

Plastic and Composite Intensive Vehicles (PCIVs): An Innovation Platform for Achieving National Priorities

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Imagine a world where safe, personal transportation is assured, where advanced technologies enable vehicles to run with virtually no tailpipe emissions, and where the transportation sector has become a success story for reducing carbon and other emissions rather than a prime contributor to this global challenge. The U.S. plastics and automotive industries are not just imagining this world—they are working toward it. Plastic and composite-intensive vehicles (PCIVs) represent one transformation needed in today's automotive industry to create the energy efficient vehicles and sustainable transportation infrastructure of tomorrow.

Nation at a Crossroads

The United States faces serious challenges. It is struggling with the worst economic downturn since the Great Depression and is hemorrhaging jobs. The nation consumes nearly 13 million barrels of imported oil each day, much of it supplied by countries with vastly different political ideologies. Energy prices are increasingly volatile and likely to continue rising over the long term. Widespread recognition of the reality and threats of global climate change is driving nations to curb carbon emissions.

What is a PCIV?

Today's average U.S. light vehicle contains about 330 pounds (150 kg) of plastics and composites— about 8% of total vehicle weight but more than 50% of vehicle volume. A plastic and composite intensive vehicle can be defined as a vehicle that contains a minimum of 30% (by weight) of lightweight plastics and composite content in one or more subsystems beyond interior trim.

In breadth and depth, transportation is fundamental to these issues. The automotive industry—the largest U.S. manufacturing industry—is among the hardest hit sectors of the economy amidst this recession. More than 230,000 U.S. automotive industry jobs have been lost between April 2008 and April 2009, almost 10% of the 2.4 million jobs that are directly attributable to the U.S. automotive industry and its suppliers.

The transportation sector is not only critical to the economy, but also the nation's energy use. The sector accounted for almost 30% of total U.S. energy use in 2007. Despite biofuels and other alternative fuel initiatives, nearly 98% of that energy is derived from petroleum. In fact, two-thirds of our nation's petroleum is consumed in transportation, with much of it imported from countries like Saudi Arabia, Venezuela, Nigeria, Iraq, and Russia (all among the top 10 oil-supplying countries to the United States). Nearly 28% of U.S. greenhouse gas emissions are generated from transportation, the second-largest source after power generation.

Advantages of PCIVs

- Sourced from strong U.S. chemical manufacturing industry
- Improved global competitiveness of U.S. automakers (technology & jobs)
- Reduced dependency on foreign oil
- Lower carbon & other emissions
- Increased sustainability through renewable materials, end-of-life recovery and recycling options
- Leapfrog fuel efficiency requirements
- Lower vehicle weight while maintaining size
- Enhanced crash safety

Meanwhile, despite decades of vehicle safety improvements and declining rates of injury and death, nearly 2.5 million people were injured, 41,059 fatally, in motor vehicle accidents in 2007 in the United States.

In challenging situations such as these, there is often tension between opposing forces. For example, increasing CAFE standards proposed by the Obama administration could advance fuel efficiency at an estimated cost of \$1,300 per vehicle, at a time when many Americans cannot afford the added cost. Technology breakthroughs are often the key to alleviating such tensions by making possible that which was seemingly impossible.

The PCIV Global Solution

Innovative approaches are urgently needed to address these complex challenges. PCIVs offer a transformational innovation platform away from traditional materials that marries higher functionality with superior design flexibility, thereby reducing energy consumption, lowering emissions, and reducing dependence on foreign oil. Lightweight vehicle structures paired with advanced powertrains, such as hybrid electric or full electric systems, will enable maximum energy efficiency, safety, and consumer choice. As a result of their lighter weight, plastic and composite materials offer a significant net savings in overall petroleum use and reduced greenhouse gas emissions over the lifecycle of a vehicle.

Plastics and polymer composites have enabled some of the most significant vehicle safety innovations in the past several decades, such as seat belts, air bags, and child safety seats. The same source of these innovations still holds significant untapped potential to further enhance vehicle safety. Furthermore, using plastics to reduce vehicle weight and improve safety will help to revitalize a beleaguered U.S. automotive industry by leveraging the strength of the U.S. chemicals industry, where the U.S. retains global leadership.

