American Chemistry Council | Plastics Division

Plastics and Polymer Composites
TECHNOLOGY ROADMAP
for Automotive Markets

EXECUTIVE SUMMARY

Now more than ever, the automotive industry is under increasing pressure to meet higher fuel efficiency, environmental, and performance demands at competitive costs. Plastics and polymer composites provide the weight savings, strength, and versatility the automotive industry needs.

Arguably the most influential force in the North American automotive market is the joint Corporate Average Fuel Economy (CAFE) standards set by the National Highway Traffic Safety Administration and the U.S. Environmental Protection Agency, which set emissions and miles per gallon (mpg) requirements for model year 2025 vehicles to more than 50 mpg. This rapid mpg increase, combined with ever-present consumer demand for better performance and appealing styling at an affordable price, has the automotive industry searching for ways they can cost-effectively drop more and more weight from vehicles while maintaining quality and safety.

All materials industries—plastics and polymer composites as well as steel, aluminum, and magnesium—are working to respond to the automotive industry's changing needs. For example, the steel industry claims that advanced high-strength steel (AHSS) will provide weight-saving improvements at an incremental cost of $0.30 per pound of weight saved, an estimate by steel producer ArcelorMittal that has yet to be validated by the automotive value chain. Combined with the ability to be produced with existing high-volume manufacturing infrastructure, AHSS is gaining use in the automotive world, albeit largely as a replacement material for conventional steel. Most auto industry forecasts also predict significant growth in the use of aluminum as a lightweight material. Clearly, the metals industries are pursuing innovation targeting the automotive market.

The plastics and polymer composites industry has a long track record of delivering strong performance and continues to pursue transformative innovations. One material class that promises such opportunity is high-performance polymer composites. In addition to potential innovative aerodynamic design and styling aesthetics, polymer composites' high strength-to-weight and stiffness-to-weight ratios have made them the material of choice in industries like motor sports and aerospace for years. Many polymer composites offer an unmatched energy-absorbing capability per unit mass, making them a strong, lightweight choice.

One type of polymer composite in particular—carbon-fiber-reinforced composites—presents major lightweighting opportunities for structural vehicle components. At a weight 50% lighter than conventional steel and 30% lighter than aluminum,[1] more automakers are taking notice: for example, BMW is using the material as the body structure of its electric city car, the i3, which goes on sale in the United States in 2014.

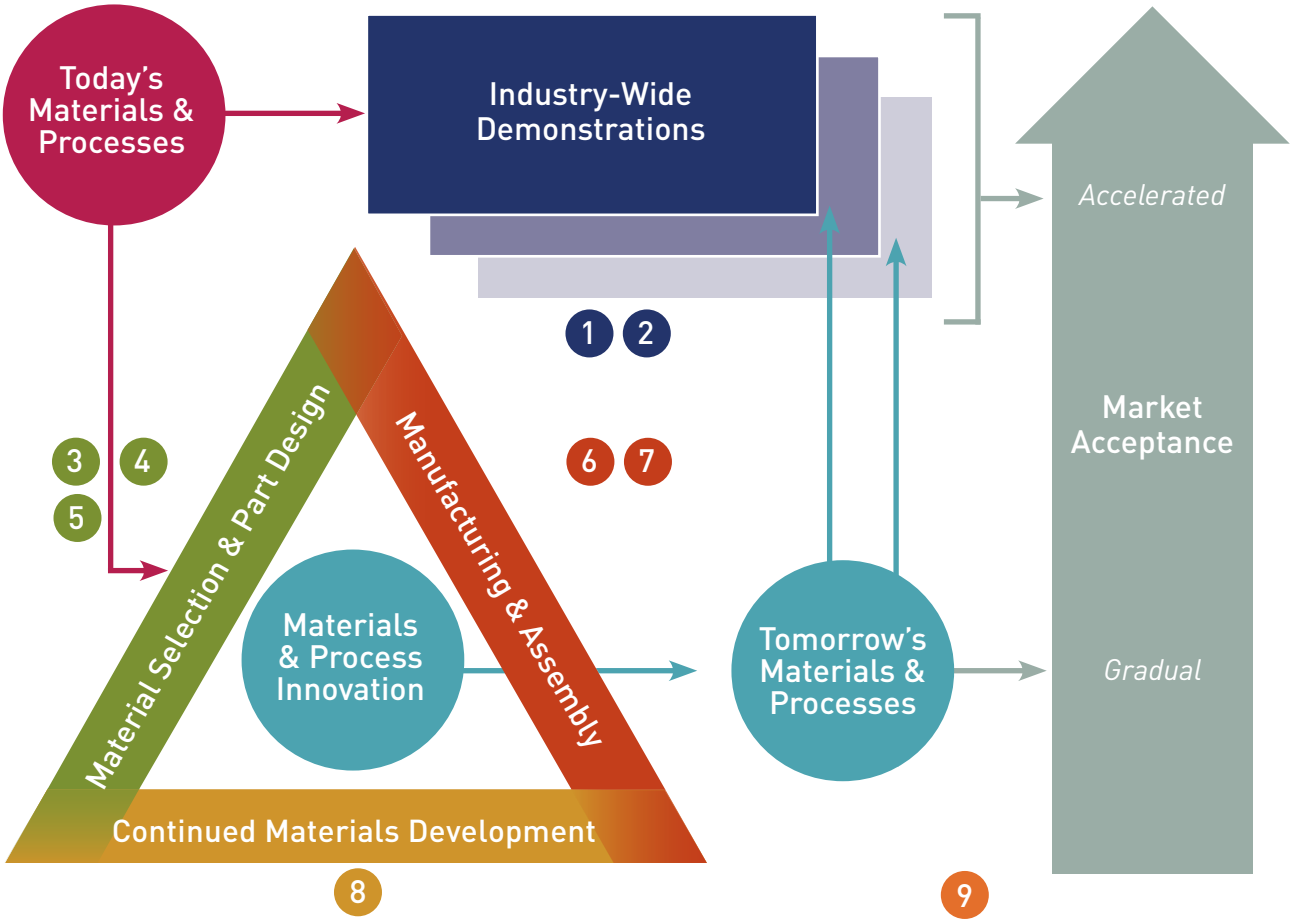
With advantages that align directly with the automotive industry's needs, plastics and polymer composites can be a major part of the solution for automakers. To fully realize this opportunity, several barriers should be addressed. For example, carbon-fiber-reinforced composites are still costly, discouraging many automakers from using them extensively in vehicle fleets, and recycling some plastic and polymer composite components can be challenging. The automotive infrastructure and workforce have evolved over the past 100 years to accommodate metals, creating barriers to plastics and polymer composites. And, the vast number of specialized, proprietary material compositions and processing techniques within the plastics and polymer composites industry—a strength that allows materials to be tailored to specific needs—also creates barriers to addressing major challenges collaboratively. The combination of opportunities and challenges that are driving the automotive plastics and polymer composites market today make it an ideal time to develop and implement a plan that capitalizes on these drivers by guiding cooperative action and supporting needed innovation.

