projects, the bill included annual 5 percent increases to the state's gas tax for the next five years.

The comprehensive transportation package was an unprecedented step toward upgrading Pennsylvania's infrastructure. However, it is estimated that some issues may not be addressed until 2019. Additionally, simply maintaining the system as it is today, combined with necessary improvements, requires more funding than is currently available. In addition to those challenges, a recent study by Interstate Natural Gas Association of America (ICF International) indicates that due to increased energy consumption and growth in shale oil production, North America will require approximately \$30 billion a year in midstream infrastructure investments. With Pennsylvania's large shale deposits, a significant portion of this new infrastructure need will fall to the state to manage.

The 2014 American Society of Civil Engineers (ASCE) Report Card for America's Infrastructure awarded Pennsylvania's infrastructure a grade of C-, unchanged from 2010.

#### Roadways

Pennsylvania's roadways carry 34 percent more goods across the Commonwealth than the average state, making it that much more critical that roads and bridges can stand up to superior performance. According to the American Society of Civil Engineers 2013 Infrastructure Report Card, 5,540 of the 22,669 bridges in Pennsylvania (24.4 percent) are considered structurally deficient and 4,370 of the 22,669 bridges in Pennsylvania (19.3 percent) are considered functionally obsolete. In addition, 57 percent of Pennsylvania's roads are in poor or mediocre condition, and driving on roads in need of repair costs Pennsylvania motorists \$2.947 billion a year in extra vehicle repairs and operating costs – or \$341 per motorist. Contributing to this problem is the lack of historical focus from past federal infrastructure programs on performance-based measurements or on achieving long-term sustainable economic growth. Pennsylvania will prosper with the implementation of a national infrastructure program that identifies a sustainable funding strategy with clear objectives, and that prioritizes infrastructure needs and investment by the greatest benefit and impact to economic growth.

Pennsylvania's roadways carry 34 percent more goods across the Commonwealth than the average state.



#### Freight Rail

Since the mid-1800s, rail transportation has been the centerpiece of industrial production and energy movement, and Pennsylvania is a critical component of the national distribution and infrastructure network. Pennsylvania is one of the nation's leaders in freight planning and investment, given the state's long and colorful industrial history. Pennsylvania's rail lines include some of the highest volume routes in the nation, such as the Norfolk Southern (former Pennsylvania Railroad) main line connecting Philadelphia, Harrisburg and Pittsburgh, and extending ultimately to Chicago. This line carries more than 120 million gross tons (MGT) annually. Another important trunk line is Amtrak's Northeast Corridor, a portion of which passes through southeastern Pennsylvania, including Philadelphia; some freight is moved on this predominantly passenger rail corridor.

With more than 5,100 miles of rail currently in use, Pennsylvania has the fifth largest rail network by mileage and leads the nation in the number of railroads per state. The Pennsylvania Rail Network accounts for 10 percent of all freight tonnage and 13 percent of all carloads in the United States. A number of benefits result from using rail freight to move goods throughout the U.S., particularly on longer routes, including reduced congestion and better air quality, less truck traffic on highways and greater economic development. Railroads are the safest and most cost-efficient mode for transporting hazardous materials, coal, industrial raw materials and large quantities of goods.

Rail projects that could be undertaken to address the Commonwealth's infrastructure needs total more than \$280 million. Annual state-of-good-repair track and bridge expenditures for all railroad classes within the Commonwealth are projected to be approximately \$560 million.



According to the 2014 Report Card for Pennsylvania's Infrastructure, three of the key freight rail priorities are:

- Physical infrastructure and bridge needs: Approximately 170 bridges, representing approximately 60 percent of those in both short and long lines, are in need of repairs and will cost an estimated \$1 million apiece.
- Choke points: There are about 45 rail traffic choke points throughout the state.
- Ability to handle heavy loads: With few exceptions, the short line and regional railroads are capable of handling the heavier loads on only 70 percent of their infrastructure.