Plastics and composite materials are not only critical for improving the fuel efficiency of traditional vehicles through lightweighting, but also for enabling transformational innovation. Advanced lightweight materials and design capabilities, when combined with advanced battery and electric powertrain technologies along with a reinvented and revitalized manufacturing base, are essential if we are to realize the promise of plug-in hybrid electric vehicles (PHEVs) and other advanced vehicle concepts that promise to break our dependence on foreign oil.

Expanded Public Private Partnerships to Advance PCIVs are Needed Now

Many of the challenges we face today are too complex and multifaceted for any single company, government agency, or country to solve on its own. Climate change, energy security, economic stability, sustainability, and safety are shared responsibilities that require collective resources and action. We must harness the resources and talents of industry, government, academia, and citizens to develop innovative and practical solutions to these pressing problems. To be successful, we must also adopt new collaborative strategies that align all stakeholders with common goals and enable each participant to pursue actions that best fit their capabilities, business environments, missions, and resources.

Public-private partnerships have been used successfully throughout government to achieve national goals that are aligned with business interests. Under the leadership of the Plastics Division of the American Chemistry Council (ACC), plastics manufacturers have partnered with the automotive industry, their suppliers, the U.S. Department of Energy (DOE), the National Highway Traffic Safety Administration (NHTSA), and researchers in universities and national laboratories to develop innovative solutions to meet the transportation needs of the 21st century.

Working closely with partners across the automotive industry, ACC's Plastics Division has recently tapped some of the nation's best minds to create a forward-looking industry Roadmap that offers a strategic framework for realizing PCIVs through an innovation platform that is already emerging. *Plastics in Automotive Markets Technology Roadmap: A New Vision for the Road Ahead* builds on several years of productive collaboration among the plastics and automotive industries, university researchers, the U.S. Department of Energy (DOE), and the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA) to advance automotive plastics technologies. The industry's Roadmap recommends several key action priorities needed in the next 10 years to fully realize the substantial benefits that PCIVs promise.

In parallel, since 2006 the plastics industry has worked with auto and safety experts to conduct a "deep dive" to determine how plastics can be used to enhance safety in automobiles. Congress recognized the importance of enhanced automotive safety by investing nearly \$2 million over four years into building an ongoing partnership between the plastics industry and the National Highway Traffic Safety Administration (NHTSA). Through this partnership, NHTSA has initiated and is currently implementing *A Safety Roadmap for Future Plastics and Composites Intensive Vehicles*.

The partnerships launched through these Roadmaps are having a profound impact on shaping research on lightweight materials, automotive design, predictive engineering, automotive safety, environmental performance, and advanced manufacturing systems. Significant successes have already been achieved. Over the past three years, ACC has worked with several government agencies to improve predictive engineering tools for reliably modeling the performance of plastic and composite material components.

Two Roadmaps for PCIVs

Plastics in Automotive Markets Technology Roadmap: A New Vision for the Road Ahead is an industry-led Roadmap developed by ACC that outlines the industry's action priorities for achieving the technology and manufacturing innovations required to realize PCIVs.

A Safety Roadmap for Future Plastics and Composites Intensive Vehicles is a government-led roadmapping initiative under the direction of NHTSA to focus efforts on a holistic safety-centered approach to PCIV innovation.

Through these initial collaborations, the plastics industry is helping to pioneer more efficient and effective research and development strategies within the Federal government. One example is the industry's efforts to build stronger links between basic science and applied R&D by facilitating a relationship between DOE and the National Science Foundation in the area of predictive engineering. Breakthrough research into automotive safety issues at NHTSA through the Volpe Center offers another excellent example of the plastics industry working closely with Federal agencies to leverage government R&D resources with those of the plastics and automotive industries to benefit all stakeholders and the nation.

A PCIV Innovation Platform Has Emerged

The PCIV innovation platform is focused on creating an integrated and collaborative automotive value chain to enhance vehicle performance and benefits through the innovative use of plastics. To do so, the plastics and automotive industries must support development of infrastructure capabilities necessary to gain the full value of plastics in vehicles. Specific research is needed to:

- improve the understanding of composite component response in vehicle crashes
- develop a database of relevant parameters for composite materials
- enhance predictive models to avoid costly overdesign

By committing to fully implement the PCIV innovation platform, industry, government, and academia will be working together to deliver the technology advances needed to address critical energy and environmental issues facing the nation while strengthening the U.S. manufacturing base and associated jobs creation and U.S. science and technology leadership globally.

