
AUTOMOTIVE ALUMINUM GROWTH SURGE

**2016-2028: ALUMINUM CONTENT IN
NORTH AMERICAN LIGHT
VEHICLES**



STUDY CONDUCTED BY DUCKER WORLDWIDE

ALUMINUM ASSOCIATION ALUMINUM TRANSPORTATION GROUP (ATG)



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RioTinto
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sapa:



PRESENTERS



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Vice President-Engineering/Technology

Kaiser Aluminum



Abey Abraham

*Project Lead & Director of
Automotive and Materials*

Ducker Worldwide

AGENDA

- **Ducker Introduction**
- **Study Methodology**
- **Findings 2020**
- **Findings Beyond 2020**
- **Questions**

DUCKER INTRODUCTION

DUCKER PROJECT OVERVIEW

2017 Project

- 8th tri-annual ATG study
- Team of researchers - multidisciplinary
- 6+ month market research

Three-Pronged Approach

- “Bottom up” forecasting process
- “Top Down” analysis of independent research

RESEARCH METHODOLOGY (THREE-PRONGED APPROACH)

Bottom-Up Analysis (2015-2020)

- OEMs, Tier 1 supplier interviews
- **Future penetration:**
 - Metals
 - Alternate materials
- **Material breakdown:**
 - Product
 - product form
- **Material content:**
 - Component
 - Vehicle segment
 - Product form

Top Down Analysis (Beyond 2020)

- EPA, NHTSA and CAR
- **Impacts of:**
 - Fuel prices, vehicle mix, secondary Weight savings, electrification, vehicle design, regulations, Vehicle launch cadence
- **Result:**
 - Three different mass reduction and timing assumptions
- **Not an attempt to predict what each OEM will do to meet regulations**

REGULATORY UNCERTAINTY: OPTIONS & IMPACTS

Mass Reduction (MR)* Scenarios

Current Proposed Regulation

7%** MR by 2025

Most Likely OEM Compromise

7% MR by 2028**

Market Driven Solution
(no CAFE regulation)

4.5% MR by 2028

* 2015 average curb mass 3,834 Lbs.

**2016 draft Technical Assessment Report (TAR)

MASS REDUCTION MEGATRENDS (2015:2028)

■ AUTO INDUSTRY

MR: 7% - 9% by 2028*

Multi-material Vehicle (MMV)

Materials Advancements

Steel, Aluminum, Plastics,
Composites, Magnesium

Consumer benefits - Lightweighting

■ AUTOMOTIVE ALUMINUM

Materials advancements

strength, formability, energy absorption, ...

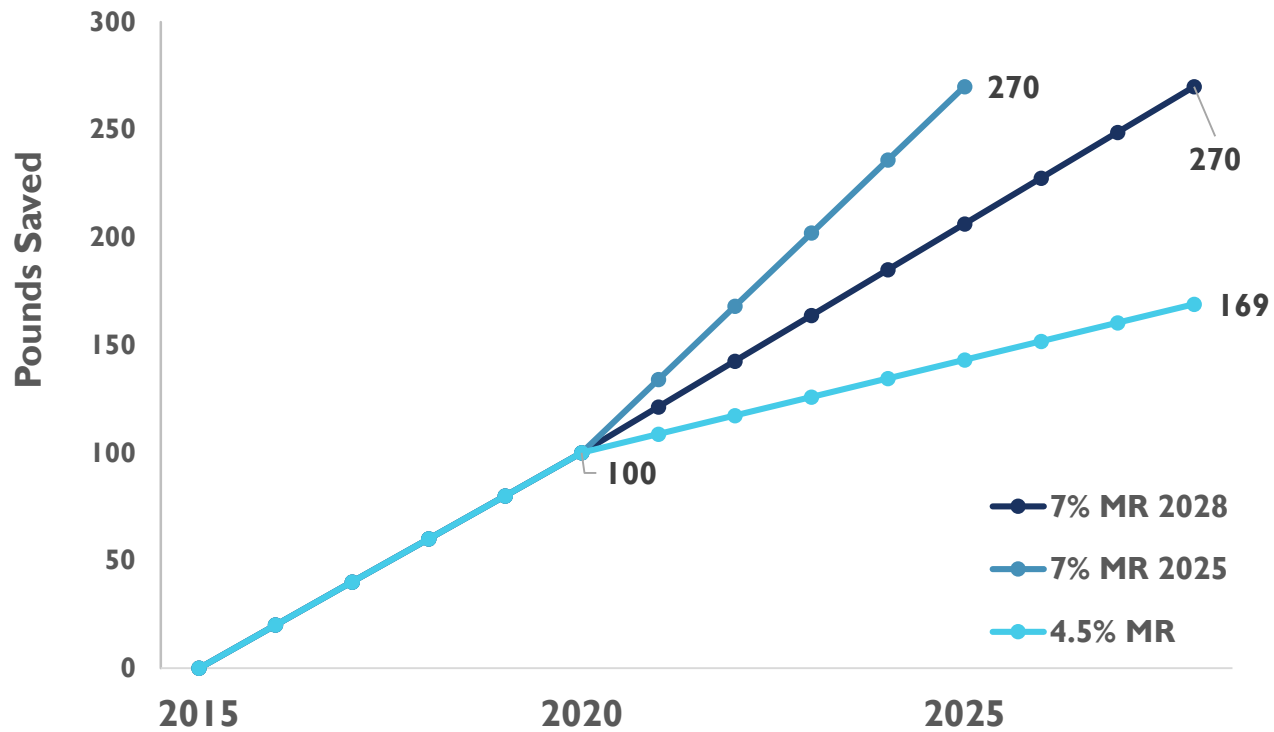
Vacuum Die Castings (VDC)

