

A grayscale photograph of an automotive assembly line. In the foreground, a car's body is being worked on by a robotic arm. The background shows a complex network of metal structures, pipes, and other robotic components. A sign with 'P 22' is visible on the right side of the frame. The overall scene is industrial and technical.

DUCKER WORLDWIDE

CRITICAL THINKING FOR CRITICAL DECISIONS.

THE ROAD AHEAD – AUTOMOTIVE MATERIALS
WWW.DUCKER.COM | 2016

CRITICAL THINKING FOR CRITICAL DECISIONS



MARKET RESEARCH

Ducker gathers unique market, customer and competitive insights when others cannot. Leveraging industry expertise and research capabilities, Ducker develops sound strategies to win in existing and new markets



TRANSACTION ADVISORY

Ducker's transaction advisors assist clients with searching and researching acquisition targets, and provide best-in-class diligence to de-risk M&A transactions. It's a natural extension of our consulting and research services



GROWTH CONSULTING

With a dynamic fact-based and advanced business analytics, Ducker works with management to develop actionable strategies and detailed go-to-market plans that represent best-fit solutions

GLOBAL INSIGHTS THAT OUTSMART THE COMPETITION



Americas

Troy, Michigan (*Global Headquarters*)

Europe

Paris, France

Berlin, Germany

London, United Kingdom

Asia-Pacific

Bangalore, India

Shanghai, China



Ducker Worldwide employs a seasoned team of 150 full-time consultants, located throughout North America, Europe, and Asia-Pacific.

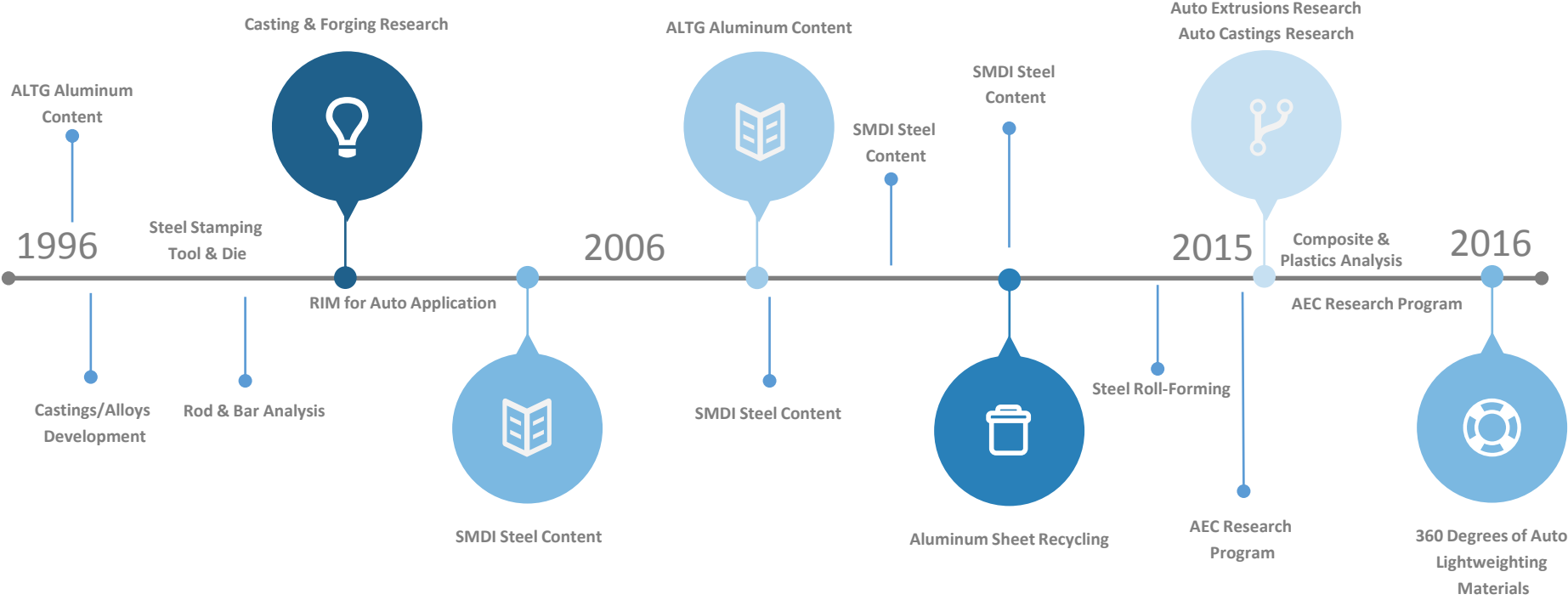
Our team covers all major languages required to do business in Europe, Asia, India, Africa, and the Middle East. This ensures the best cultural fit and most accurate exchange of information needed to turn insights into effective decisions.



In addition to Ducker's general markets served, Ducker Europe brings their considerable expertise to the emerging energy and environmental industries.

Ducker also offers operational consulting in India and critical data analytics for complex markets across the region.

SINCE 1996 DUCKER WORLDWIDE HAS:



REGULATORY ENVIRONMENT



DUCKER WORLDWIDE

REGULATORY ENVIROMENT

NEW DRAFT TAR 2016 FROM THE EPA INIDCATES SOME EXPECTED MOVEMENT

54.5 MPG For All Cars by 2025 With New CAFE Standards? Not Exactly

Government raises fuel economy standards, but don't expect gas-guzzling SUVs anytime soon.



54.5-mpg rules expected to stick

David Shepardson, Detroit News Washington Bureau 11:30 p.m. EDT April 7, 2015

GREEN CARS TRAVERSE CITY

54.5 mpg isn't a done deal, EPA official says

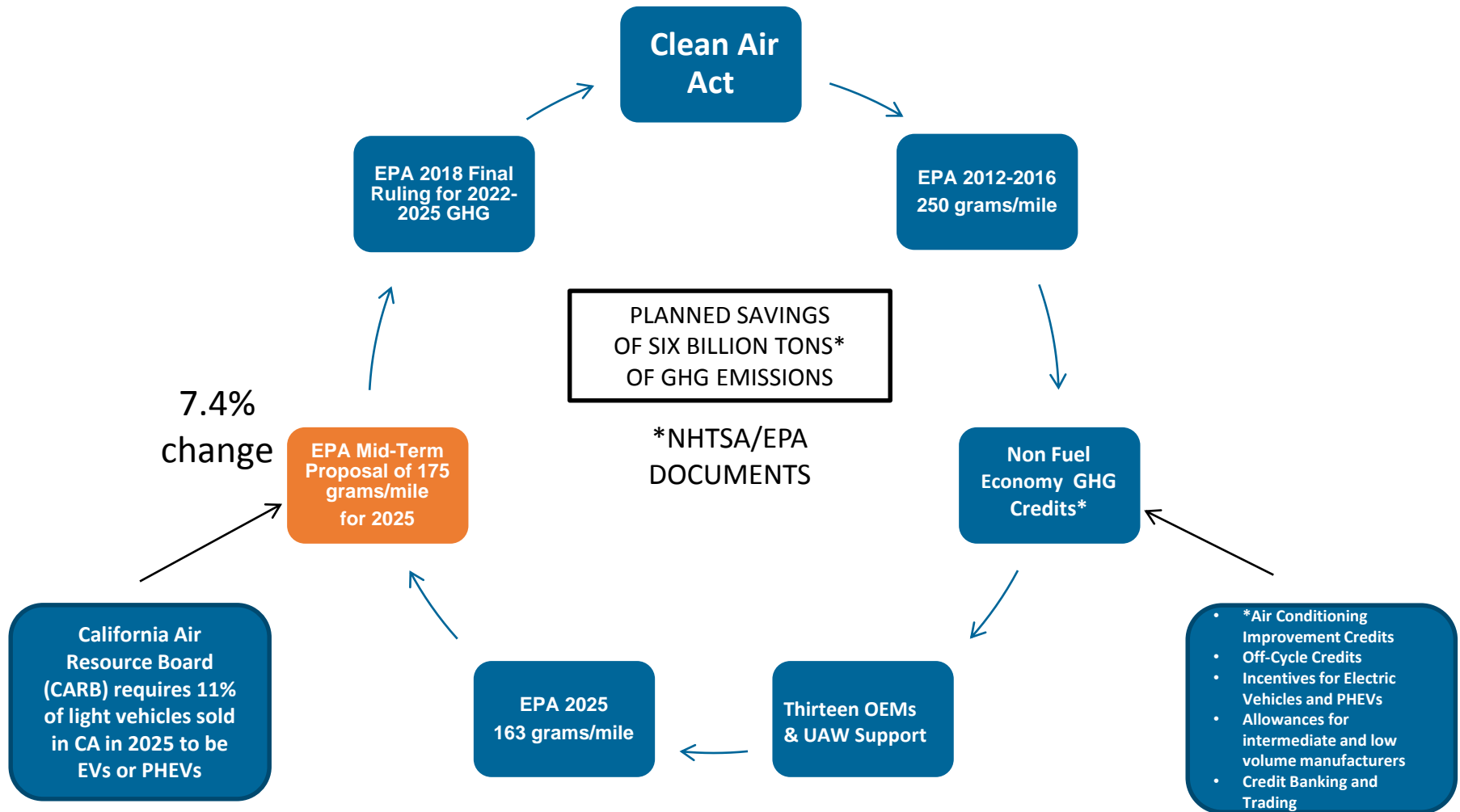
Decision on proposed '25 model year standard will come in '18

