Overview of Aluminum

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Overview of Aluminum

- Aluminum can achieve weight savings in 35-50% range, but is not currently cost neutral.
- Aluminum is well established in cast powertrain applications and selected chassis components.
- Material cost, formability characteristics, and joining and assembly issue remain barriers for body and structures.

Materials Strategic View

From MTT All Tech Team Presentation

Materials have two major roles in FreedomCAR:

- Enablers for providing lightweight vehicle structures thereby improving fuel economy and reducing demands on the vehicle powertrain and ancillar systems (e.g., braking).
- Enablers for specific vehicle applications predicated on use of hydrogen as an energy conversion medium, including fuel cells, hydrogen storage, electric drives and hydrogen-fueled internal combustion engines.

MTT Mission & Scope

From MTT All Tech Team Presentation

Mission:

- **Achieve Technology - Specific 2010 Goals:**
  - Material and manufacturing technologies for high volume production vehicles which enable/support the simultaneous attainment of:
    - 50% reduction in the weight of the vehicle structure and subsystems
    - Affordability
    - Increased use of recyclable/renewable materials

Scope:

- All materials
- Across all vehicle systems

Lightweight Material Challenges

Increasing Severity of Challenge

Increasing Impact on Mission

Material	Critical Challenges				
Carbon-fiber Composites	Low-cost fibers	High-volume Mfg.	Recycling	Joining	Predictive Modeling
Aluminum	Feedstock Cost	Manufacturing	Improved Alloys	Recycling	
Magnesium	Feedstock Cost	Improved Alloys	Corrosion Protection	Manufacturing	Recycling
Advanced High-strength Steels	Manufactur-ability	Wt. Reduction Concepts	Allo Development		
Titanium	Low-cost Extraction	Low-cost Production	Forming & Machining	Low-cost PM	Allo Development
Metal-matrix Composites	Feedstock Cost	Compositing Methods	Powder Handling	Compaction	Machining & Forming
Glazings	Low-cost Lightweight Matls.	Noise, struc. models simulations	Noise reduction techniques	UV and IR blockers	
Emerging Materials	Material Cost	Manufacturing	Design Concepts	Performance Models	

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From MTT All Tech Team Presentation

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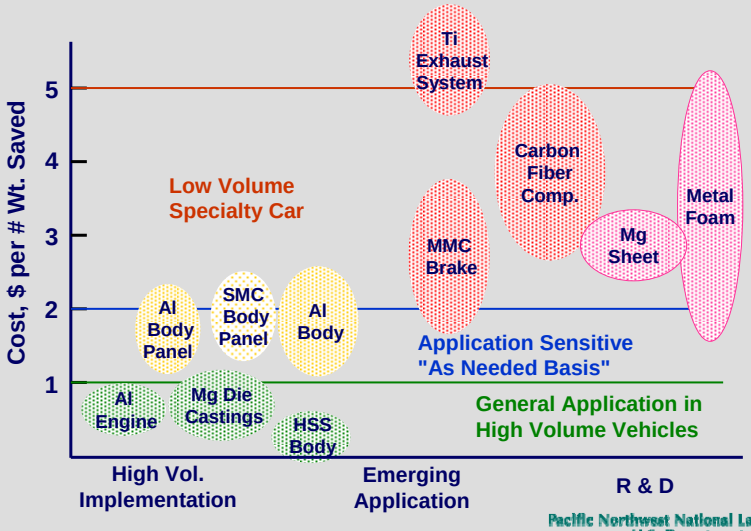
Lightweight Automotive Materials - Market Penetration vs. Cost



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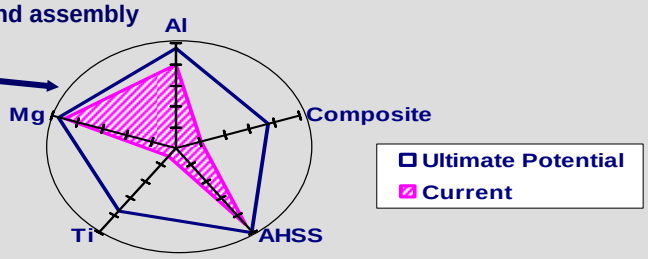
Cost Comparison

Reflects total cost of components or subsystems, including material, fabrication and assembly

FreedomCAR Goal

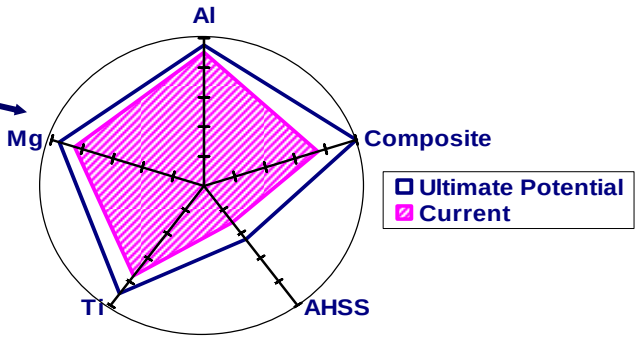


Comments:

- Mg and Al are close to attaining cost neutrality however, it is believed that full neutrality may never be reached. Both materials are subject to world market fluctuations.
- Development work currently underway in composites and Ti will move the points out; however, neither will reach complete neutrality

Weight Savings

FreedomCAR Goal



Comments:

- It is generally recognized that steel will not attain the 50% weight savings goal for FreedomCAR
- The other materials possess the potential for the desired weight savings achievement.

Overview of Aluminum

Current Aluminum Projects

- Improved Automotive Suspension Components Cast with B206 Alloy – AMD 405 (E. McCarty)
- Die-Face Engineering Project for Advanced Sheet-Forming Materials – AMD 408 (E. McCarty
- Ultra-Large Casting Demonstration – AMD 406 (E. McCarty)

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Recent and Completed Aluminum Projects

- Warm Forming of Aluminum Sheet (AMD)
- Electromagnetic Forming of Aluminum Sheet (Ford/PNNL)
- Forming Limits of Weld Metal in Aluminum and AHSS (PNNL, US Steel, Alcoa, USCAR)
- Enhanced Resonance Inspection for Light Metal Castings (NDE 701 + PNNL)

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New and Proposed Aluminum Projects

- Pulse Pressure Forming of Lightweight Metals (USCAR + PNNL)
- Electromagnetic Joining and Hemming of Aluminum and Magnesium (USCAR + PNNL)
- High Strength Superplastic Aluminum Sheet for Automotive Applications (USCAR + PNNL)
- Low-Cost Alternative Manufacturing to Replace Aluminum Castings in BIW Structures (PNNL)