#### The National Gateway Project

The National Gateway Project is an \$850 million public-private partnership (P3) that will upgrade tracks, equipment and facilities, and provide doublestack intermodal clearance. P3 provided \$35 million in investment in 17 clearance projects in southwest Pennsylvania. One of the 17 projects includes the J&L Tunnel project, located in Pittsburgh. This project will provide vertical clearance along the CSX rail lines through the Tunnel to allow trains carrying double-stack containers. After the completion of the J&L Tunnel, which will improve access to the intermodal freight shipping options, there will be a decrease in the cost of doing business in and around the Pittsburgh region, as well as a decrease in pressure on regional highways.

CSX is exploring ways that the National Gateway Project can connect the ports in Virginia and North Carolina with manufacturing centers in the Midwest. CSX estimates the project will provide more than \$650 million in public benefits to Pennsylvania. The Pennsylvania Department of Transportation (PennDOT) has historically funded rail freight infrastructure using several successful tools:

- The Rail Freight Assistance Program (RFAP) Capital Budget Grants for doublestack projects (freight containers that are stacked two high on rail cars) and clearance projects. RFAP was created by the Commonwealth's Rail Freight Preservation and Improvement Act of 1984, No. 119, which provides funds to preserve essential rail freight service and stimulates employment through generation of new or expanded rail freight service.
- PennDOT also established the Pennsylvania Infrastructure Bank (PIB) for rail freight projects and provided \$500,000 in initial seed capital to kick-start a program that provides low-interest loans to railroads and shippers for their use on railroad infrastructure projects. The PennDOT Freight Bureau periodically adds funds to PIB. Also, the Bank slowly grows its funding, because when payments are made with interest, it is able to provide a new loan with its slightly increased funds.

- PennDOT is beginning to utilize other funding programs such as the Congestion Mitigation Air Quality (CMAQ), TIGER funding and various grants through the FRA.
- Pennsylvania's Department of Community and Economic Development (PADCED) administers several economic development loan and grant programs that assist rail infrastructure expansions, including the Infrastructure and Facilities Improvement Program, the Tax Increment Financing Guarantee Program.

In recent years, the state has had successful outcomes with public-private partnerships for maintenance and improvement of rail infrastructure. Use of public funds to leverage private funding through a P3 is one method of financing where there are both public and private benefits.



Pennsylvania's Conrail double-stack project of the 1990s is a prime example of a successful P3, in which the state funded \$35.8 million of the \$100 million project. There are several other Pennsylvania projects now under consideration or which have been recently completed, including a \$30 million public/private initiative to improve 16 bridges in southeastern Pennsylvania to accommodate double-stack trains, and a project to improve the railroad's Philadelphia Navy Yard Intermodal Facility by doubling the size of the rail yard. The investment is part of Norfolk Southern's multistate Crescent Corridor Initiative, aimed at establishing a high-speed intermodal rail-freight route between the Gulf Coast and the Northeast.

#### Ports and Inland Waterways

Pennsylvania's inland waterway infrastructure, which connects the Commonwealth to the national waterway system, was built over the last 150 years. Many of its locks and dams are in a severe state of disrepair due to lack of maintenance and capital improvements funding over several decades. The grade of D+ reflects the fact that none of Pennsylvania's navigation dams and only 18 percent of the locks have a "satisfactory" condition assessment rating, and delays at the most degraded facilities are frequent. While the American Recovery and Reinvestment Act (ARRA) funding provided a much-needed boost to construction and operations and maintenance budgets, the ongoing and significant federal funding limitations have greatly delayed completion of major rebuild projects. A catastrophic failure within the inland waterway system, like any major infrastructure failure, would have serious effects on the industries that rely directly on river transport of heavy bulk commodities.