Feds: New 2025 CAFE 'target' could be about 50.8 mpg, down from infamous 54.5 mpg

By John Huetter on July 27, 2016



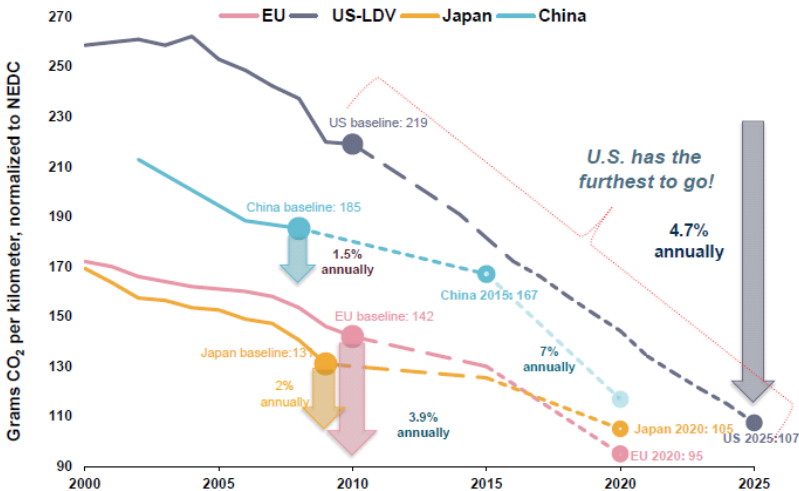
EPA CO2 GREENHOUSE GAS EMISSION REDUCTIONS



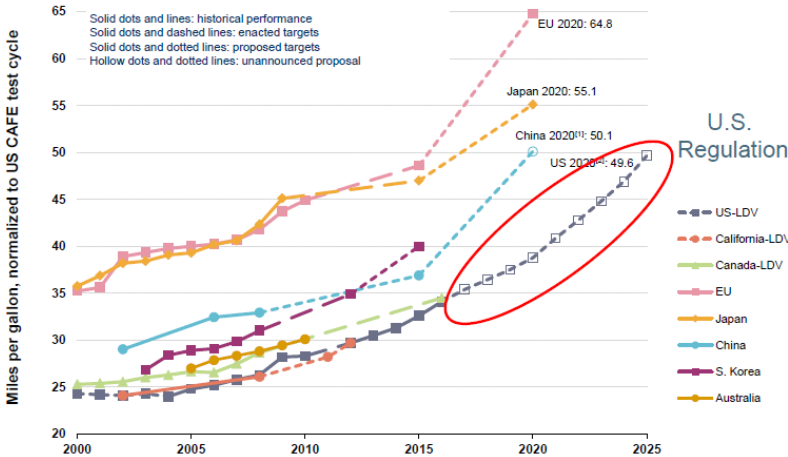
REGULATIONS

STILL REQUIRE CO2 TO BE CUT BY ONE HALF AND MPG TO BE DOUBLED BY 2025

CO2 DOWN

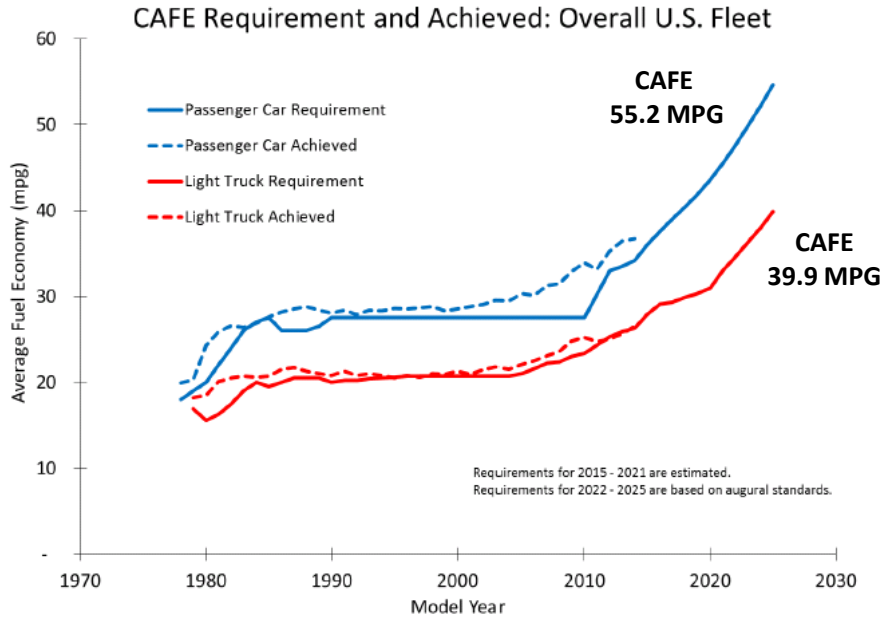


MPG UP



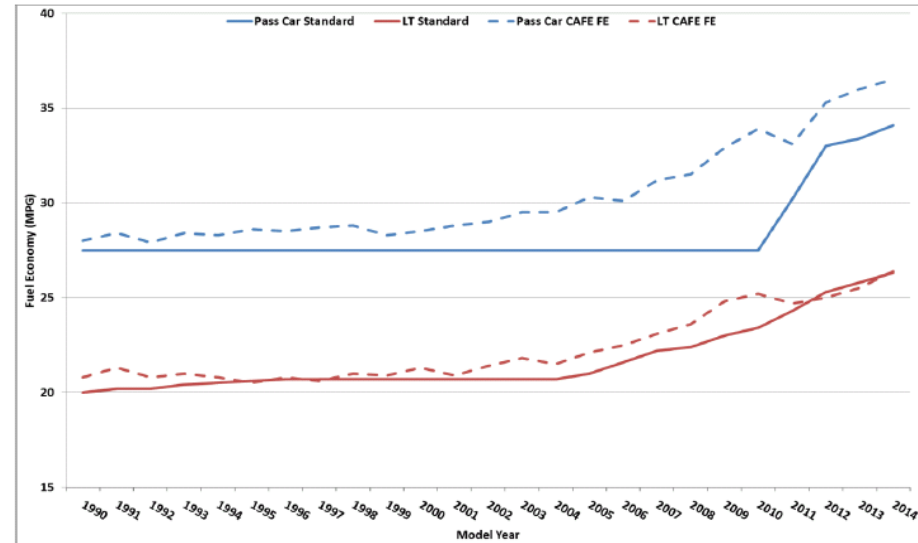
REGULATIONS

OEMs HAVE DEMONSTRATED THEY CAN MEET HIGHER CAFE TARGETS WHEN PRESENTED WITH THE CHALLENGE



Draft TAR 2016 Figure 1.1 Average Required and Achieved Fuel Economy Levels

Meeting Light Truck CAFE is More Difficult Than Meeting Car CAFE



Draft TAR 2016 Figure 13.4 Industry Average CAFE and Standard 1990 - 2014

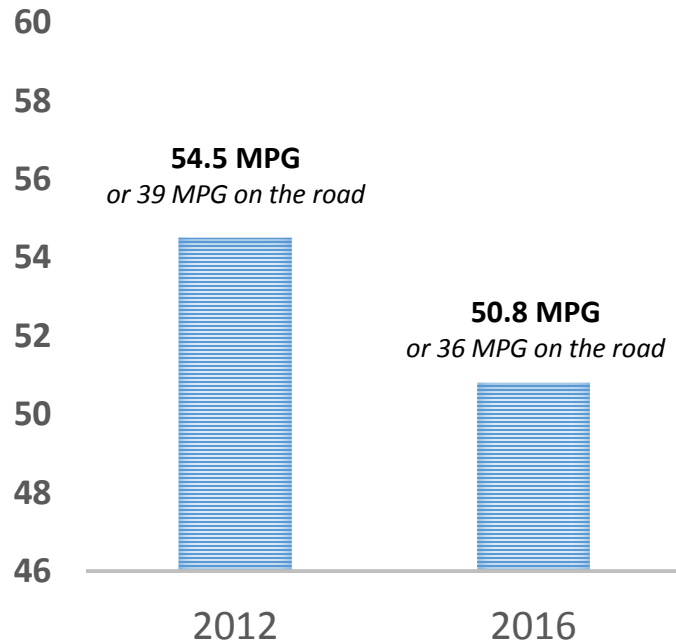
2016 TAR Targets for 2025	Car	Truck	Fleet
CO2 Target as MPG	60.3	43.2	50.8*
Effective MPG with Credits	55.2	39.9	46.7
On the Road MPG	42.6	30.8	36.0

*2012 Calculation was 54.5 MPG.