Micro Mill



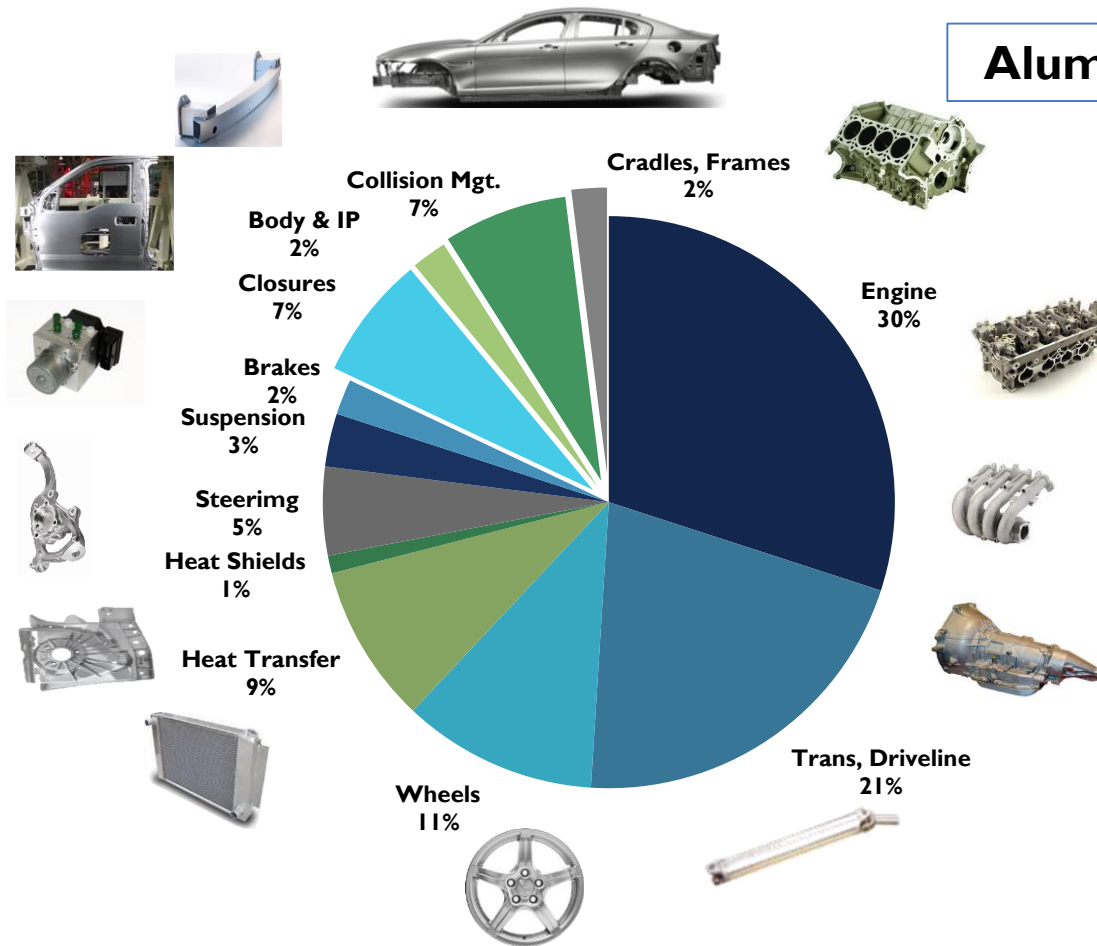
MASS REDUCTION SCENARIOS

Mass Reduction Scenarios



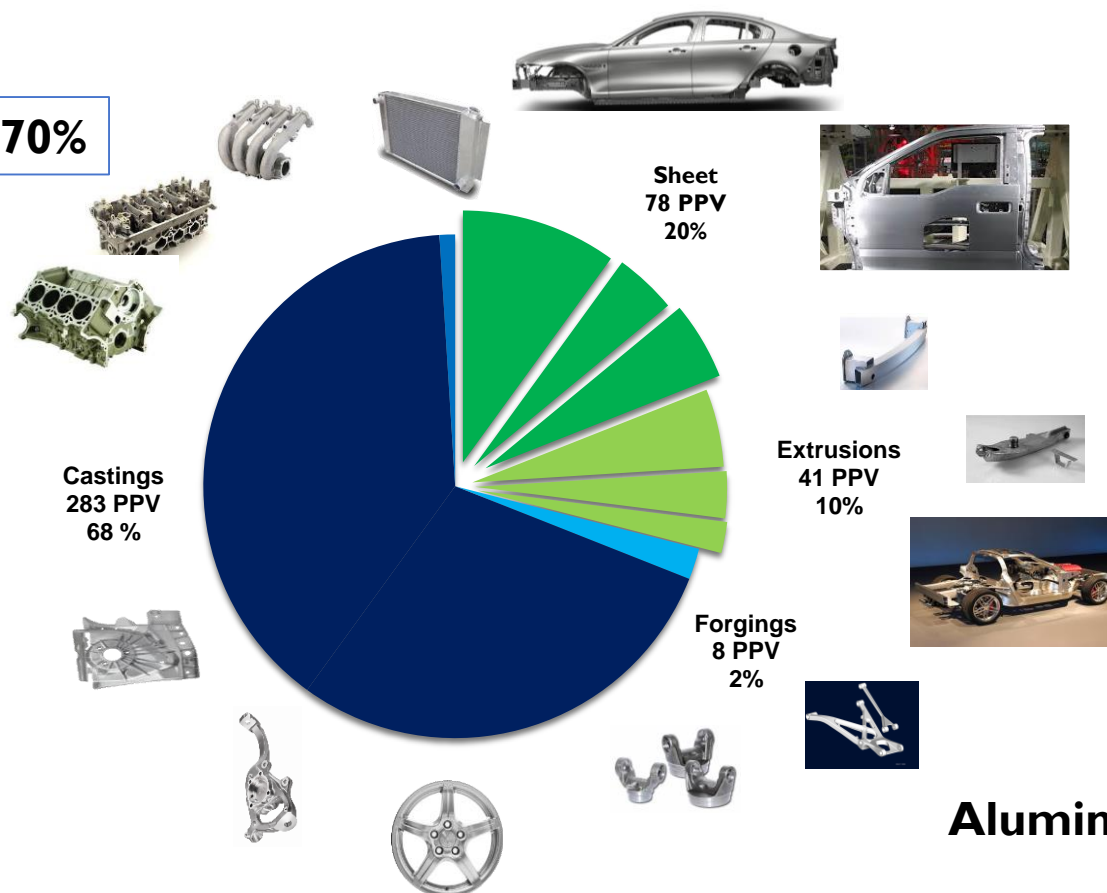
AUTOMOTIVE ALUMINUM: 2015 BY VEHICLE SYSTEM

Aluminum: 397 PPV



AUTOMOTIVE ALUMINUM: 2015 BY PRODUCT FORM

Castings/Forgings: 70%

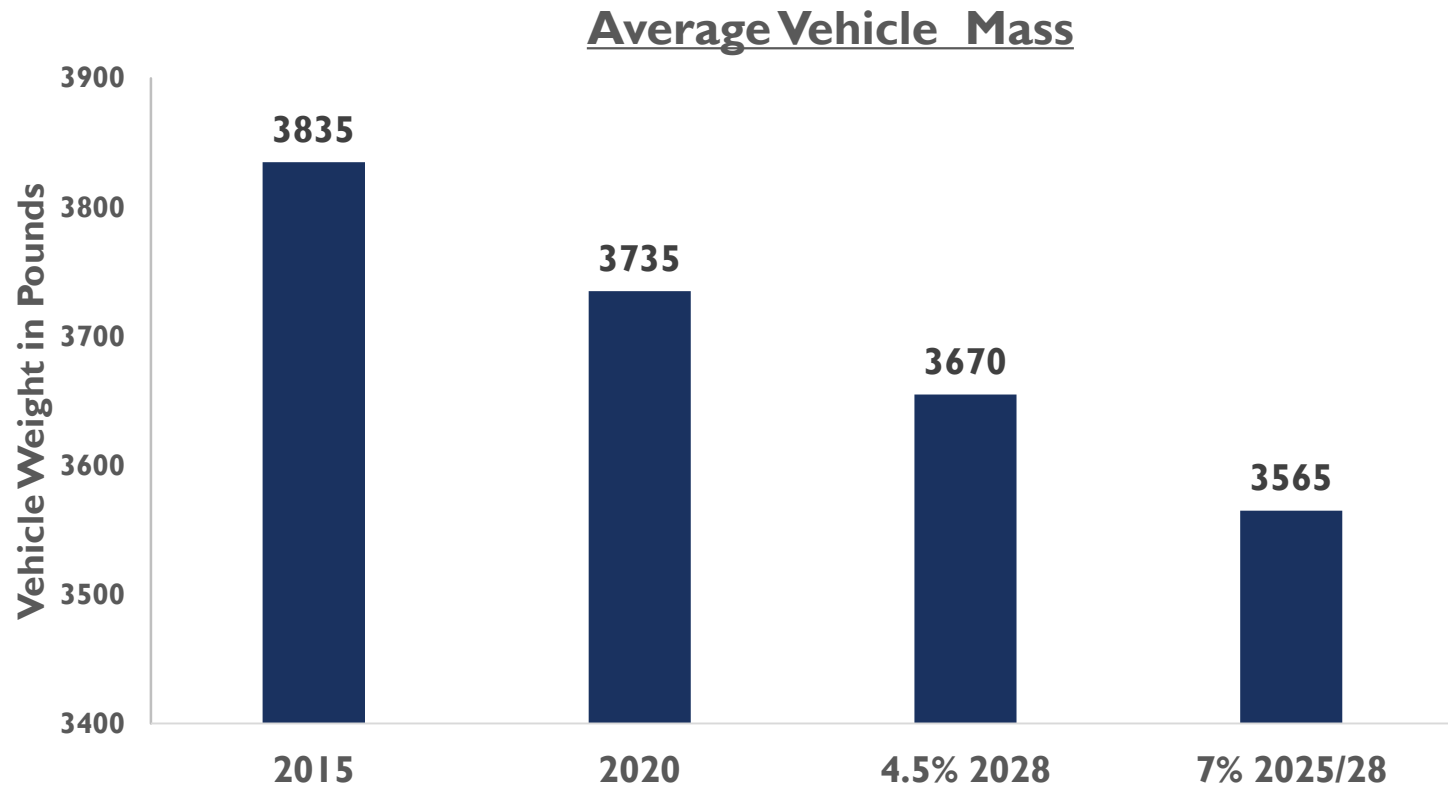


Aluminum: 397 PPV



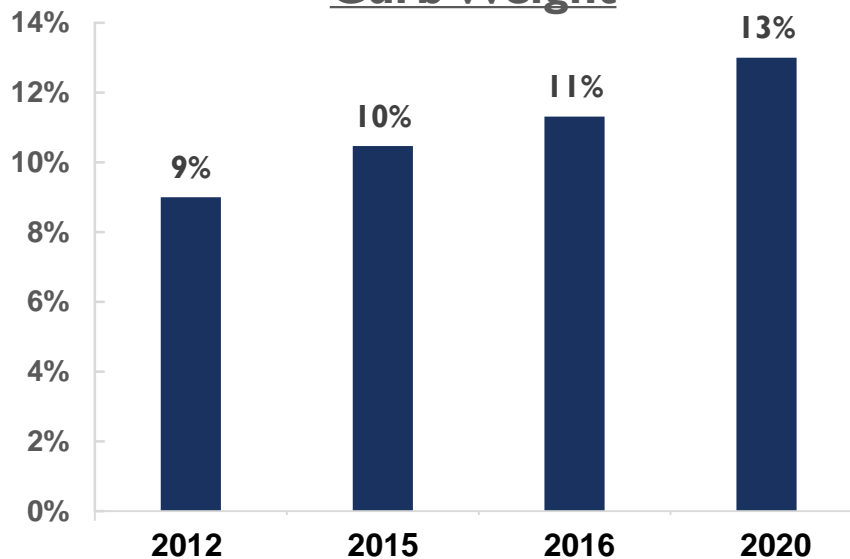
FINDINGS: 2015:2020

VEHICLE MASS REDUCTION (2015:2028)