#### Western Pennsylvania

The U.S. Army Corps of Engineers (USACE) owns, operates and maintains approximately 200 miles of navigable waterways and 17 navigation locks and dams on the Ohio, Allegheny and Monongahela rivers in western Pennsylvania, a large piece of a critical infrastructure network. In 2012, the Port of Pittsburgh was the second busiest inland port in the nation and the 17th busiest port of any kind. At 35 million tons of cargo per year, it accounted for 50 percent of the Commonwealth's waterborne commerce and supports more than 200 river terminals and barge industry service suppliers. The life and success of the Port is directly dependent on the efficient operation of the navigable waterway transportation system. Funding constraints have caused the USACE to conduct critical maintenance work in small, fundable pieces; at the current funding rate, completion of these projects may take 10 years or more.

#### Eastern Pennsylvania

The facilities on the navigable portions of the Delaware and Schuylkill rivers in Pennsylvania are an integral part of the Ports of Philadelphia (Pennsylvania), Camden (New Jersey) and Wilmington (Delaware). The Delaware and Schuylkill river navigation channels are sea-level channels with no locks or dams and can accommodate sea-going vessels.

Potential failure of the navigation dams at Elizabeth and Emsworth are of particular concern. These dams have been given the worst rating possible by USACE inspectors, and their failure would result in loss of the navigation pools that they create. Failure of these dams would cause a complete halt of barge traffic through those stretches of river for an extended amount of time.



According to the American Society of Civil Engineers 2013 Infrastructure Report Card, Pennsylvania's ports handled 90.8 million short tons of cargo in 2009, ranking it 8th in the nation.

Pennsylvania has 260 miles of inland waterways, which support 45,000 direct jobs and more than 200,000 total jobs, according to independent studies.

#### **Pipeline Infrastructure**

Not only does Pennsylvania meet its own demand for natural gas, it also sends excess natural gas out of the state. New pipeline infrastructure is being built to transport Marcellus gas to interstate natural gas pipelines. Pennsylvania also has one of the largest natural gas storage capacities in the nation.

According to the FY 2012-2013 PUC Annual Report, natural gas production in the Marcellus and Utica formations is being hindered by insufficient pipeline infrastructure. The report projects that the additional infrastructure development needed to serve the major Pennsylvania portion of the Marcellus Shale would cost nearly \$2.4 billion and would result in 275 miles of new pipeline capacity. If fully realized, the new pipeline capacity could allow an additional 3.7 billion cubic feet per day of natural gas to be transported to market.

To fully capitalize on its vast natural gas resources, Pennsylvania needs to continue to develop a robust pipeline and storage infrastructure to effectively move excess quantities to higherdemand markets.

#### The Solution

- Define a long-term infrastructure funding strategy.
   Implementation of a long-term transportation infrastructure funding strategy that defines a clear objective, prioritizes infrastructure needs and investment by greatest benefit and impact, and places economic growth at the forefront will allow Pennsylvania to gain the most economic benefit from increased roadway use.
- Facilitate an environment for infrastructure investment. Infrastructure investments with significant economic impact will help drive industry growth, especially within the advanced manufacturing sector in Pennsylvania. There are several key pieces of the funding puzzle, and all should be considered to improve the level of investment in critical projects.
- Recognize the connection between railroads and highways as projects are prioritized. Rail investments will shift the freight balance away from long-haul trucks in high-traffic corridors, reducing congestion and extending the life of interstate roadways in this region.
- Support multi-modal transportation and coordinate planning efforts. Cities and communities should not be short-sighted concerning freight planning and should also look at statewide and regional planning to maximize their own intermodal options.
- Enable further investment and improvements in Pennsylvania's natural gas, road, rail, electricity, water and sewer systems through the use of public-private partnerships to enhance the state's economy as a regional gateway.
- Modernize rail freight infrastructure. Support rail modernization efforts to keep Pennsylvania's rail network efficient and safe, as well as advance state funding appropriations for existing freight rail projects.
- Continue to weigh in with federal delegation to promote effective Water Resources Reform and Development Act (WRRDA) legislation to fund the operation, maintenance and rehabilitation of the Western Pennsylvania inland waterway system appropriately.