REGULATIONS

TEST TARGETS ARE UNCHANGED, MIX OF CAR AND TRUCK DRIVE NEW NUMBERS AND CAN LEAD TO VARIABILITY IN ULTIMATE MPG GOALS

TEST TARGET MPG FOR 2025



2016 DRAFT TECHNICAL ASSESSMENT REPORT

	Base	Base	High	Low
2025 Assumptions	2012	2016	2016	2016
Car Share	67%	52%	62%	48%
Light Truck Share	33%	48%	38%	52%
CO2 (g/mile) Compliance Target	163	175	169	178
CO2 (g/mile) On the Road	205	220	213	224
MPG Compliance Target	54.5	50.8	52.6	50.0
MPG On the Road	39	36	37	35

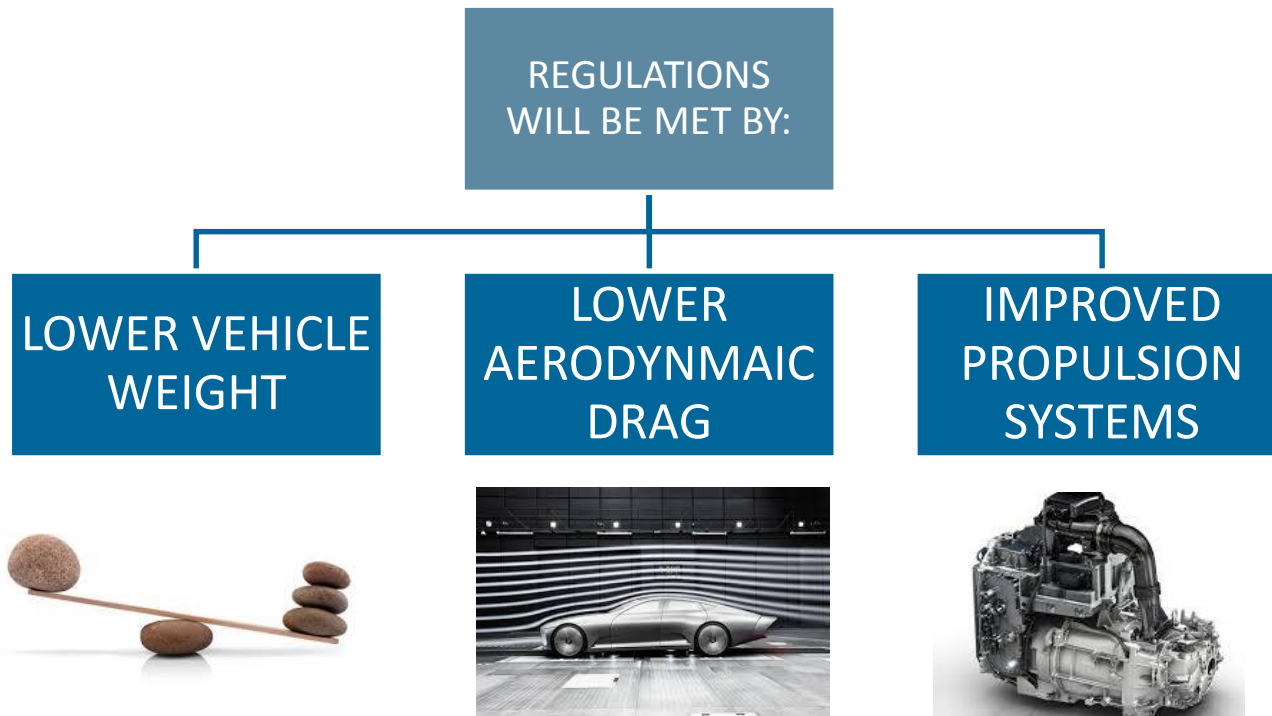


THE SOLUTION



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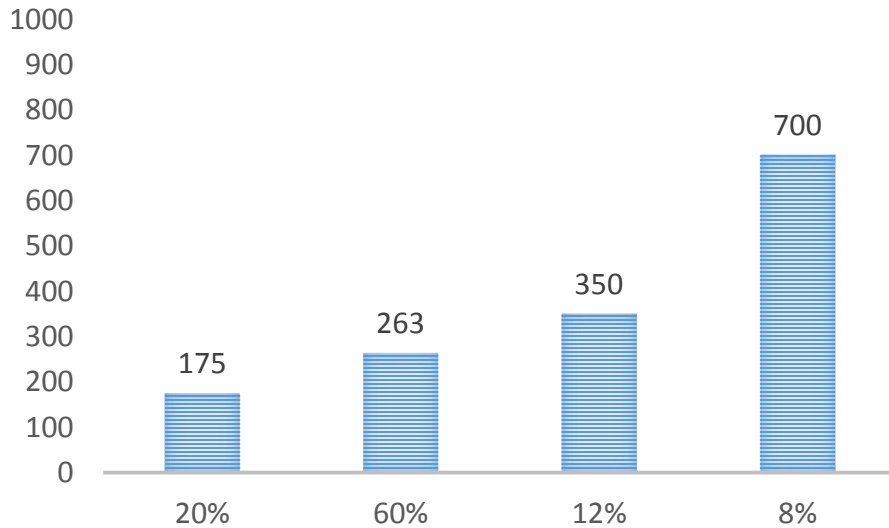
THE SOLUTION



MASS SAVINGS

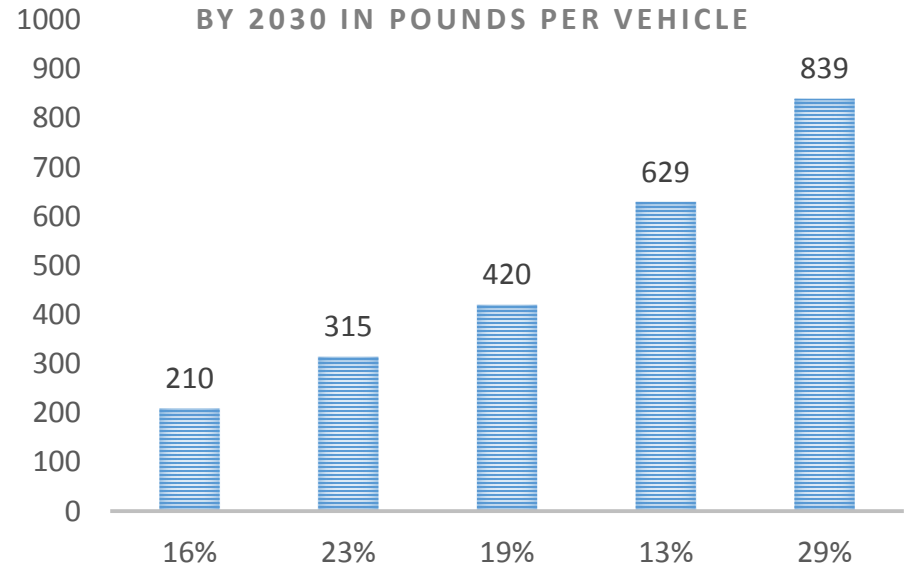
BY 2030 PASSENGER CARS WILL NEED TO SAVE ANYWHERE FROM 175 POUNDS TO 700 POUNDS AND LIGHT TRUCKS FROM 210 POUNDS TO NEARLY 850 POUNDS

PASSENGER CAR WEIGHT SAVINGS BY 2030 IN POUNDS PER VEHICLE



Eighty Percent of the passenger cars will require mass reduction between 263 pound per vehicle and 350 pounds per vehicle

LIGHT TRUCK WEIGHT SAVINGS BY 2030 IN POUNDS PER VEHICLE



Nearly thirty percent of the light trucks will require mass savings of approximately 840 pounds

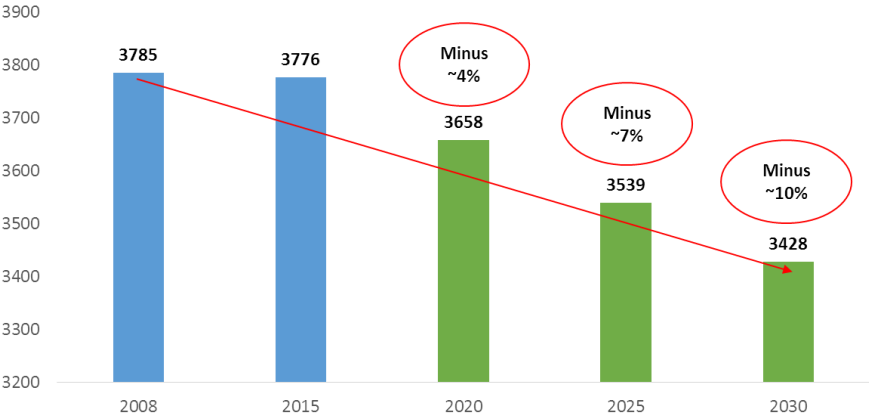
Source: Draft TAR Chapter 13

MASS SAVINGS

EXPECTED MASS REDUCTION WILL BE VARIABLE GIVEN VEHICLE SIZE CLASS. LARGER VEHICLES WILL REQUIRE GREATER SAVINGS

A curb weight reduction of nearly 400 pounds is required to meet the CO2 mandates

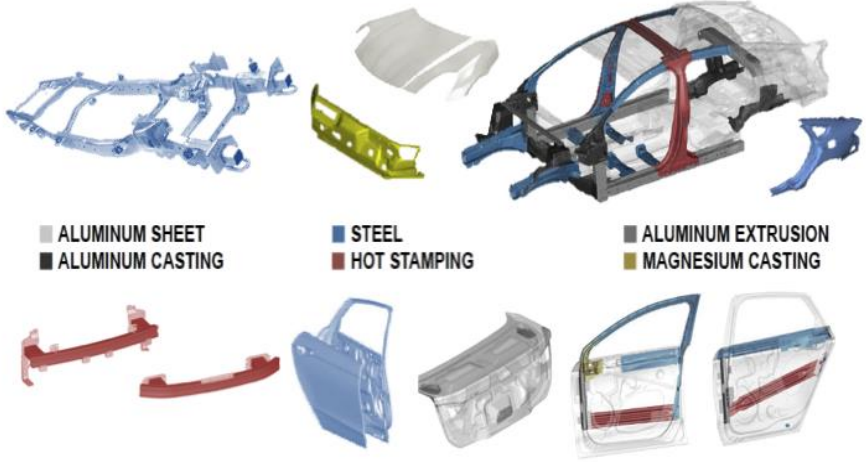
Targeted Curb Weight



The weight savings are for vehicle curb weight and are mix dependent; savings from the Body in White and Closures will account for a greater share

10%

Is Needed

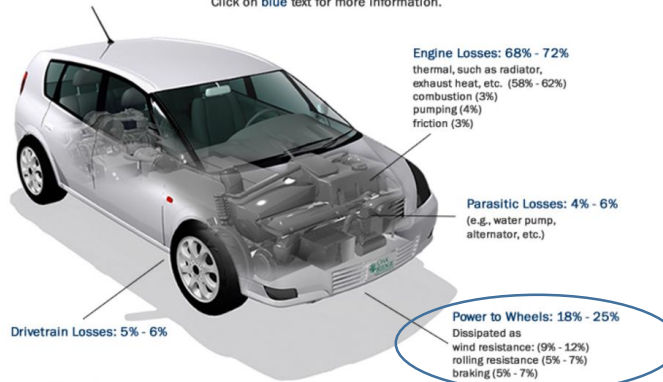


AERODYNAMIC IMPROVEMENTS



Energy Requirements for Combined City/Highway Driving

Click on blue text for more information.