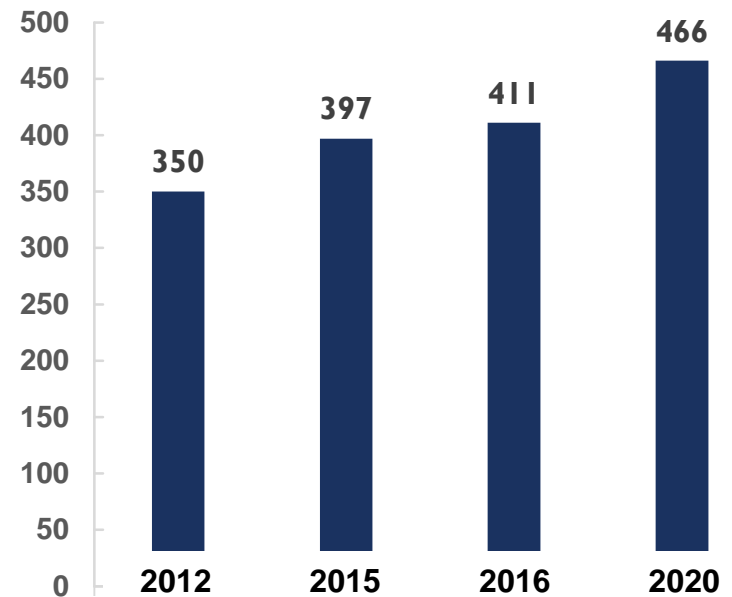


ALUMINUM CONTENT GROWTH (2015:2020)

Aluminum Share of
Curb Weight



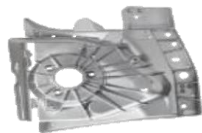
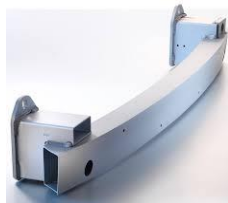
Avg. Aluminum Content
in Pounds per Vehicle



HIGH GROWTH ALUMINUM APPLICATIONS



High Growth



- 1) Closures
- 2) Body-in-White
- 3) Shock Towers
- 4) Sub-frames / cradles
- 5) Bumpers
- 6) Suspension Knuckles

2020 ALUMINUM GROWTH TRENDS

Sheet – Body

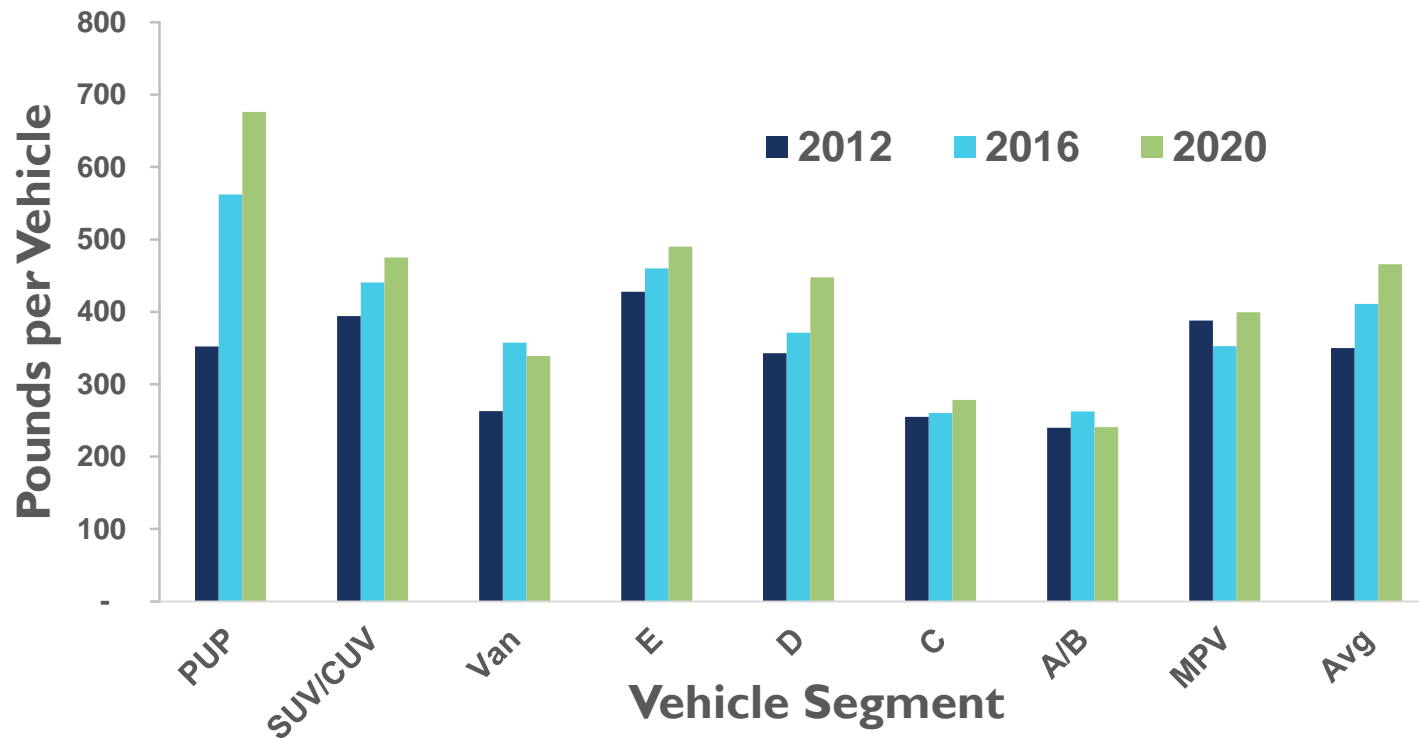
- **Closures – 165% increase:**
 - 2015 - 23 PPV
 - 2020 – 61 PPV
- **Hoods:**
 - 2015 – 50%
 - 2020 – 71%
- **Doors:**
 - 2015 – 5%
 - 2020 – 25%
- **BIW components:**
 - 83% increase 2015 to 2020
- **Body-in-White (BIW) & closure sheet:**
 - 1.6 billion pounds

Extrusions/Castings/Forgings

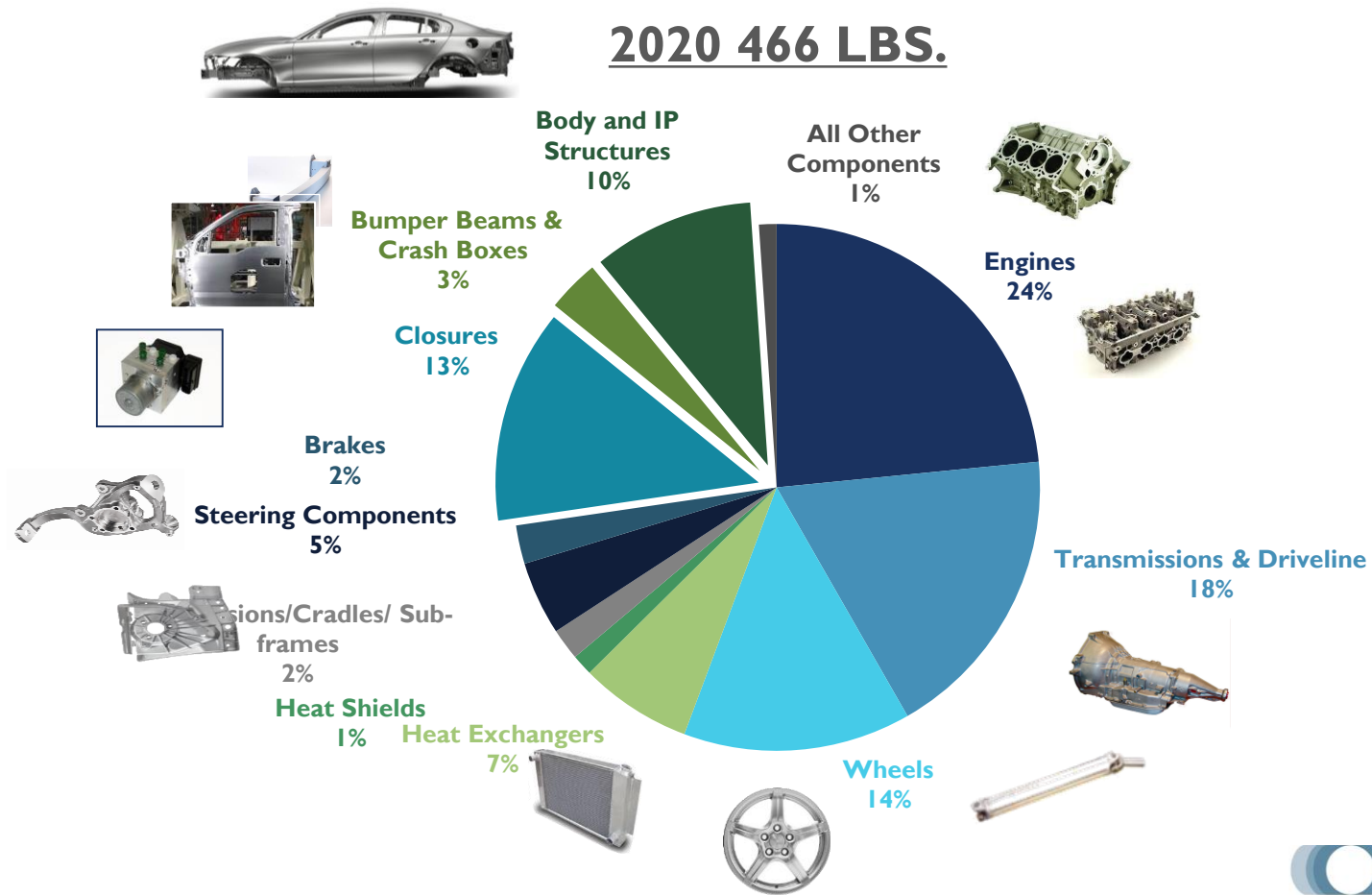
- **Extruded products – 35% increase:**
 - 2015 - 36 PPV
 - 2020 – 49 PPV
 - Crash management: + 65%
 - BIW: + 100%
- **Castings and Forgings:**
 - Steering knuckle - + 35%
- **Vacuum Die Castings: +360% increase:**
 - 2015 - 3 PPV
 - 2020 – 14 PPV



