

# GOALS AND STATUS OF THE PCIV SAFETY RESEARCH PROJECT

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# NHTSA/Volpe Research Implements FY06-FY08 Congressional Guidance

## *Plastic and Composite Vehicles.*

The Committee recognizes the development of plastics and polymer-based composites in the automotive industry and the important role these technologies play in improving and enabling automobile performance. The Committee recommends ... a program to **examine possible safety benefits of Lightweight Plastic and Composite Intensive Vehicles [PCIV]**. The program will help facilitate a foundation between **DOT, the Department of Energy and industry stakeholders for the development of safety-centered approaches** for future light-weight automotive design.

# Goals of Previous Work

- Develop vision
- Situation Analysis to identify
  - R&D collaboration opportunities
  - Barriers to/opportunities for PCIV safety
- Survey experts on advanced materials and crash safety
- Identify consensus of R&D priorities for 2020 PCIV safety
- Develop safety-centered PCIV R&D roadmap

# R&D Collaboration Opportunities

- American Chemistry Council – Plastics Division:
  - 2002 Technology Integration Roadmap
  - 2006 Workshop (“Enhancing Automotive Safety With Plastics”)
  - 2008 Updated roadmap development
- DOE/USCAR FreedomCar Partnerships
  - Automotive Materials Partnership (USAMP)
- Standards-developing organizations (SAE, CMH-17, ASTM)
- Academia
- Synergy with NHTSA R&D:
  - Integrated safety research
  - CAFE fuel efficiency regulations
  - Safety R&D (H<sub>2</sub> and other advanced vehicles)

# 2020 Vision For PCIV Safety

*“NHTSA, in partnership with Federal agencies, industry, and academia, will support research on safety-centered design and performance modeling and validation to enable and foster superior, integrated safety performance of future light-weight Plastics and Composite Intensive Vehicles (PCIVs).”*

# PCIV Safety R&D Roadmap - 1

RESEARCH AND TECHNOLOGY INTEGRATION FOR PLASTICS AND COMPOSITE INTENSIVE VEHICLES SAFETY			
Present		SCREEN & SELECT COMPOSITE MATERIALS FOR PLASTICS AND COMPOSITE INTENSIVE VEHICLES LIGHT-WEIGHTING DATABASE TAILORED TO PART DESIGN AND FEATURES.	
Near-term (3-5 years)	Mid-term (5-10 years)	Long-term (10-15 years)	Far-term (15+ years)
Use Computational Crashworthiness Model To Predict Loading, Crash Energy Management, And Failure Behavior.	Prototype Component Or Sub-System (e.g. Door Panels)	Integrate Into Full Scale Concept Car, Field Test And Compare Safety Performance In Standardization Tests	NHTSA, DOE And P3 Review NCAP PCIV Crash Safety Results
Compile A Comprehensive Database On Mechanical Properties (Static & Dynamic)		Develop Test Procedures	
Optimize Design for Crash Safety Performance, focusing on Older Demographic	Perform Accelerated Validation & Verification Static And Dynamic Lab Scale Test To Optimize Crash Performance	Field Test PCIV Prototypes to Improve Production Model	Collect and Analyze Crash-Test Data to Verify Older Occupants Safety

# 2020 PCIV Safety R&D Roadmap - 2

Enhancing Plastics and Composite Intensive Vehicles Safety Performance with Plastics			
Challenges / Milestones		<ul style="list-style-type: none"> <li>•Design concepts</li> <li>•Materials screening</li> <li>•Testing Standards</li> <li>•Simulations and Validation</li> </ul>	<ul style="list-style-type: none"> <li>•Systems Integration</li> <li>•Crash Safety Testing</li> <li>•Performance Metrics</li> <li>•PCIV Deployment</li> </ul>
Performers	Near-term (3-5 years)	Mid-term (5-10 years)	Long-term (10-15 years)
<b>Industry – Government – University Public Private Partnerships (P3)</b>	Research, Development and Technology on Automotive Composites	Test & Evaluation Of PCIV Prototype Crash Safety	System Integration of PCIV Safety Technologies 10-15 yrs.
	Develop Testing Standards and Safety Evaluation Tools for PCIV Designs 1 yr.		
	Select Light-weight Structural Materials for PCIV 2-3 yrs.	Crash-Safety Verification & Validation Simulations 5-6 yrs.	PCIV Commercial Deployment 15+ yrs.
	Develop PCIV Materials Processing / Parts Fabrication 3-5 yrs.	Crash Safety Testing & Validation For PCIV Subsystems and Vehicle 6-8 yrs.	
<b>NHTSA Role</b>	NHTSA Monitors Progress in Crash Safety Research and Development	NHTSA Evaluates Results of Crashworthiness Verification & Validation	NHTSA Verifies PCIV Crash Safety Compliance (NCAP and FMVSS)