Source: Fueleconomy.gov

PROPULSION

THE UNFORSEEN DECLINE IN GASOLINE PRICES HAS HAD A PROFOUND IMPACT ON VEHICLE MIX AND POWERTRAIN

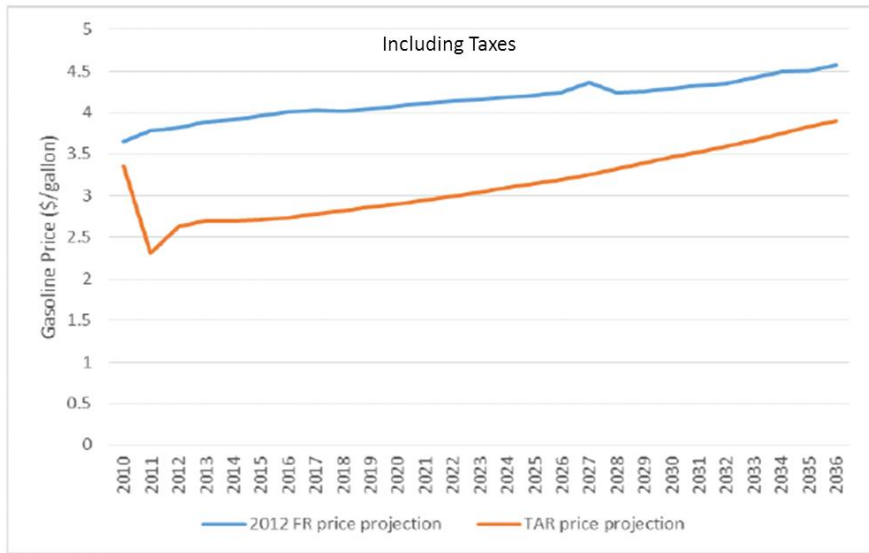
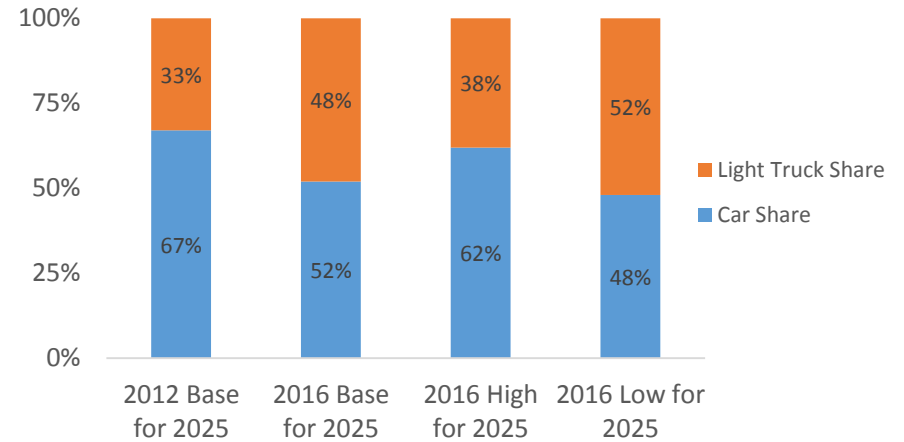


Figure 13.16 Comparison of Fuel Price Estimates in Draft TAR and 2012 Final Rule Analysis

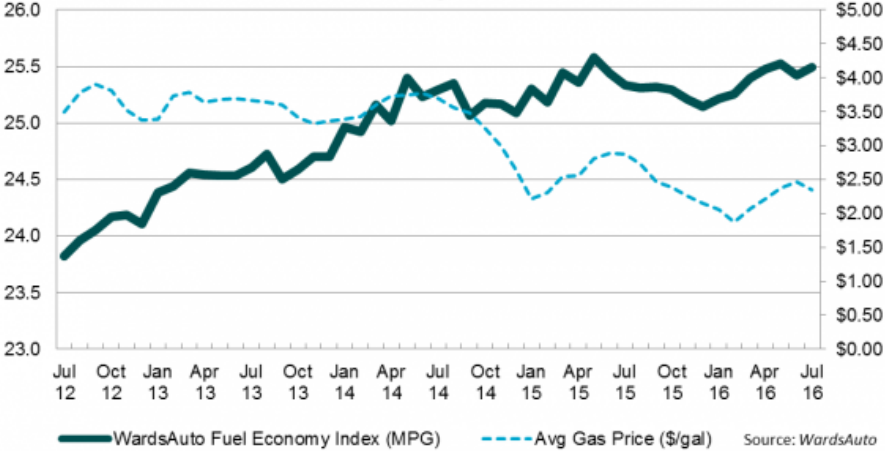
Car vs. Truck Mix 2012 vs. 2016 Estimates for the 2025 Mix with a Range of Fuel Prices