ALUMINUM CONTENT BY VEHICLE SEGMENT

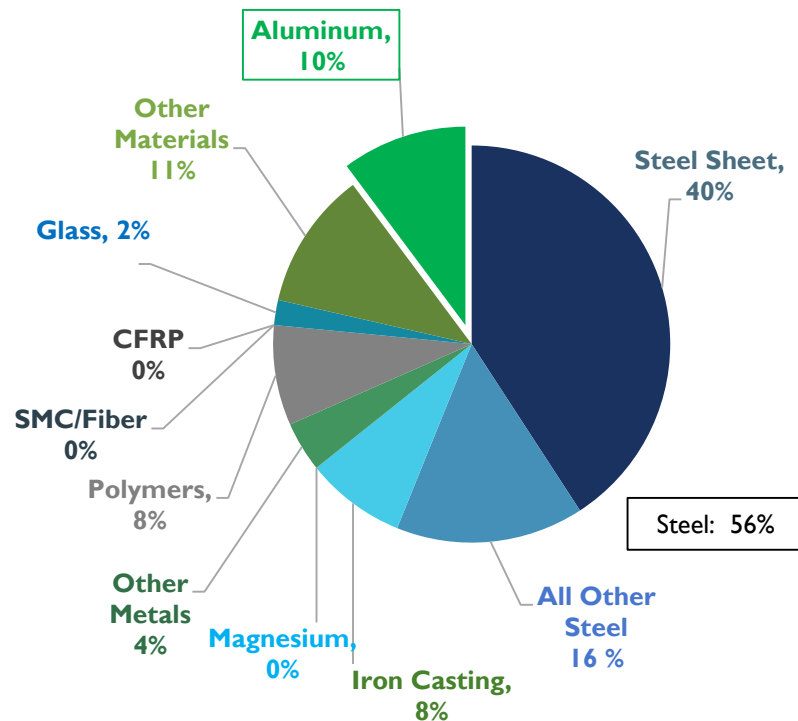


AUTOMOTIVE ALUMINUM CONTENT (2020)

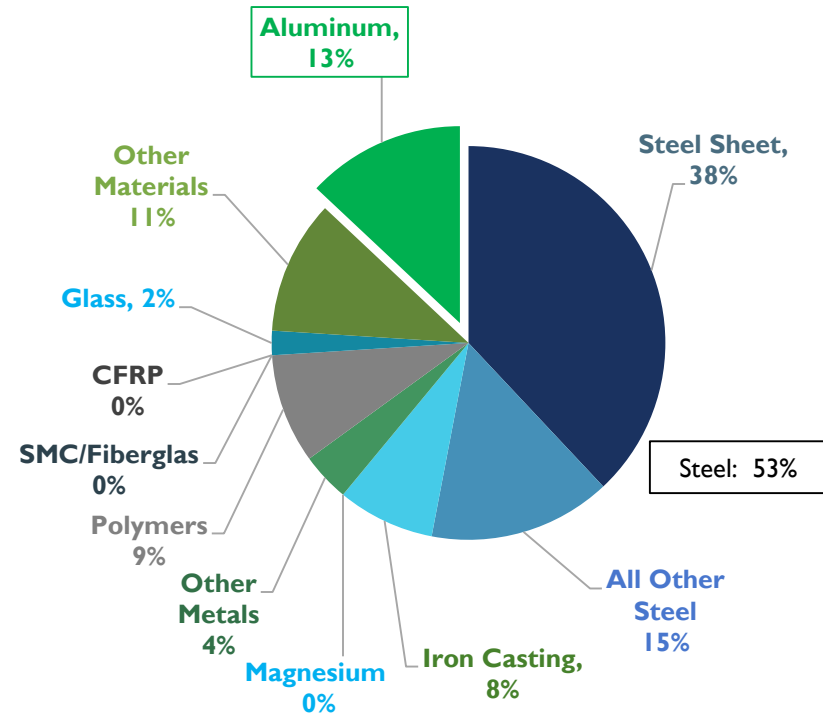


AUTOMOTIVE MATERIALS MIX SHIFT (2015:2020)