### **Education and Workforce Development**

#### Overview

The extent and quality of STEM education levels is a matter of national concern. Because STEM education begins at the pre-school level and extends through elementary, secondary and post-secondary education, Dow believes that a comprehensive integrated approach provides the best path to ensuring a steady stream of STEM talent to help build the future of advanced manufacturing and innovative solutions.

STEM jobs are indeed the basis for a successful, globally competitive U.S. economy as well as a competitive Pennsylvania. Getting students interested early on in pursuing STEM careers and ensuring they receive a high-caliber STEM education will be critical to filling these roles. Experts project that approximately 259,000 STEM and STEM-related jobs need to be filled in Pennsylvania by 2020, representing an 11 percent increase in STEM jobs this decade. The majority of these jobs will be in computer-related and mathematical science, engineering and technician roles. Enhancing the quality of and access to science and technology at all levels of education will enable Pennsylvania's citizens to compete globally for high-paying jobs. Further, as these jobs get more technical, there will be an increased need for workers with some form of postsecondary education. According to the Georgetown Public Policy Institute, in Pennsylvania, 63 percent of all jobs by 2020 will require some form of postsecondary education, with 29 percent requiring an associate's degree or a vocational certificate, 22 percent requiring a bachelor's degree, and 11 percent requiring a master's degree or higher. These percentages are even higher for STEM-related jobs. Thus, in addition to high quality education in STEM subjects in K-12, students must be offered different pathways for careers in STEM.



When it comes to K-12 and workforce development, Pennsylvania has made strides on several fronts:

- In terms of K-12 education, the state has posted improvements in student performance in both math and science since 2003 and has reduced its high school dropout rate.
- The state has also introduced improved standards in algebra, literature and biology that outline the essential concepts students must master to graduate high school with the skills to succeed in college and career training programs, and has aligned its state exams to these standards. The state has also focused on improving the quality of teaching and introduced a new teacher evaluation system that incorporates multiple measures, including student achievement.
- The state launched the Labor & Industry Advisory Council on Advanced Manufacturing in 2009, with a mission to develop long-term strategies aimed at preventing and reversing the decline of local manufacturing jobs.
- The U.S. Department of Labor also partnered with the Pennsylvania College of Technology and Westmoreland County Community College to implement ShaleNET, a multi-state network launched in 2010. The network focuses on widespread recruitment, training, placement and retention programs for occupations in the natural gas drilling and production industry.
- The state also works to identify potential leaders through the Governor's School for the Sciences. The school selects more than 50 of the state's brightest incoming high school seniors to spend five weeks at Carnegie Mellon University for an intensive learning program in STEM-related courses including biology, chemistry, computer science, math and physics. According to the Department of Energy 2014 State Energy Plan, 100 percent of alumni from the program entered college, and nearly 90 percent pursued jobs in STEM fields.
- The state has also reinvented its Career and Technical Education (CTE) system to ensure that graduates of these programs have much stronger communication, critical thinking, collaboration and creative skills than ever before.
- In March 2014, the governor launched JOBS1st PA Regional Partnership Grants to develop employee training programs across the state. The grants support the governor's "Talented Workers" initiative, which includes funding for online training programs, such as WEDnetPA, and online sites for job seekers, such as JobGateway<sup>SM</sup>.



#### **Dow's Actions**

As a manufacturing company concerned about finding the STEM talent needed to stay competitive, Dow has supported STEM programs in communities around the world.