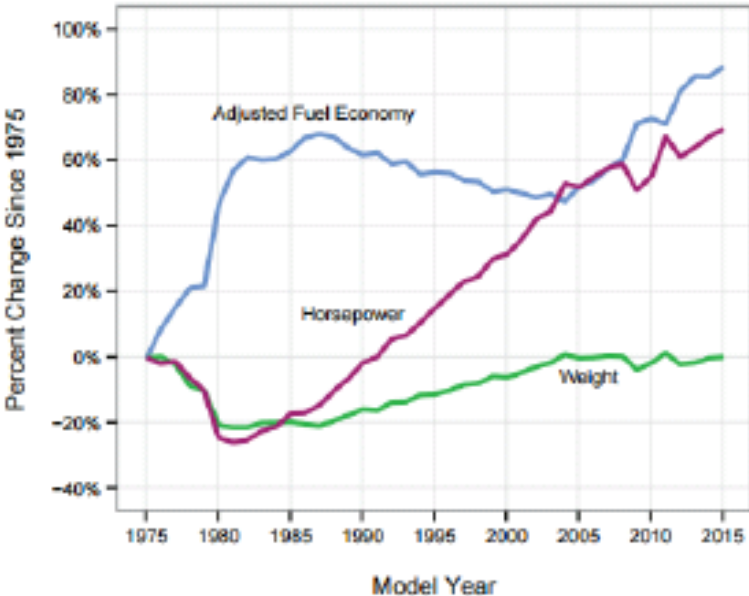
PROPULSION

IC ENGINES HAS CLOSED THE GAP AT A FASTER RATE THAN EXPECTED. MPG HAS INCREASED AS HAS HORSEPOWER

WardsAuto Fuel Economy Index 25.5 mpg
July 2016



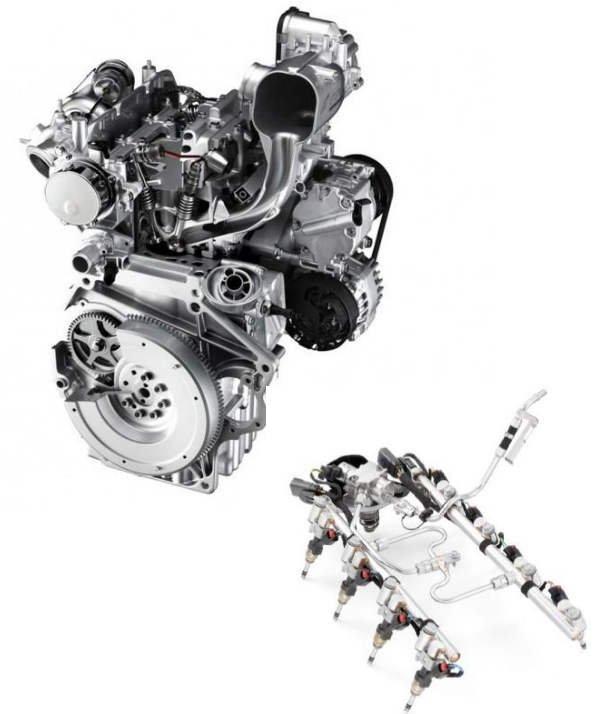
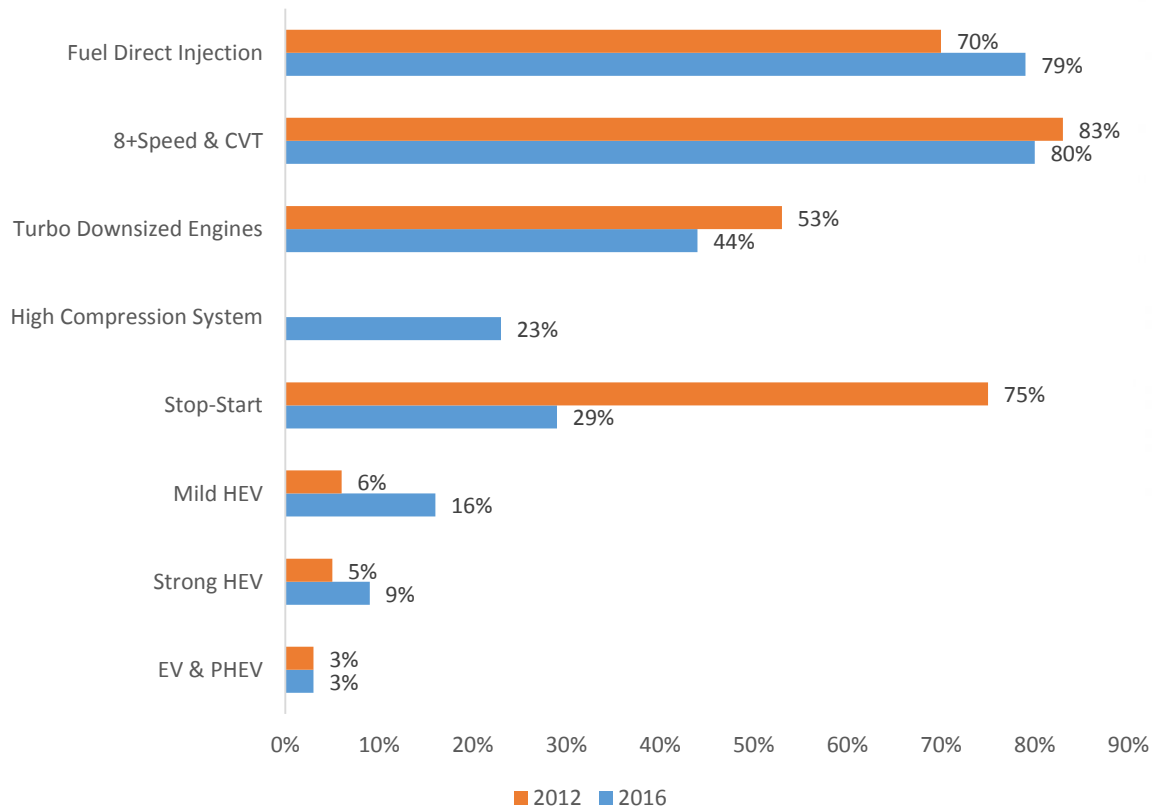
Change in Adjusted Fuel Economy, Weight, and Horsepower for MY 1975-2015



PROPULSION

LEADS TO AN ALTERED PROJECTION FOR POWERTRAIN TECHNOLOGIES

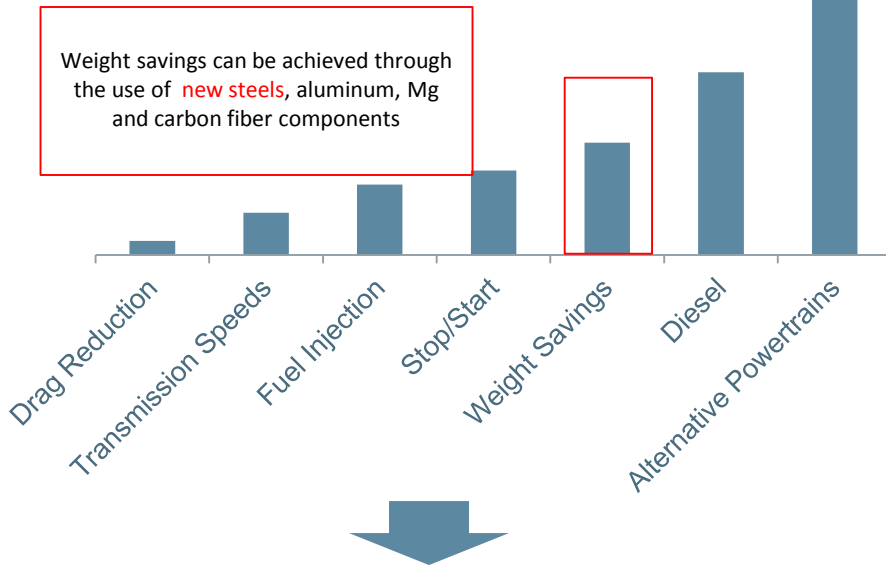
2025 Powertrain Technology Penetration Estimates
(2012 vs. 2016)



WEIGHT SAVINGS CAN BE COSTLY

A VARIETY OF OLD AND NEW TECHNOLOGIES WILL BE NEEDED TO ACHIEVE THE NEARLY 100% IMPROVEMENT IN FUEL ECONOMY BY 2025

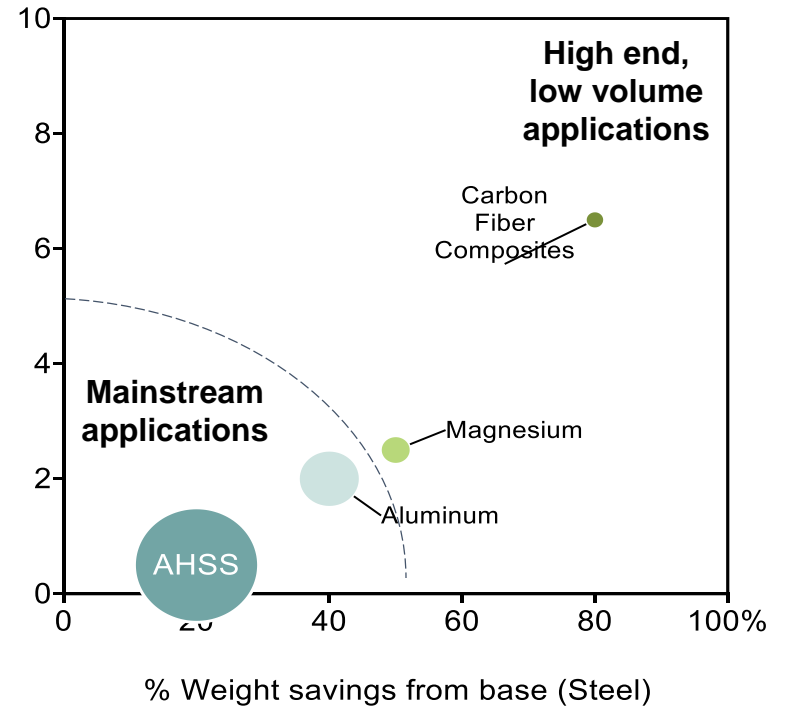
RELATIVE COST FOR 1% IMPROVEMENT IN FUEL ECONOMY



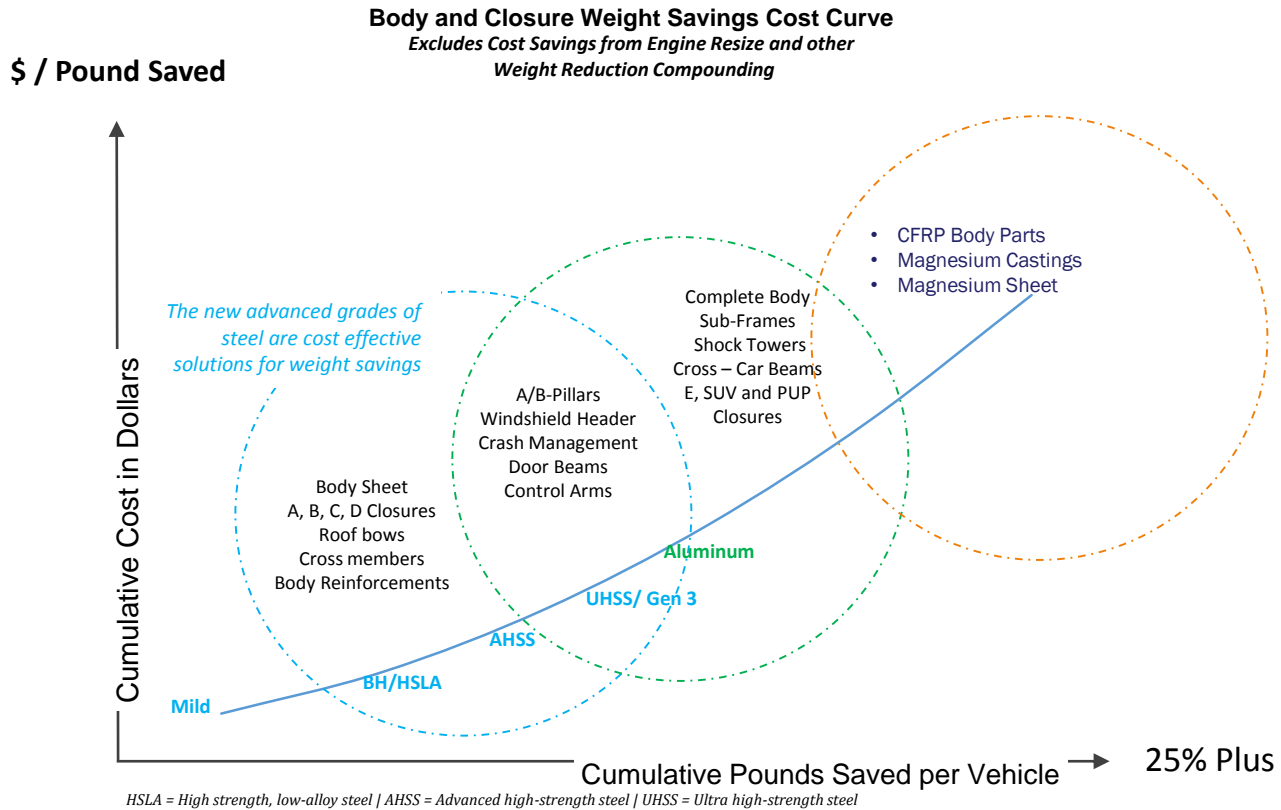
EACH OF THESE TECHNOLOGIES COMES WITH A DIFFERENT COST FOR A 1% IMPROVEMENT IN FUEL ECONOMY