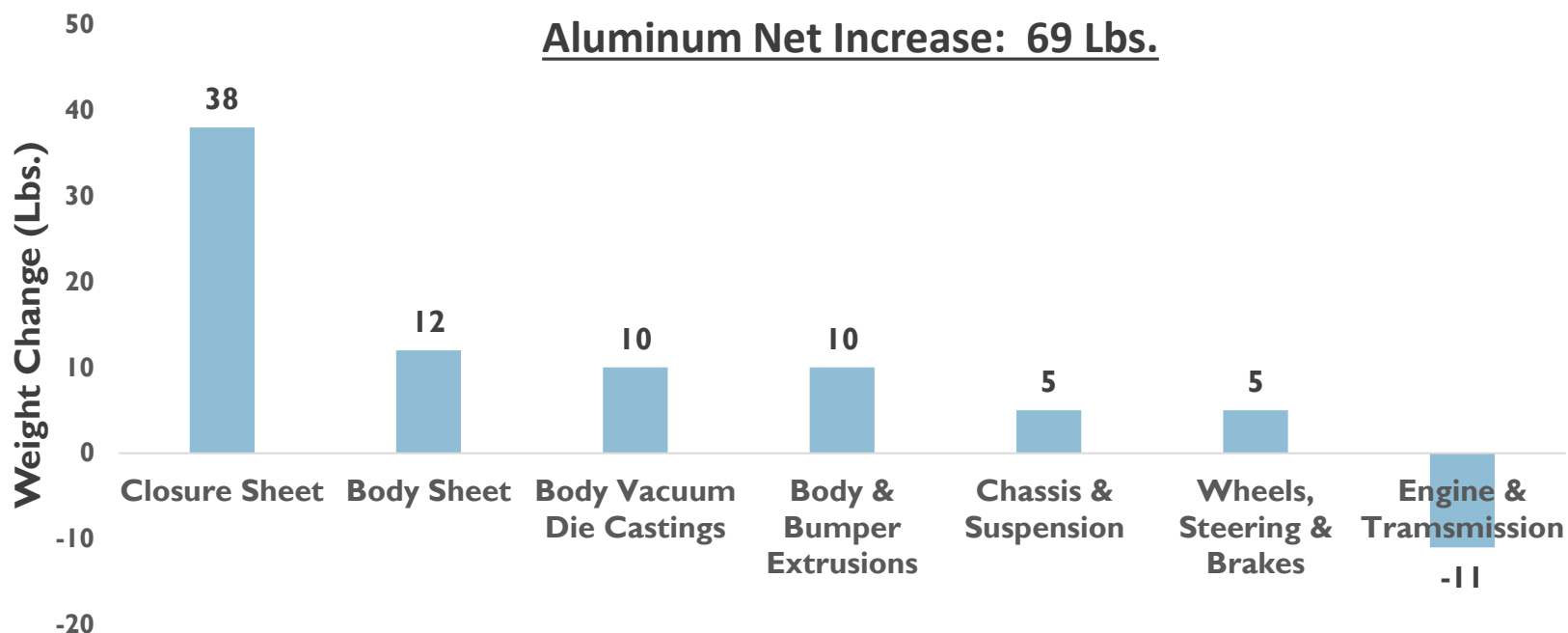
2015 CURB WEIGHT 3835 LBS



2020 CURB WEIGHT 3735 LBS

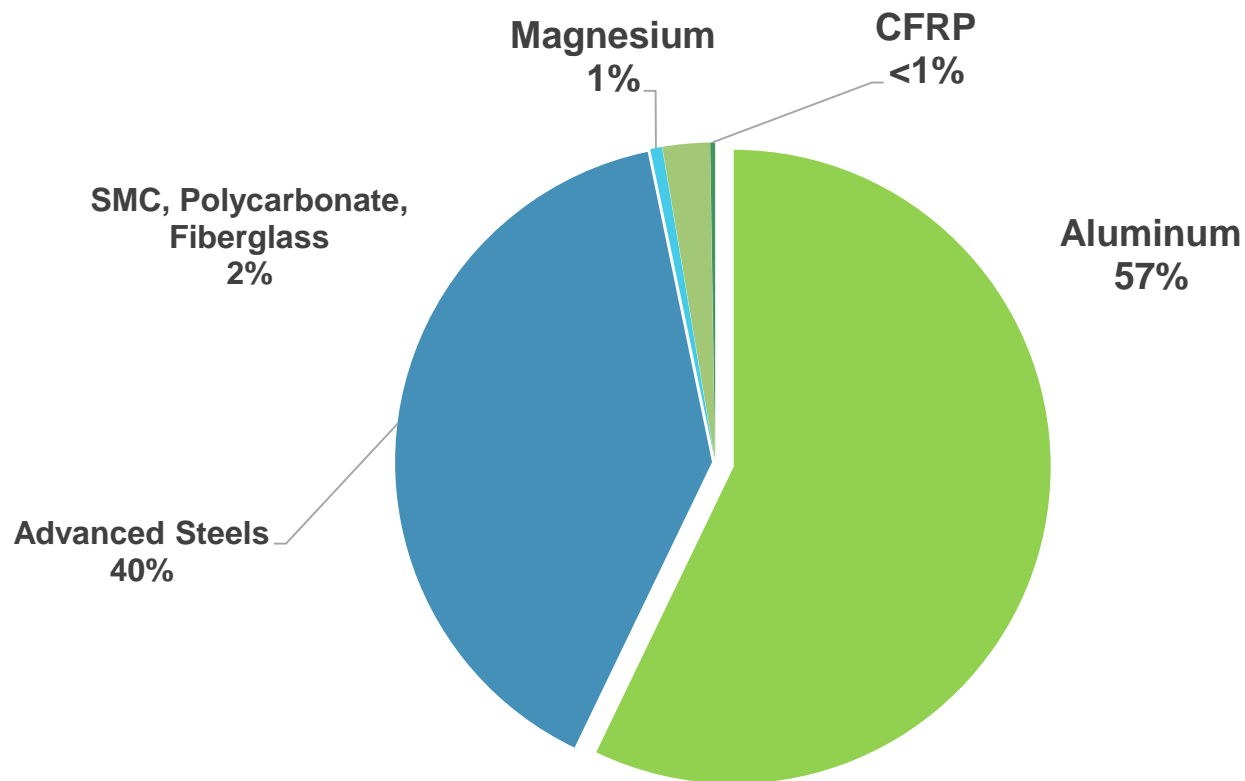


ALUMINUM COMPONENT WEIGHT CHANGES (2015:2020)



SOURCES OF MASS SAVINGS MATERIAL SELECTION (2015:2020)

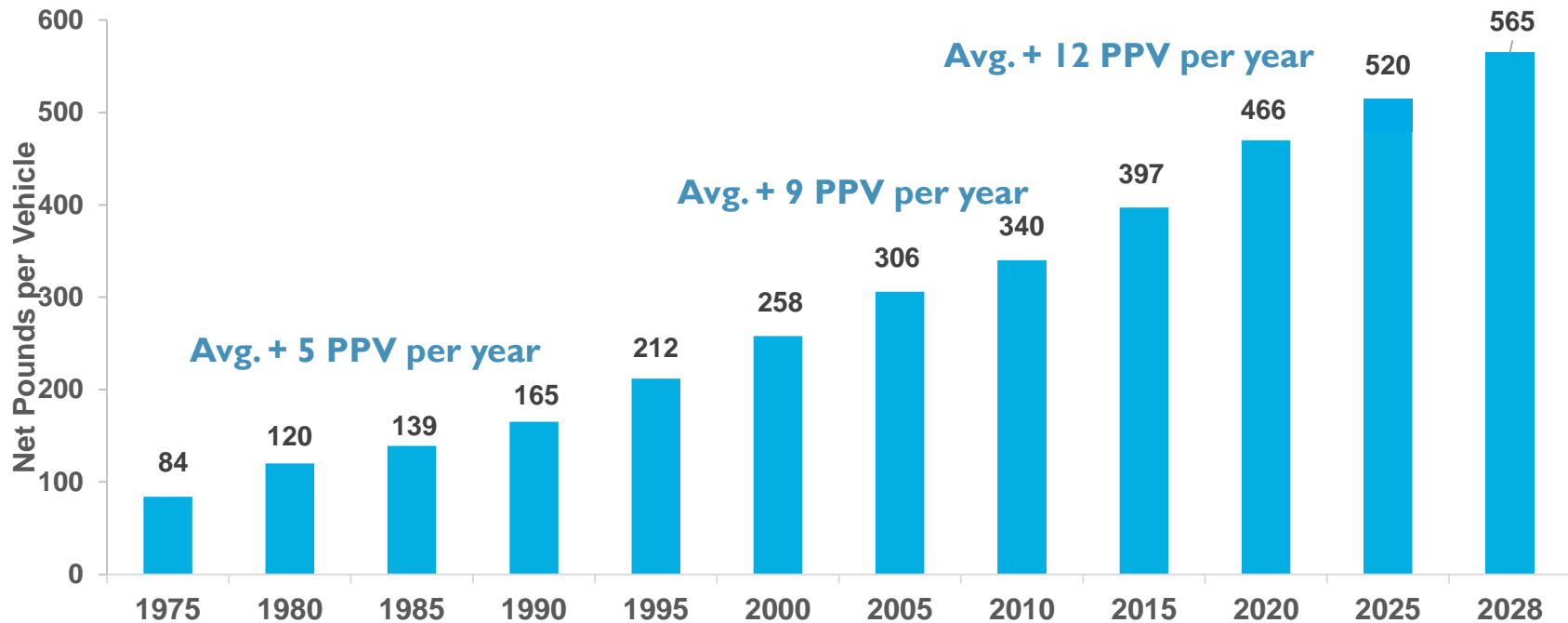
2015:2020 — 100 Pounds Saved



55 YEARS UNINTERRUPTED ALUMINUM GROWTH

N.A. Light Vehicle Aluminum Content

Net Pounds per Vehicle (PPV) @ 7% MR Scenario by 2028





FINDINGS: BEYOND 2020

7% MASS REDUCTION SCENARIOS

7% Mass Reduction Scenario (2025 or 2028):

- Total aluminum content: 565 PPV
- Aluminum share of curb mass: 16%
 - Nearly 25% of vehicles having partial aluminum BIW with some complete BIW

Multi-Material Body Design:

- Significant quantities: Aluminum, AHSS/UHSS, Magnesium and some CFRP

ALUMINUM TRENDS BEYOND 2020

7% Mass Reduction

- Closures grow to 100+ PPV
- Hood penetration of 90%
- Door penetration near 60%
- Aluminum BIW parts grow to 61 PPV
- Vacuum Die Castings are the most secure aluminum parts for BIW
- Aluminum, Advanced Steel, Magnesium, CFRP and Polycarbonate additions are critical

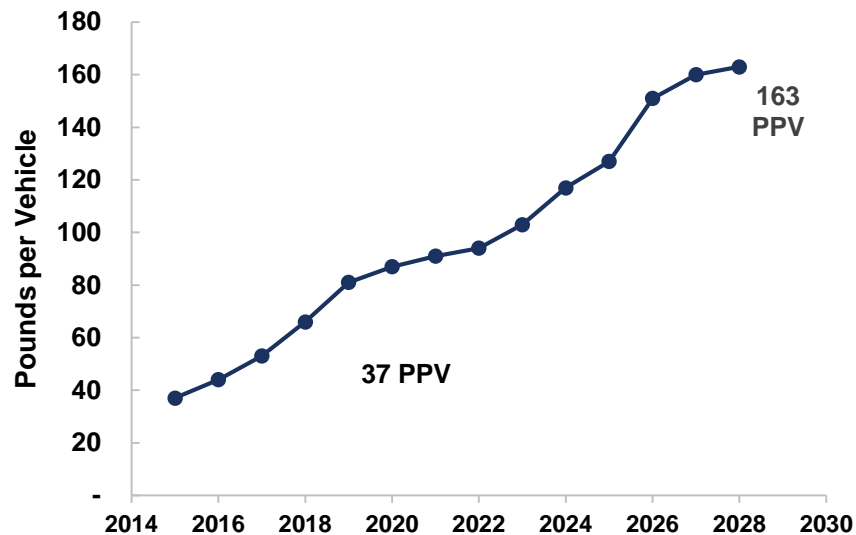
4.5% Mass Reduction

- Aluminum closures:
2020: 62 PPV
2025: 85 PPV
- Aluminum stamped BIW parts: 34 PPV
- Total aluminum content: 494 PPV

