

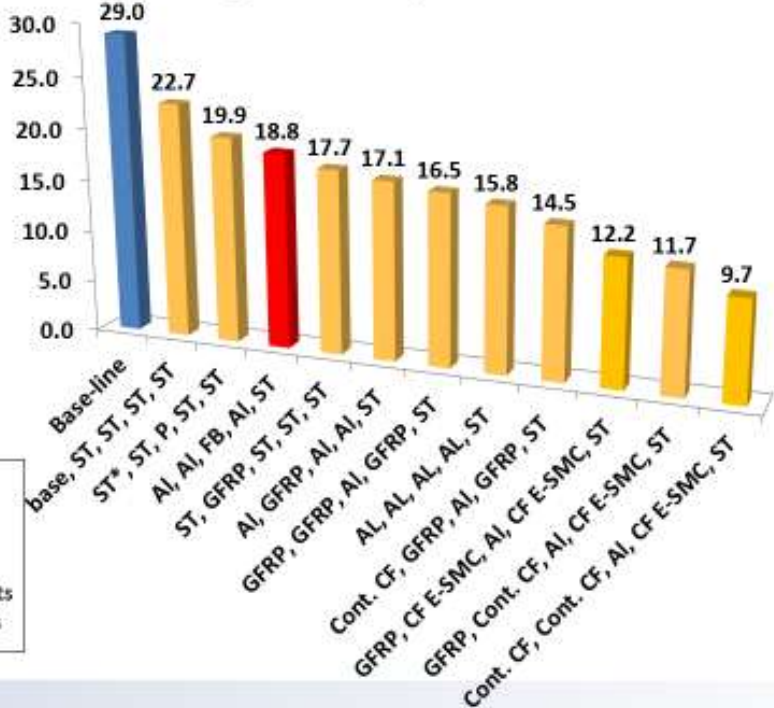
Lightweighting and the Potential for Additive Manufacturing

Center for Automotive Research

Ann Arbor, Michigan

Lightweight Materials & Processes

Door weight from 5 parts based on material



ST = Steel
 GFRP = Glass Fiber Reinforced Plastics
 Al = Aluminum
 CF-E-SMC = chopped fiber epoxy sheet molded compound
 DP = Dual Phase steel
 P = Press hardened steel
 FB = Ferritic bainite steel

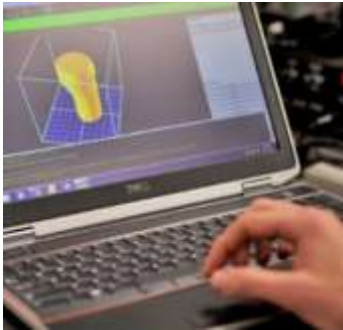
* baseline steel optimized

Sequence:
 Outer
 Inner
 Beam
 Reinforcements
 Hinge brackets

Additive Manufacturing in the Auto Industry



Processes: Jigs & Fixtures, Hand Tools



Prototypes: R&D, Design, Engineering



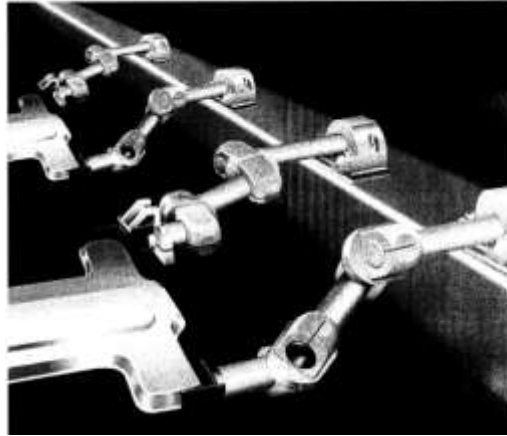
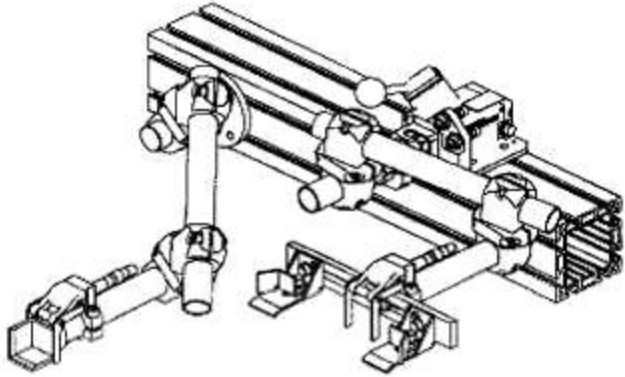
Production Parts: Vehicle Bodies and Components

Potential Application Areas

- Plastics
- Metals
- Sand



Specific Application Areas: Lifters



Potential Strategies



- Parts
 - Die Lifters
 - Special Punches and Retainers
 - Checking Fixture Components
 - Hand Tools for Assembly
- Machines
 - Clamps on Fixtures
 - Blocks on Fixtures
 - Die Lifter Components
 - End Effectors for Automation



Lightweighting Material Architectural Strategy



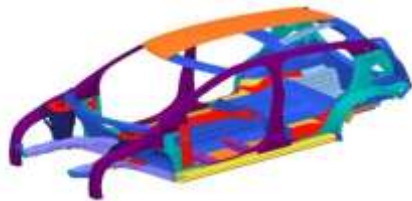
Ford 2015 F-150

All technology pathways anticipate lightweighting

The “monolithic” car with one dominant material is:

- Easier to design, and
- Easier to manufacture, but
- Not optimum for reducing mass and cost

Aluminum body & bed
Steel frame



- Future Steel Vehicle
 - 35% reduction in body mass

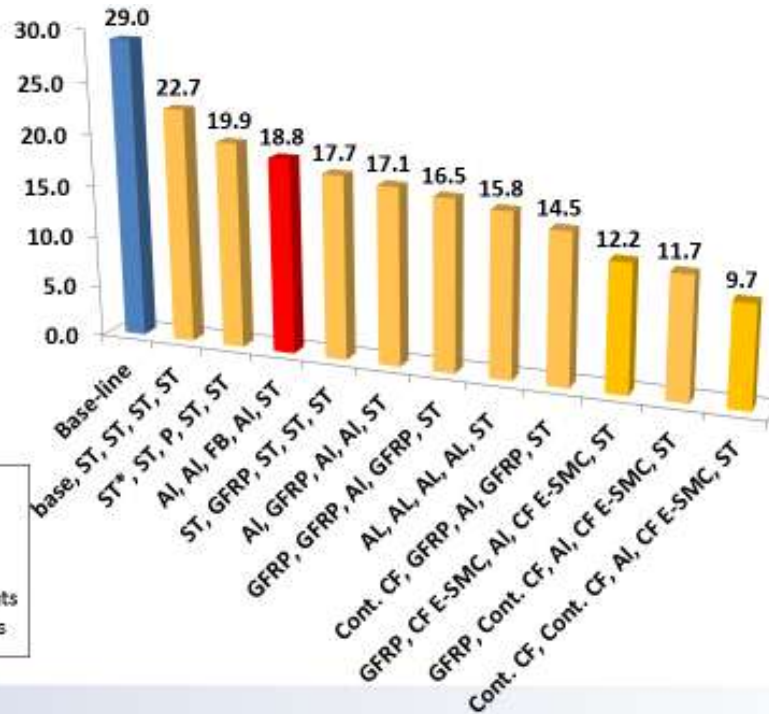


- Aluminum Intensive
 - 45% reduction in body mass



- Composite Car
 - 55% reduction in body mass

Lightweight Materials & Processes



New Materials Requiring
New Processes
Are The Solution

- Thank You