Source: Ducker Analysis

Extra \$ /pound saved



VEHICLE MANUFACTURING COST VS. WEIGHT SAVINGS





LIGHT VEHICLE MATERIALS TODAY

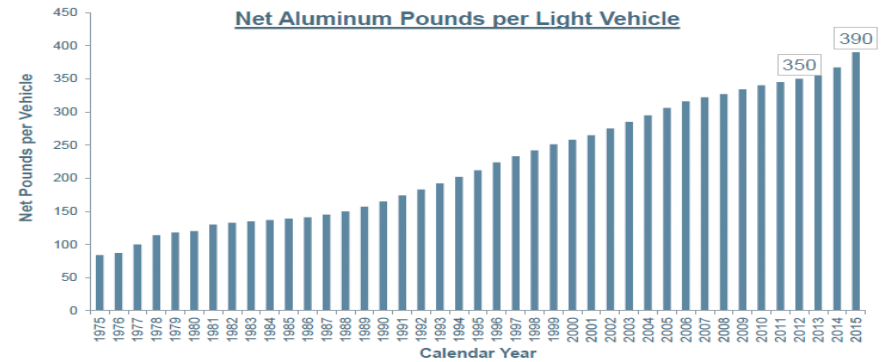
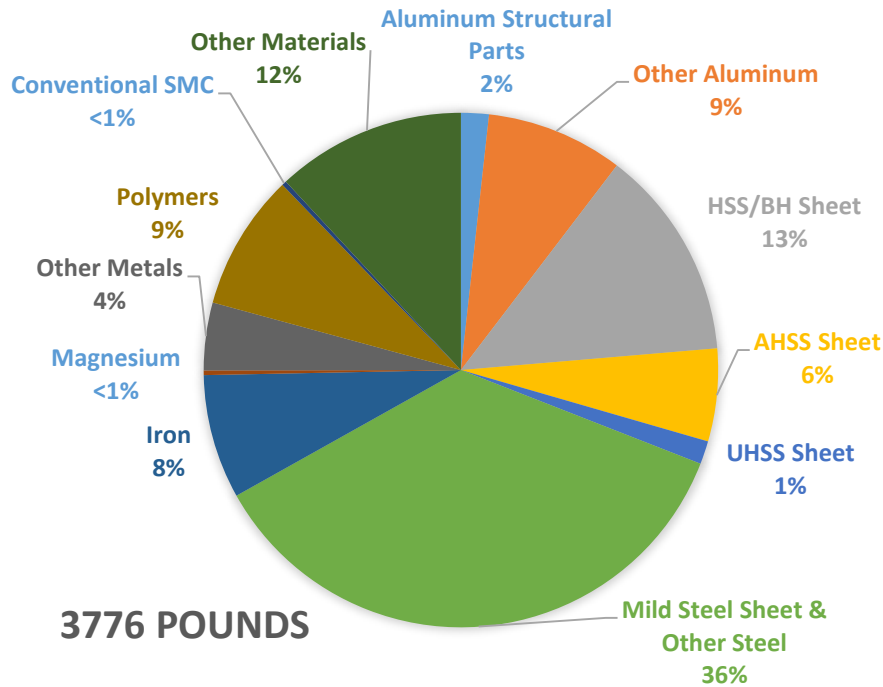


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LIGHT VEHICLE MATERIALS TODAY

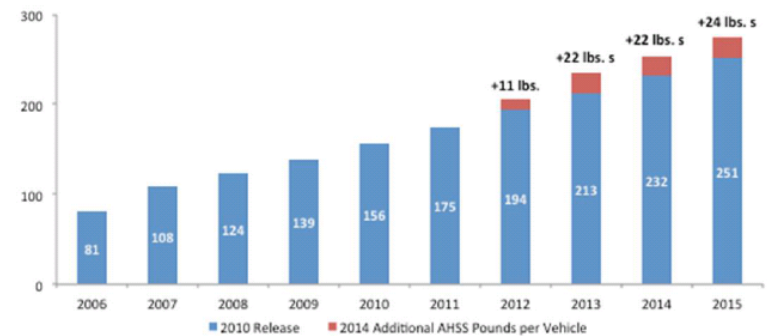
IN 2015, STEEL IN ITS VARIOUS FORMS ACCOUNT FOR OVER 55% OF THE CURB WEIGHT, WITH ALUMINUM AT 11%

2015 Material Mix of Curb Weight



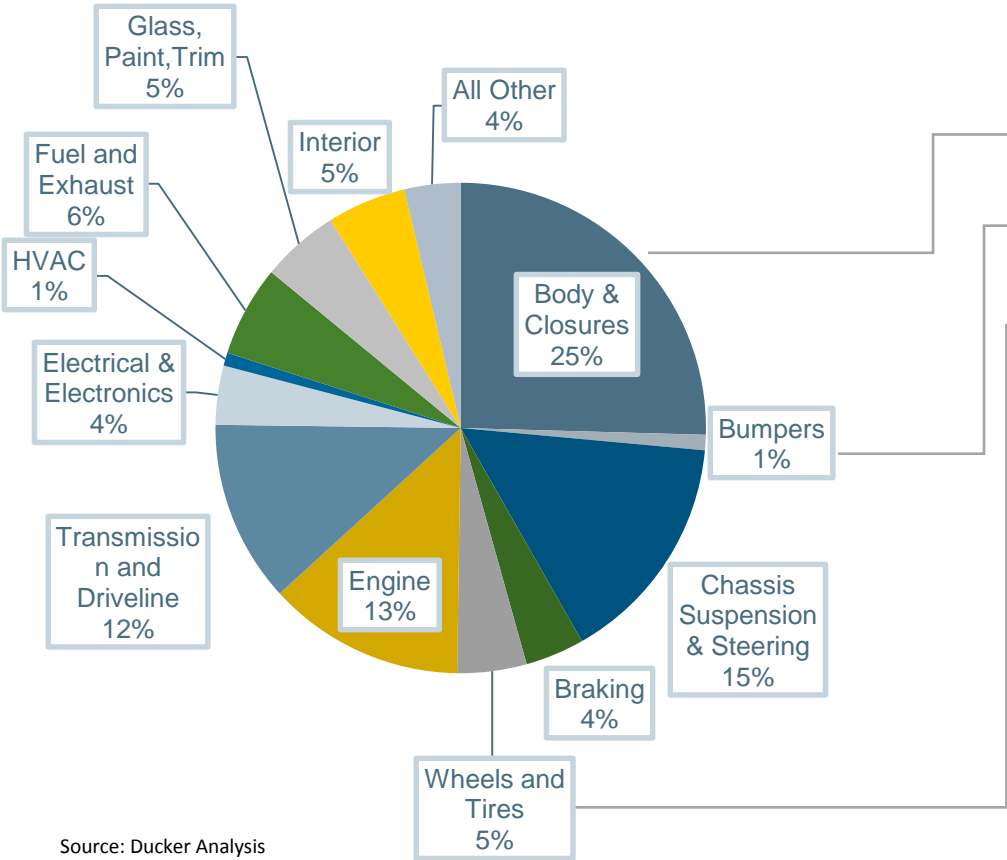
AHSS KEEPS GROWING

AHSS Pounds per Vehicle 2010 Study vs. 2013/14 Study



WHERE IS THE WEIGHT?

WHERE ARE THE MATERIALS USED IN THE AVERAGE LIGHT VEHICLE TODAY?