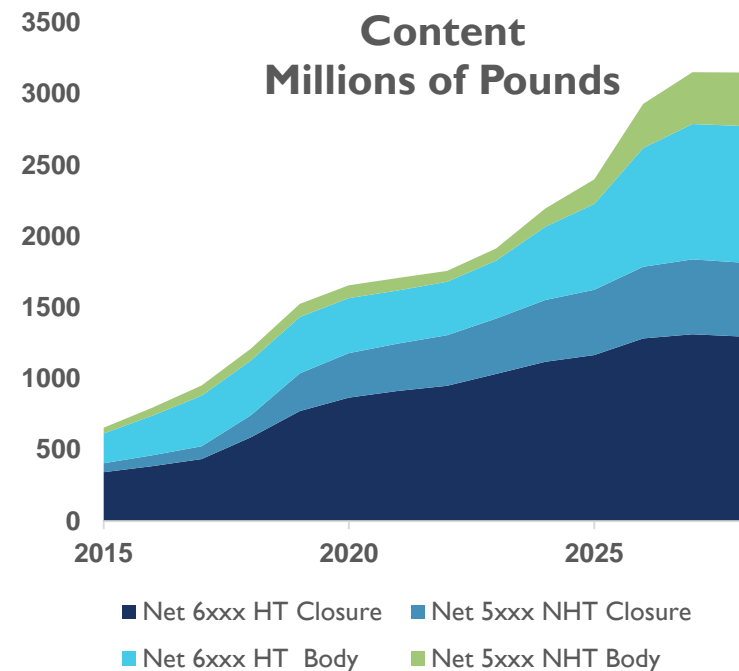


ALUMINUM BODY SHEET GROWTH (2015:2028)

Aluminum Sheet Growth
BIW & Closure
7% Mass Reduction 2028

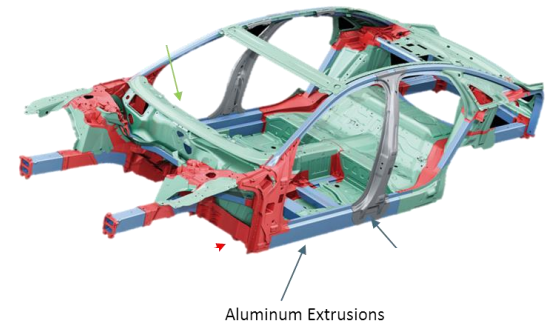
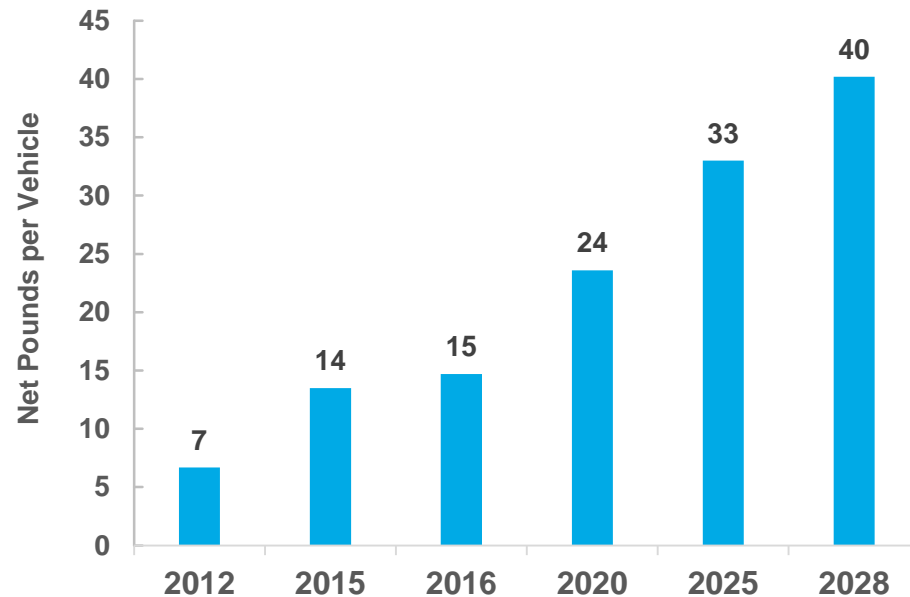


Net Aluminum B & C
Content
Millions of Pounds



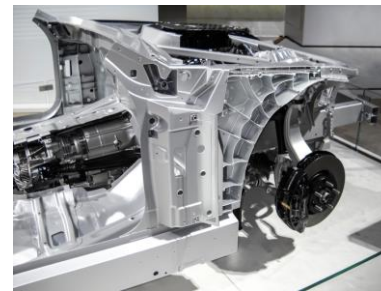
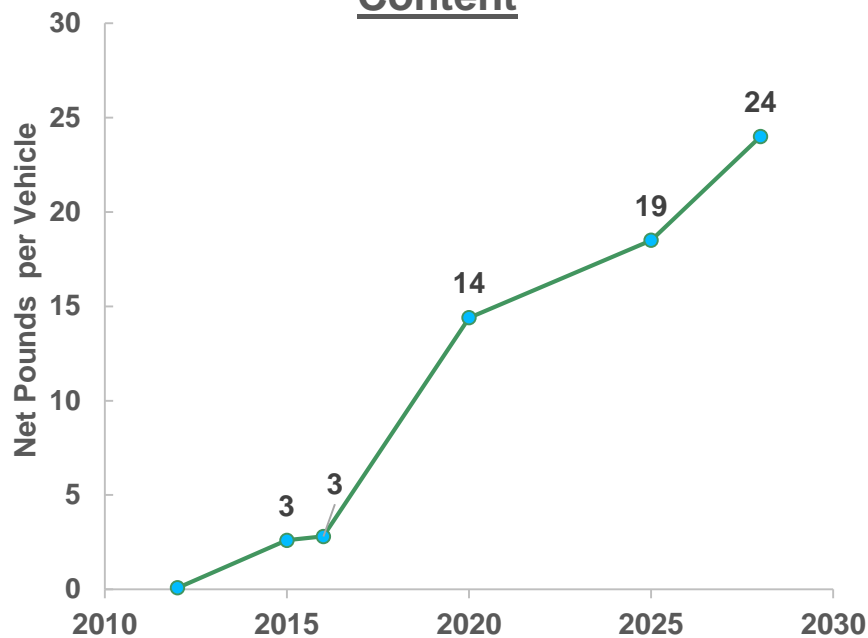
ALUMINUM EXTRUSION GROWTH (2015:2028)

BIW and CMS Extruded Shapes and Tube

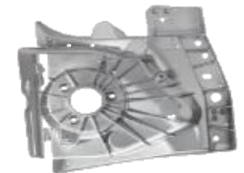
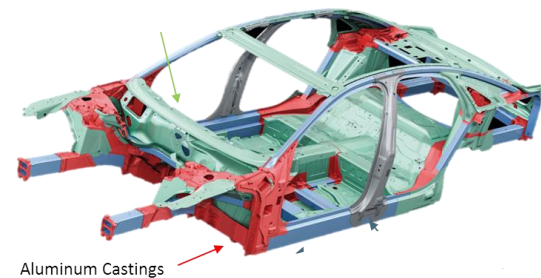


ALUMINUM VACUUM DIE CASTINGS (2015:2028)

Aluminum Vacuum Die Casting
Content

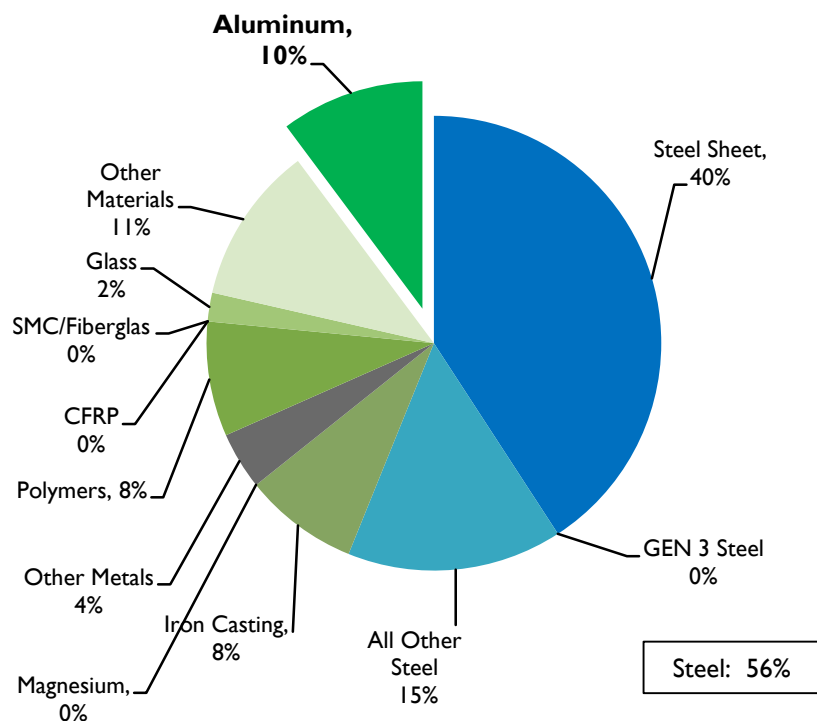


CT6: 198 Lbs.