NHTSA Leadership

Now is the time to establish a strong national commitment to innovative, sustainable transportation under fresh leadership from NHTSA. NHTSA is in a unique position to lead the Federal government's PCIV efforts. NHTSA holds both the responsibility and authority for establishing and promulgating Federal motor vehicle safety standards and fuel economy requirements for all vehicles. To fulfill this responsibility, NHTSA must have complete access to vehicle technologies in order to conduct rigorous cost-benefit analyses that inform its rulemaking actions.

As PCIVs are developed, demonstrating the safety, feasibility, and practicability of these vehicles is essential. Due to the light weight of the PCIV, it is crucial that NHTSA experts have a leadership role in investigating not only the traditional crashworthiness systems for the vehicle as it interacts with the fleet and the roadside, but also in investigating and understanding the unique handling and stability characteristics of the PCIV to confirm its safety while being driven in the highway environment. Furthermore, NHTSA has transitioned its research program to include integrated safety—the coupling of pre-crash safety systems with

post-crash systems in order to optimize safety performance. A strong leading role in PCIV development for NHTSA will ensure that the PCIV program is kept in step with these developments.

NHTSA can also engage other needed partners from other government agencies. For example, in response to climate change and oil consumption concerns, NHTSA and the U.S. Environmental Protection Agency announced on May 19, 2009 that they will work in coordination to propose standards for fuel economy and control of greenhouse gas emissions. NHTSA can also call upon the DOE expertise as needed in areas where DOE can bring unique contributions in vehicle lightweighting to the PCIV program. Such expanded partnerships were envisioned by Congress in directing NHTSA to undertake initial PCIV safety roadmapping activities.

The Road to Success

Much has been accomplished. Careful planning, strong partnerships, and focused research programs have laid the groundwork for an aggressive program to drive automotive innovation here in the United States through plastic and composite intensive vehicles. Such innovation will have a global impact. Now is the time for an aggressive, sustained national commitment to realizing PCIVs and the benefits they promise consumers and society. This commitment can form a critical component of a broader National strategy to address today's pressing economic, energy, environmental, and public health challenges.

A significant national investment in PCIV-enabling research, development, design, testing, and commercialization supports a larger U.S. strategy to invest in science and technology in an effort to solidify its global leadership in science and engineering expertise.

Through the combined efforts of the plastics and automotive industries, government, and academia, PCIVs are forming an innovation platform that plays a vital role in driving the

automotive industry to higher performance, safety, and sustainability levels while making meaningful contributions to critical national priorities in 2020 and beyond.

Revolutionizing the Automobile Through Plastics and Composite Intensive Vehicles

Reducing Energy Use	Mitigating Climate Change	Reducing Oil Imports	Improving Vehicle Safety	Stimulating Economic Recovery
<p>Plastic and composite components can offer similar performance at 50% lighter weight than traditional materials.</p> <p>Every 10% reduction in vehicle weight improves fuel economy by seven percent.</p>	<p>By improving fuel economy, plastics help to avoid greenhouse gas emissions. Each gallon of gasoline saved through lightweighting avoids 20 pounds of CO₂ emissions.</p> <p>In use, plastics help to avoid 20 million tons of CO₂ emissions each year.</p>	<p>In use, plastics reduce energy demand during the life of the fleet, saving 88 million barrels of oil equivalent each year.</p>	<p>Motor vehicle accidents injure more than 2.5 million people each year and are the leading cause of death among people 15-24 years old.</p> <p>Experts agree that future PCIV structural composites with high energy absorption have potential to enhance crash safety.</p>	<p>Becoming the world leader in PCIV technology and manufacturing will create highly valued manufacturing jobs that will remain in the United States.</p> <p>Further, such “green collar” jobs help the environment, due to the energy efficiency and low emissions associated with PCIVs.</p>