# 2020 PCIV Safety - Strategic Priorities

Major Challenges			
Perform focused, coordinated and integrated safety research, development, test, and evaluation Program to improve crash-safety performance of plastic/composite components and subsystems for a 2020 PCIV			
Research, Development, Test, and Evaluation Priority			
	Near-term (2007-2010)	Mid-term (2010-2015)	Long-term (2015-2020)
<b>Materials Selection</b>	Perform research and technology to address "Knowledge gaps" on crash-safety performance of PC materials:	Modeling and simulation to verify and validate plastic/composite crash safety in structural, semi-structural applications	Demonstrate integrated safety performance for prototype PCIV to enable commercial deployment
	<ul style="list-style-type: none"> <li>Standardize testing protocols for composite materials</li> </ul>	<ul style="list-style-type: none"> <li>Validate plastic/composite materials choices in safety applications</li> </ul>	<ul style="list-style-type: none"> <li>Industry crash-test and self-certify PCIV safety</li> </ul>
<b>Testing Crash Performance</b>	<ul style="list-style-type: none"> <li>Characterize mechanical behavior of plastic/composite materials in safety applications</li> </ul>	<ul style="list-style-type: none"> <li>Prototype and test components (door panels, roof, front and back "crush boxes")</li> </ul>	<ul style="list-style-type: none"> <li>Identify and overcome PCIV crash-compatibility problems for all occupants</li> </ul>
	<ul style="list-style-type: none"> <li>Establish comprehensive Database for light-weighting materials options</li> </ul>	<ul style="list-style-type: none"> <li>Verify and validate for baseline PCIV design to evaluate integrative safety system performance</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrate enhanced PCIV safety performance for older occupants (using advanced dummies)</li> </ul>
<b>PCIV Integration</b>	<ul style="list-style-type: none"> <li>Refine predictive engineering tools for Modeling and Simulation of PCIV components and system crash performance</li> </ul>	<ul style="list-style-type: none"> <li>Devise and evaluate special crash-protection needs for older occupants</li> </ul>	<ul style="list-style-type: none"> <li>NHTSA verifies PCIVs compliance with crash- safety regulatory requirements</li> </ul>
<b>Milestones</b>	<ul style="list-style-type: none"> <li>Test Standards Issued</li> <li>CHM-17 Crash Energy Database Standardized and Current</li> <li>Modeling and Simulation Crash Safety Tools Available</li> </ul>	<ul style="list-style-type: none"> <li>PCIV Structural and Propulsion Validated for Realistic Crash Loads</li> <li>Full PCIV System is Crashworthy</li> <li>Improved Older Occupants Survivability is Demonstrated</li> </ul>	

# Current Work: Volpe's FY07 Project

- Build on, disseminate Phase 1 project findings
- Continue collaboration with ACC-PD
- Conduct outreach to leading subject matter experts (SMEs) for inputs
- Monitor and assess development of testing standards and crash modeling tools:
  - Global advances in automotive plastics, composite and hybrid structures
  - USCAR/DOE materials testing results
  - Facilitate development of composites crashworthiness standards
  - Evaluate predicted vs. actual crash performance for existing and concept vehicles with composite bodies

# Workshop Goals

- Identify and characterize safety benefits
- Refine near-term PCIV safety roadmap priorities
- Identify collaborative R&D strategies to optimize PCIV designs for:
  - Reduced weight (Enhance fuel efficiency)
  - Equal or better crash safety
- Define crash performance metrics and milestones for multi-material PCIVs