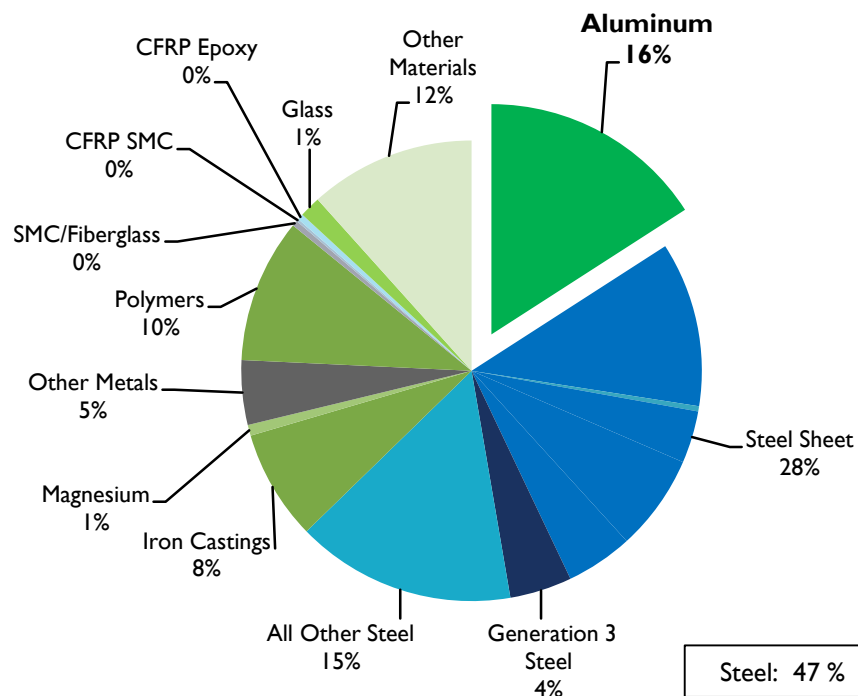


AUTOMOTIVE MATERIALS CONTENT SHIFT (2015:2025[28])

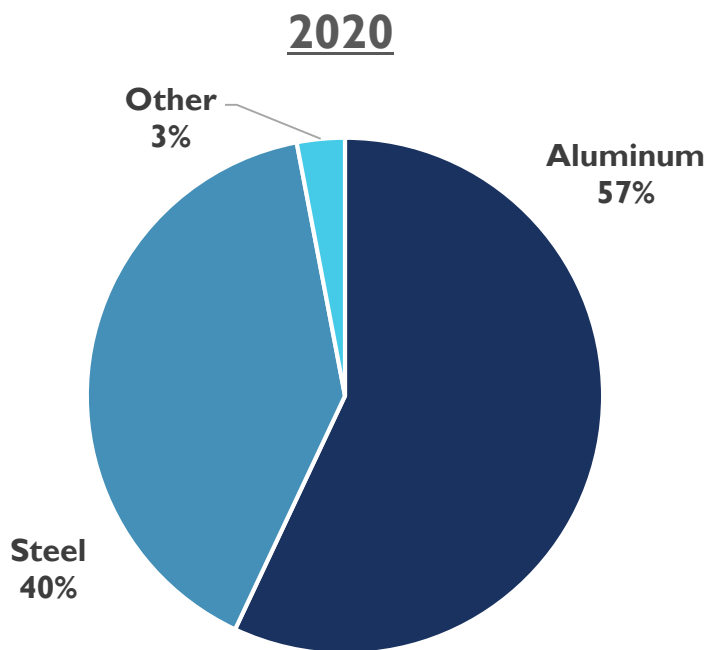
2015 CURB WEIGHT
3835 Lbs.



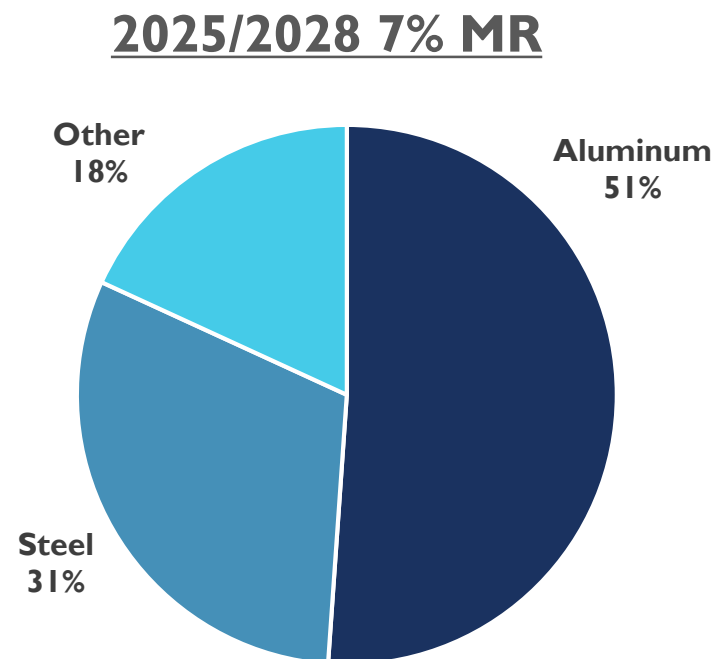
2025 CURB WEIGHT
3554 lbs.



SOURCES OF MATERIALS RELATED MASS REDUCTION



Average Mass = 3735 Lbs. (-100 Lbs.)



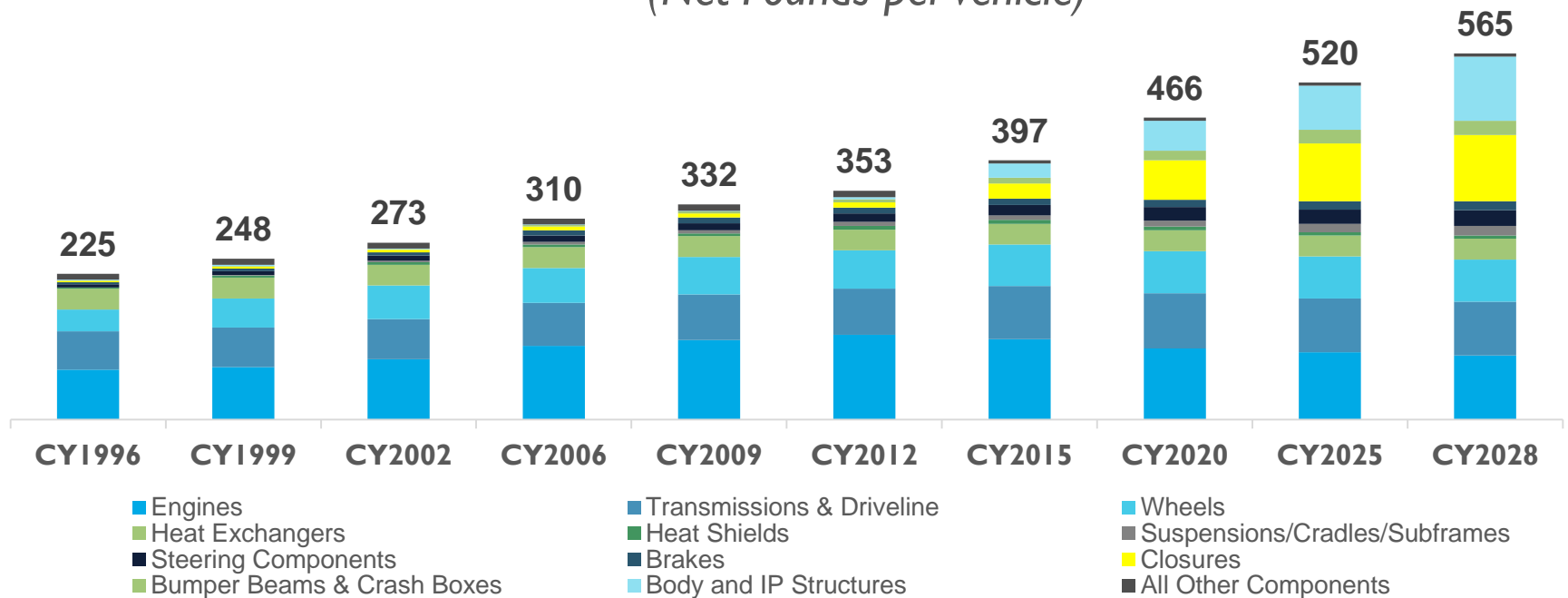
Average Mass = 3565 Lbs. (-270 Lbs.)