Recognizing this pressing need, the automotive and plastics and polymer composites industries worked together with the guidance of the American Chemistry Council (ACC) Plastics Division to create this roadmap—a new strategic framework for collaborative progress. The roadmap sets a path to realizing the previously established vision for the automotive plastics and polymer composites industry: **by 2030, the automotive industry and society will recognize plastics and polymer composites as preferred material solutions that meet, and in many cases set, automotive performance and sustainability requirements**.

[1] David Sedgwick, "New techniques cut cost of carbon fiber," Autoweek (July 2011), http://www.autoweek.com/article/20110711/CARNEWS/110719991.

The 2014 Chevrolet Corvette Stingray features carbon-fiber-reinforced hood and roof assemblies, resulting in a roof that is approximately seven pounds lighter than the previous version. In addition, panel gap consistency was improved by 30% and part costs/unit area were reduced roughly 40% compared to the previous model.

Plastics and Polymer Composites Technology Roadmap for Automotive Markets Strategy



Supporting Initiatives

Industry-Wide Demonstrations

1. Establish an independent, pre-competitive technology development center where OEMs and suppliers can conduct laboratory work and test concepts at small volumes while collecting standardized data
2. Develop generic cost models to demonstrate the cost and benefit of plastics and polymer composites compared to alternative materials as examples to provide mass reduction possibilities

Material Selection & Part Design

3. Define a standard package of material properties desired for automotive applications, and then test the data through simulation for a specific automotive system (e.g., engine mounts, instrument panel, cross-car beams)
4. Establish design guidelines (e.g., for wall thickness, radii) and tools for typical plastic and polymer composite structures that are intended to be used by design engineers
5. Develop models that can simulate the behavior of plastic and polymer composite materials and components during and after impact events

Manufacturing & Assembly

6. Develop a manufacturing center or consortium to advance high-speed polymer composites processing
7. Develop technically and economically viable techniques to join plastics and polymer composites to similar or dissimilar materials and study service, repair, and disassembly

Continued Materials Development

8. Support development of engineered plastics and polymer composites with improved properties (e.g., stiffness, strength, fatigue, environmental resistance, creep, energy management, temperature capability), and develop performance standards to characterize the properties for designers

Supporting Initiatives

9. Advocate for plastics and polymer composites training classes and degree programs at all major universities

A New Strategy

The strategy outlined in this roadmap leverages the lightweighting drivers the automotive industry is facing as well as the significant opportunities presented by plastics and polymer composites.

To accomplish this, the roadmap outlines key initiatives and actions that should occur within each aspect of the materials development and implementation process, as well as across it:

- **Industry-Wide Demonstrations** – Conduct high-profile demonstrations of plastics and polymer composites in increasingly challenging automotive applications to help accelerate innovation and market acceptance.
- **Material Selection and Part Design** – Enable tier suppliers and original equipment manufacturers (OEMs) to more easily select the best plastic and polymer composites for automotive applications and to model part designs to ensure that a material has the necessary performance capabilities.
- **Manufacturing and Assembly** – Improve the way materials, components, and systems are manufactured and assembled into vehicles, as well as the final appearance and functionality of the vehicle throughout its lifecycle.
- **Continued Materials Development** – Improve the properties and cost-effectiveness of existing and newly discovered materials to better address the future needs of automotive applications.
- **Supporting Initiatives** – Improve coordination across the supply chain and strengthen the workforce to help accelerate innovation in plastics and polymer composites and increase industry support for these technologies.

Critical to the success of this strategy is the ability of the plastics and polymer composites industry to work together with the automotive industry and its supply chain to implement the actions it contains in an appropriate, pre-competitive environment. The *Plastics and Polymer Composites Technology Roadmap for Automotive Markets* will foster a culture of collaboration that will revolutionize not only plastics and polymer composites and how they are used, but also the way that the plastics and polymer composites industry works together and with automakers to achieve greater efficiency, performance, and value.

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