Across the United States, Dow's education initiatives showcase our commitment to education as we collaborate with teachers to provide professional development and cutting-edge teaching and curriculum resources. Further, by promoting and funding programs that focus on STEM education, Dow has been able to help demonstrate for students the excitement, challenge and reward that careers in these fields can offer. The following are some examples of Dow's actions in Pennsylvania and the tristate area, as well as nationally:

Philadelphia Science Festival – The Philadelphia Science Festival is a nine-day, community- and regionwide celebration of science that takes place annually in April, featuring lectures, debates, hands-on activities, special exhibitions and a variety of other informal science education experiences for people of all ages. Organized by The Franklin Institute and presented by Dow, the 2014 Festival had 200 partners and nearly 90 educational events, and was attended by more than 55,000 people.

- **Delaware Valley Science Fairs** Through a partnership with Delaware Valley Science Fairs (DVSF), Inc., Dow supports the 13 regional fairs in Delaware, Southern New Jersey and Southeastern Pennsylvania as well as the Delaware Valley Science Fair. DVSF is a non-profit entity partnering with and located at Drexel University. It is now also one of the largest and oldest fairs in the country. The fairs were designed as a vehicle for stimulating interest in STEM among students in middle and high schools in the tri-state area. The philosophy behind the fairs is that students learn science by doing science. Dow's involvement consists of providing volunteer judges, a board member and financial support.
- Philadelphia Math and Science Coalition Coordinated by the Philadelphia Education Fund (PEF), and supported by Dow, this collaborative and city-wide STEM stakeholder community coordinates resources that help prepare all Philadelphia public school students to become productive citizens in a 21st century STEM economy. In addition, Dow and PEF offer classroom grants of up to \$1,000 to enhance math or science classroom instruction to certified K-12 math and science teachers in the Philadelphia District and charter schools.
- Bristol and Spring House Community Advisory
  Council STEM Grants The Community Advisory
  Councils (CAC) and the Dow CAC Grant have supported innovative and impactful initiatives designed to prepare the next generation to be passionate innovators in STEM.
  In 2013, \$30,000 CAC STEM Grants were awarded to Bristol Township School District's Educational Advancement Fund and the North Penn Valley Boys and Girls Club.
- Smithsonian Science Education Academies for Teachers –Through our partnership with the Smithsonian Science Education Academies for Teachers, Dow supports the professional development of K-12 science educators in communities where Dow has a presence.
- National Science Teachers Association Dow is also a sponsor of the National Science Teachers Association's (NSTA) prestigious Robert H. Carleton Award for National Leadership in the Field of Science Education and supports teacher training as well as science education materials. Through the NSTA academy, Dow has funded the yearlong training and mentorship of more than 500 new science teachers across the United States since 2011.

#### The Solution

Dow applauds Pennsylvania for its efforts to improve its educational system, to raise student achievement and to connect students to in-demand career pathways. Because results from improvement efforts will take time and perseverance to materialize, the state can benefit from putting in place a well-defined plan for workforce development and addressing the skills gap.

We urge state and district policymakers and other key stakeholders to:

- Ensure that the state's improved K-12 standards assess not only content mastery, but also "inquiry" competence skills required for a 21st century workforce, including problemsolving, critical thinking and data-based argumentation.
- Make investments in public education a top priority and implement a funding formula that takes into account the demographics of both students and communities.
- Continue to focus on improving the high school dropout rate, particularly in struggling districts such as Philadelphia.
- Ensure that vocational curricula are aligned with industry needs through on-the-job training, internships and partnering with local manufacturers.
- Develop an educational system with multiple career and academic pathways to enable improved student access to a wide range of post-secondary education opportunities.
- Expand the Pell Grant Program and state grant programs to include more post-secondary programs.
- Provide adequate funding for CTE programs, community colleges and other relevant programs, so that more high school students are allowed to take college courses and/or career and technical courses.
- Continue developing partnerships among government, academia and industry focused on creating the workforce of the future with an emphasis on workforce training and retraining.
- Consider partnerships with and incentives for industry to develop and offer apprenticeship programs.
- Build a positive image and perception of advanced manufacturing as a dynamic, creative and rewarding profession.

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