*** Reference: 2015 Average Mass 3865 Lbs.**

7% MASS REDUCTION SCENARIO BY 2028

North American Net Aluminum Content in Light Vehicles

(Net Pounds per Vehicle)



ALUMINUM: THE FASTEST GROWING AUTOMOTIVE MATERIAL

GROWTH SURGE 2015:2028+



DOWNLOAD FULL REPORT

www.DriveAluminum.org



ALUMINUM CONTENT IN NORTH AMERICAN LIGHT VEHICLES 2016 TO 2028

Summary Report

July 2017

This Report Has Been Prepared Solely For :



DUCKER WORLDWIDE

THANK YOU

Please submit questions through the box that appears on your screen

*Full Report available for download:
www.DriveAluminum.org*

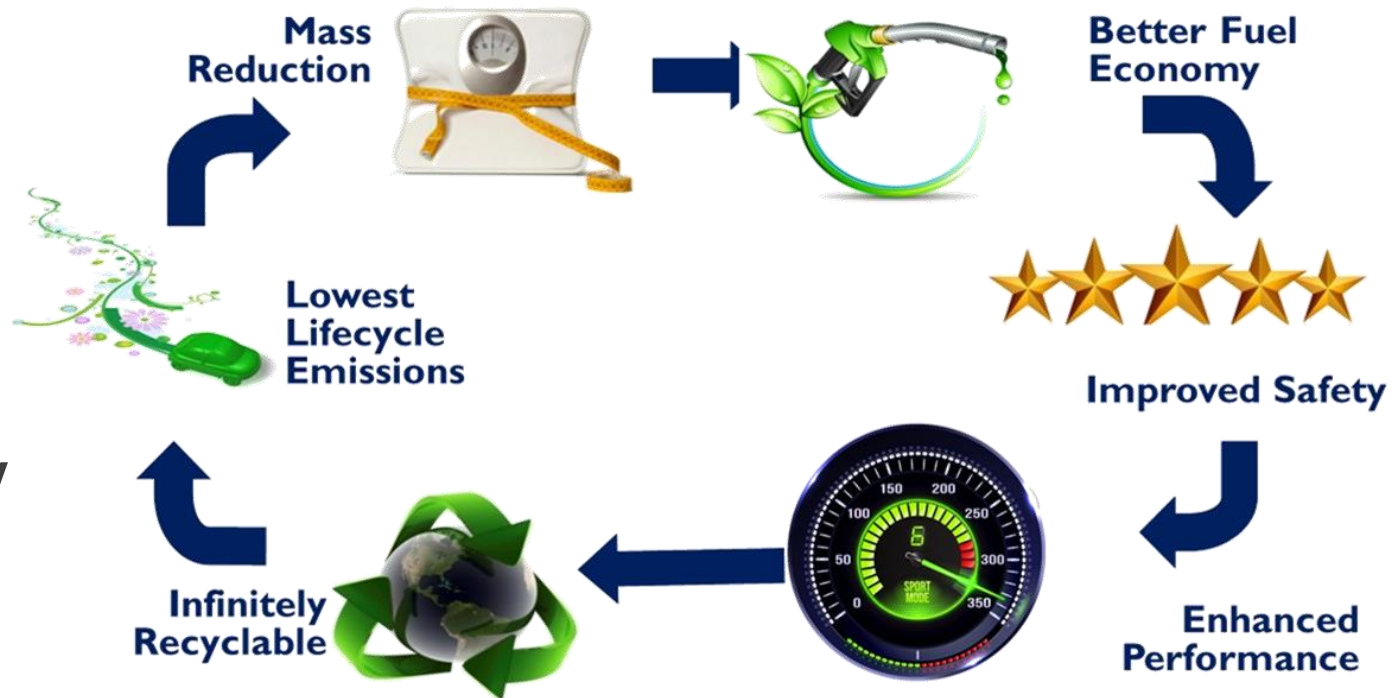


SCENARIO MODELING CONSTRAINTS

- Weight savings from aluminum constrained to 50%.
- Model replacement cadence 2023 to 2026
 - conducive to some dramatic changes in materials and powertrains
- OEM preferences recognized in study
 - spot welded body structures, aluminum structural castings
 - advanced steels for occupant compartments, steel/polymer for pickup cargo
- Emphasis on proven mass production technologies
- Advanced material technology
 - most 2025 technology already in OEM development (Al, Steel, Composites)

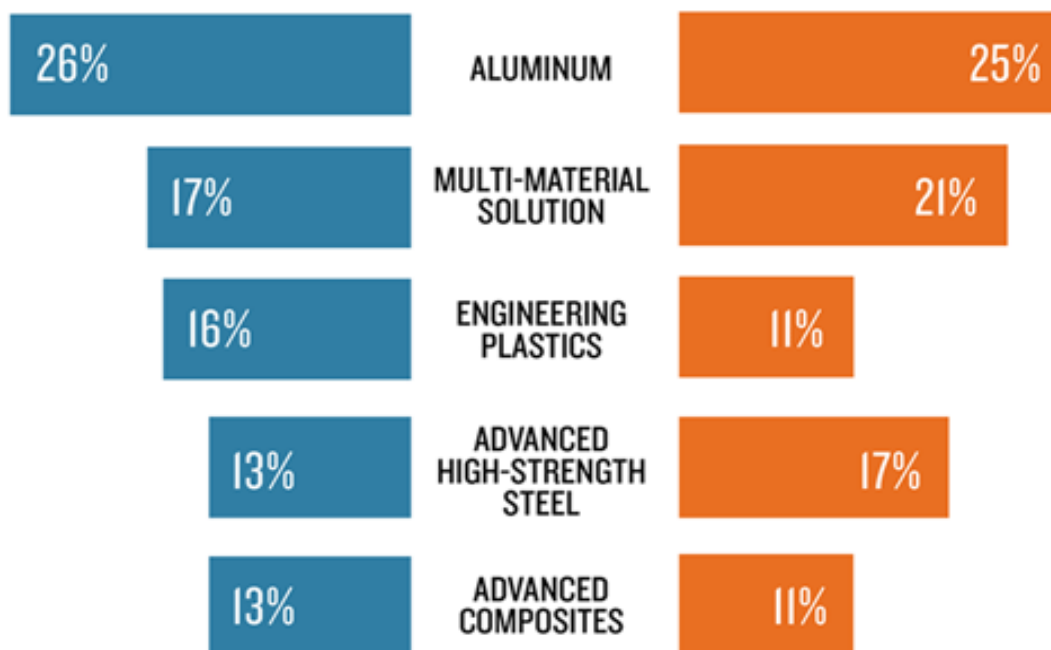
CONSUMERS ARE RECOGNIZING BENEFITS OF LIGHTWEIGHTING

- Safety
- Performance
- Fuel Economy
- Braking
- Handling
- Ride



AUTO INDUSTRY FAVORS ALUMINUM, MULTI-MATERIAL SOLUTIONS

Question: Which material family are you relying upon most heavily to help meet the 2025 CAFE fuel economy standards?



Base: 678 Not Shown: Magnesium 2%; Other, 13%

Base: 492 Not Shown: Magnesium 1%; Other, 14%

■ 2017 Response ■ 2016 Response

Source: 2017 WARDAUTO, DuPont Automotive Trends Benchmark Study, conducted by Penton Research

ALUMINUM 2020 BY VEHICLE SEGMENT

2020 Vehicle Segment Average Aluminum Pounds and Share of 2020 Production

A/B Segment
Fiat 500
Ford Fiesta



240.6 lb.'s

3% of Production

MPV Segment
Honda Odyssey
Chrysler Pacifica



399.7 lb.'s

3% of Production

C Segment
Ford Focus
Honda Civic



278.4 lb.'s

15% of Production

SUV Segment
Chevy Suburban
Jeep Grand Cherokee



475.1 lb.'s

41% of Production

D Segment
Chevy Malibu
Dodge Charger
MUSTANG



447.6 lb.'s

17% of Production

VAN Segment
Dodge Sprinter
Ford Transit



338.9 lb.'s

2% of Production

E Segment
Daimler E Class
Cadillac CT6



490.0 lb.'s

2% of Production

PUP Segment
Ford F150
Toyota Tundra



676.3 lb.'s

17% of Production

STUDY FINDINGS: 2020

- Aluminum content 2015 to 2020:

	<u>2015</u>	<u>2020</u>
Average Aluminum Pounds per Vehicle	397	466
% Share of Curb Mass per Vehicle	10%	13%
Average Curb Mass Pounds per Vehicle	3835	3735

- 50% of total aluminum growth driven by:
closures, crash management, steering knuckles, structural vacuum die castings
- Aluminum content range by vehicle segment
262 PPV in the A/B segment passenger cars
550 PPV for the average pickup.

UNPRECEDENTED ALUMINUM GROWTH

2015:2028

- + 168 PPV (+ 12 PPV per year)
- + 3.2 B Lbs. p.a.
- Major growth:
closures, BIW, bumpers
- Maintain import role:
engine, wheels, heat exchanger, driveline
- Emerging AL technologies:
materials advancements, VDC, MicroMill



By 2028

- 565 PPV (2015 397 PPV)
- 16% of average vehicle mass (2015 10%)
- 10.8 B lbs. year - Total Auto Aluminum (2015 6.9 B)