BODY PARTS, CLOSURES, BUMPERS, CHASSIS AND SUSPENSION PARTS ARE THE PRIME CANDIDATES FOR FURTHER WEIGHT REDUCTION

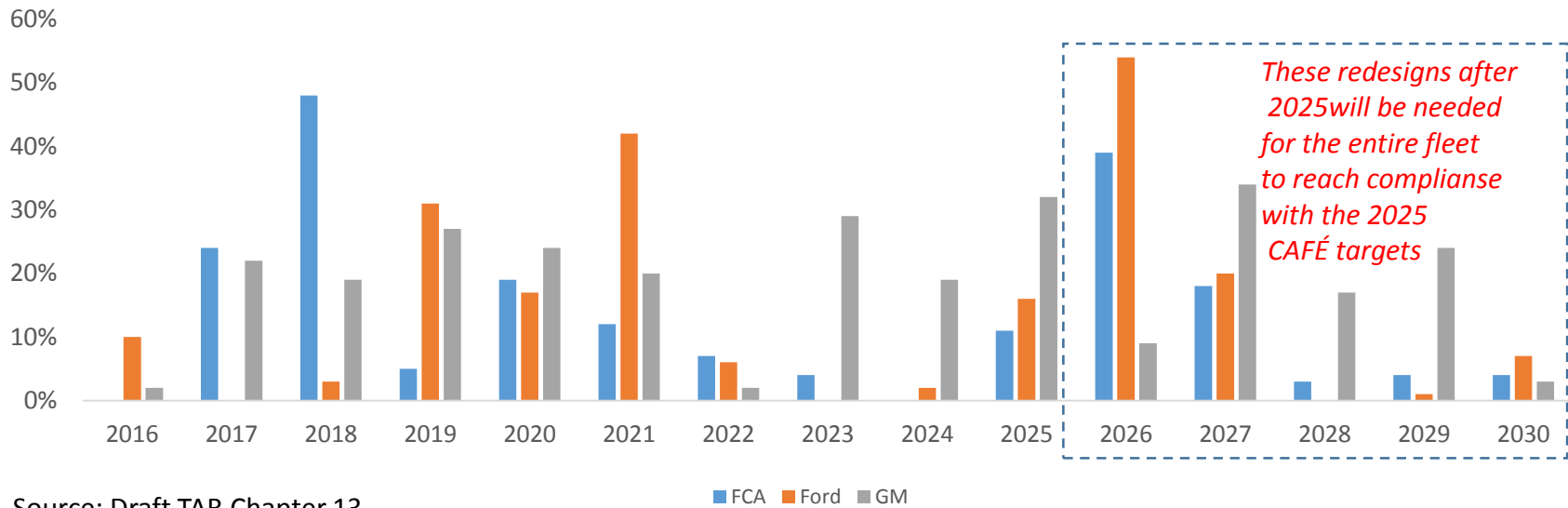
Source: Ducker Analysis

3776 POUNDS

OEM ENVIROMENT

The number of new vehicles to be launched over the next five years will give the OEMs many opportunities to introduce the latest weight saving technologies. Several of these vehicles will still be in production in 2025. OEMs are only willing to use proven technologies for high volume programs.

Launch Pattern for Redesigned FCA, Ford and GM Light Vehicles



Source: Draft TAR Chapter 13



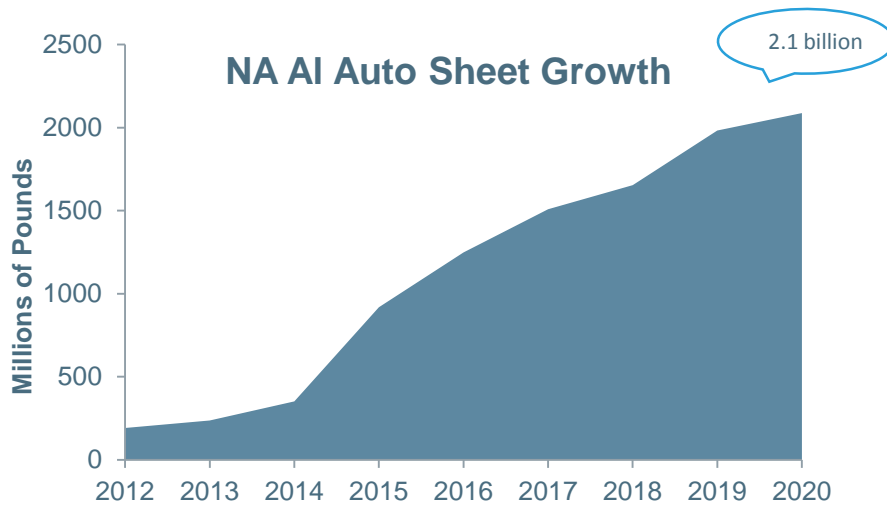
THE FUTURE



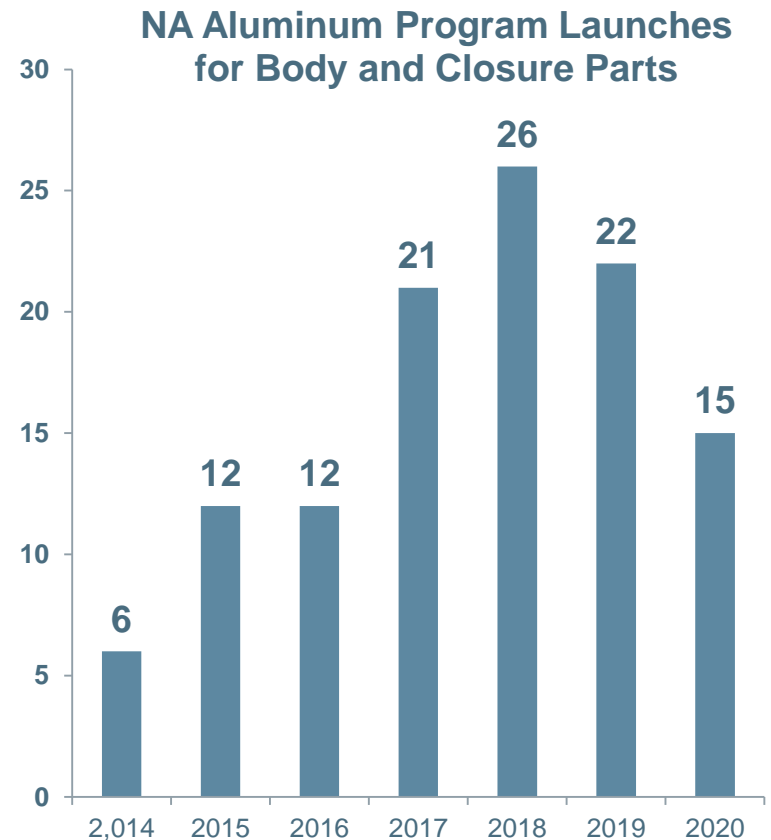
DUCKER WORLDWIDE

WHAT DO WE KNOW ABOUT ALUMINUM IN THE SHORT TERM?

4Q15 Ducker forecast for aluminum body and closure sheet in North America

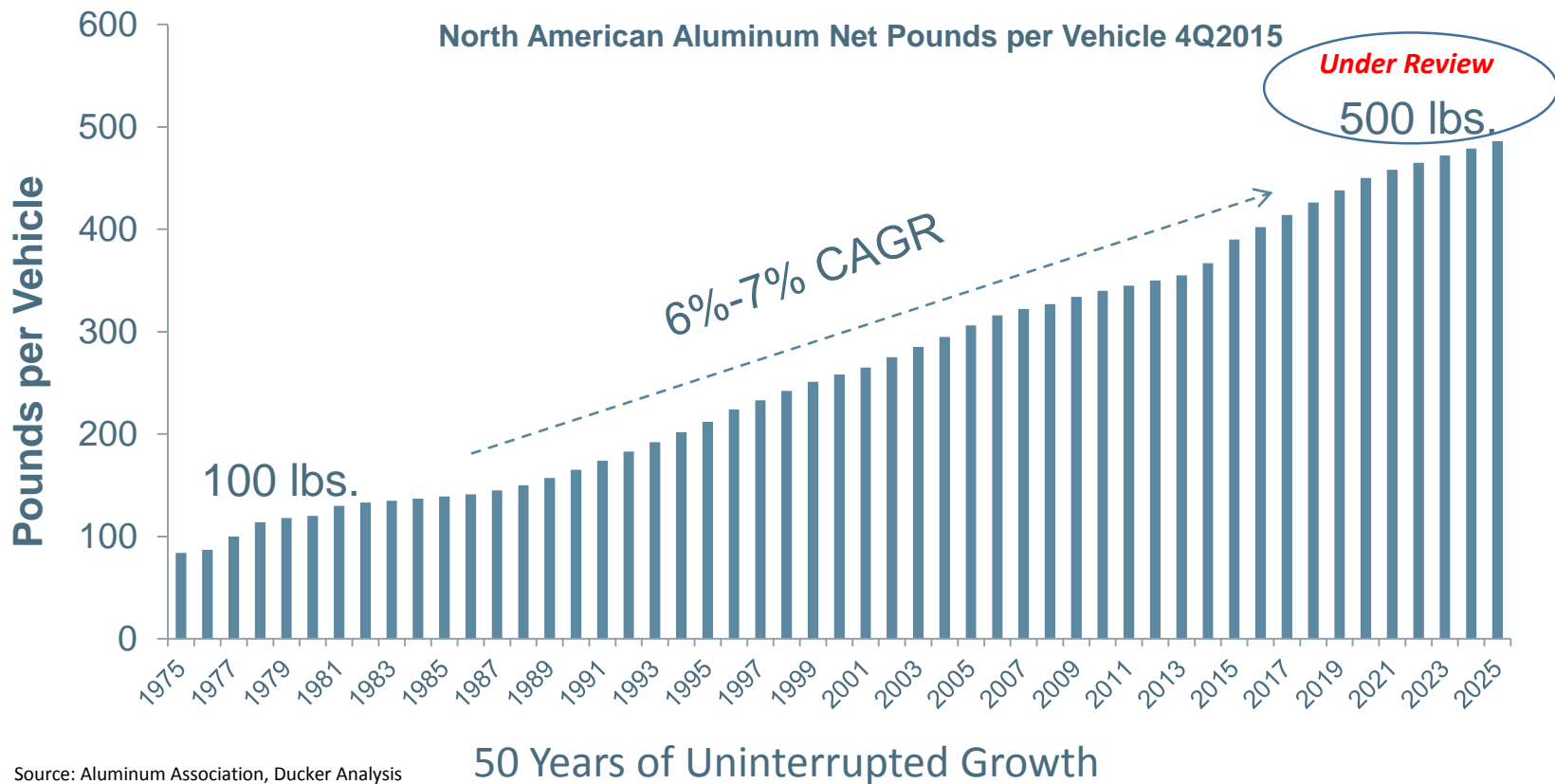


Note: The 2.1 billion pounds expected in 2020 is approximately 20% below the Ducker forecast in June 2014 due primarily to the removal of two moderate to high volume platforms aluminum bodies



WHAT DO WE KNOW ABOUT ALUMINUM LONG TERM?

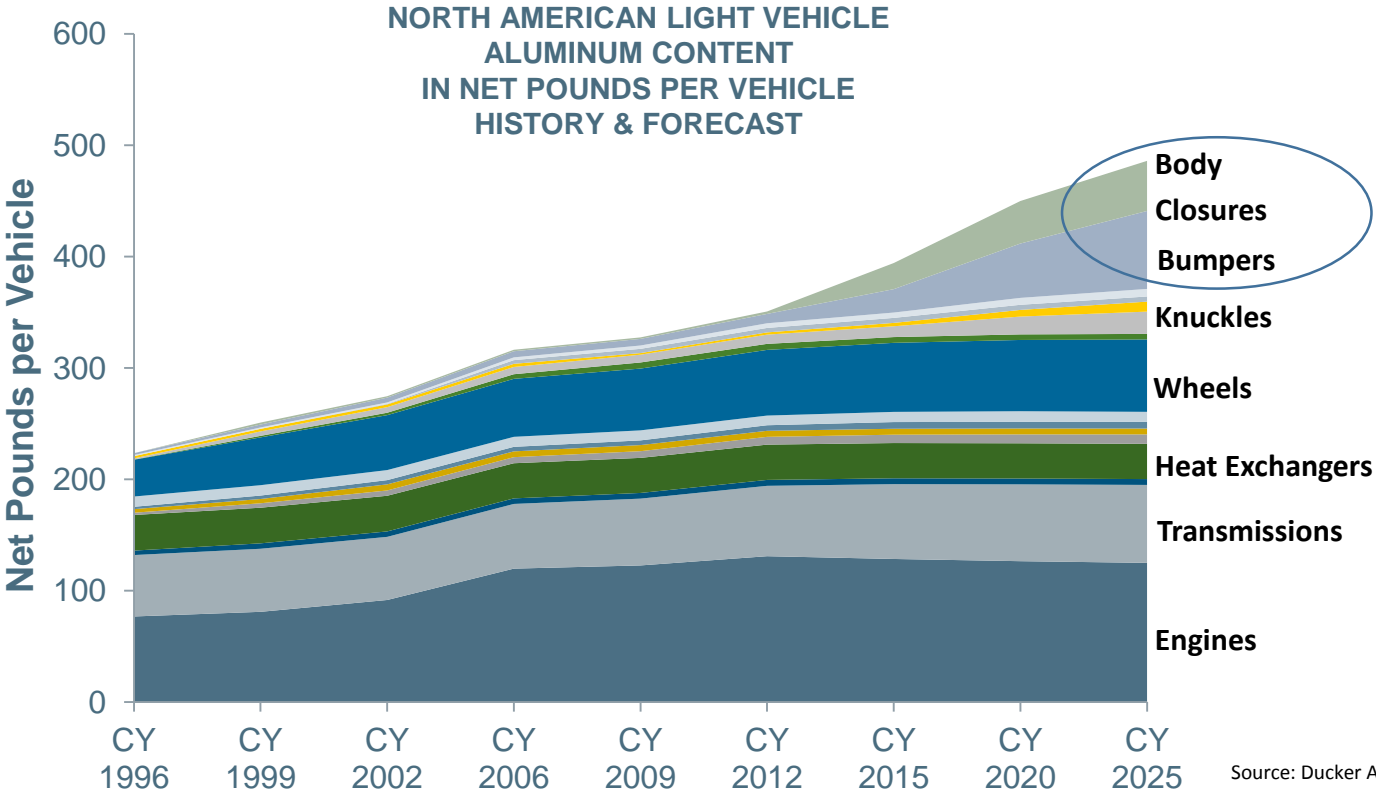
Aluminum will continue its growth to at least 500 pounds per vehicle by 2025



Source: Aluminum Association, Ducker Analysis

50 Years of Uninterrupted Growth

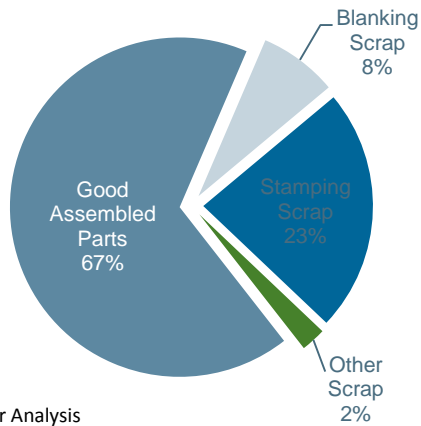
MOST OF THE ALUMINUM GROWTH WILL BE IN STRUCTURAL PARTS



ALUMINUM SCRAP IS A MONEY MAKER IF PROPERLY HANDLED

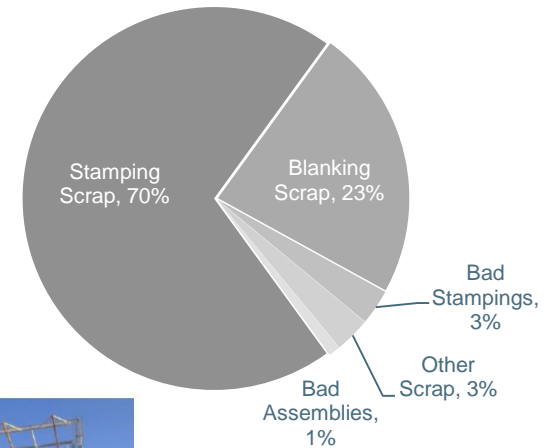
The high value of aluminum scrap that is shredded and segregated by alloy is critical to the value proposition of aluminum stampings

Coiled Aluminum Recovery and Scrap (10,000lb. coil)



Source: Ducker Analysis

Aluminum Body and Closure Scrap (3,300lbs.)

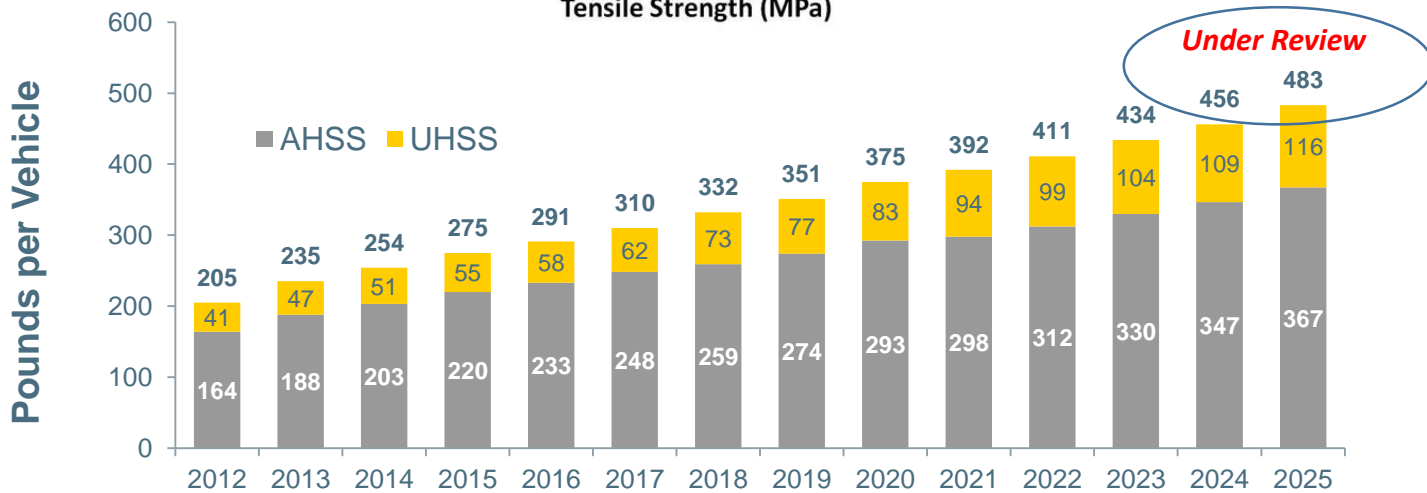
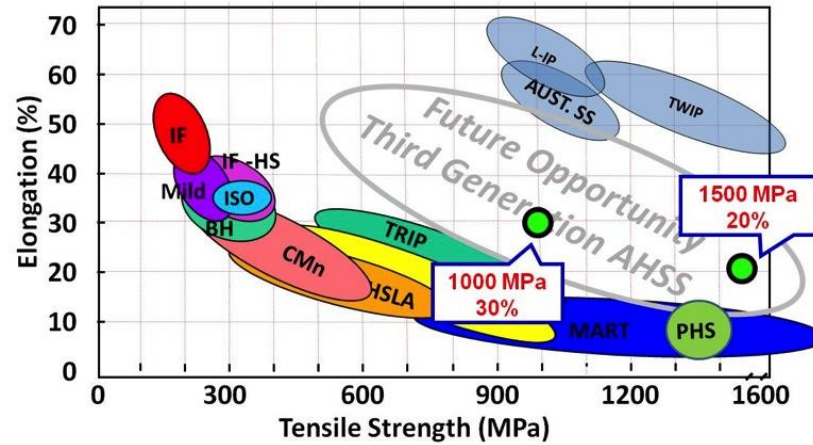


**Ford Dearborn
Aluminum Stamping
Scrap Recovery System**



Courtesy of Compass Systems Akron, Ohio

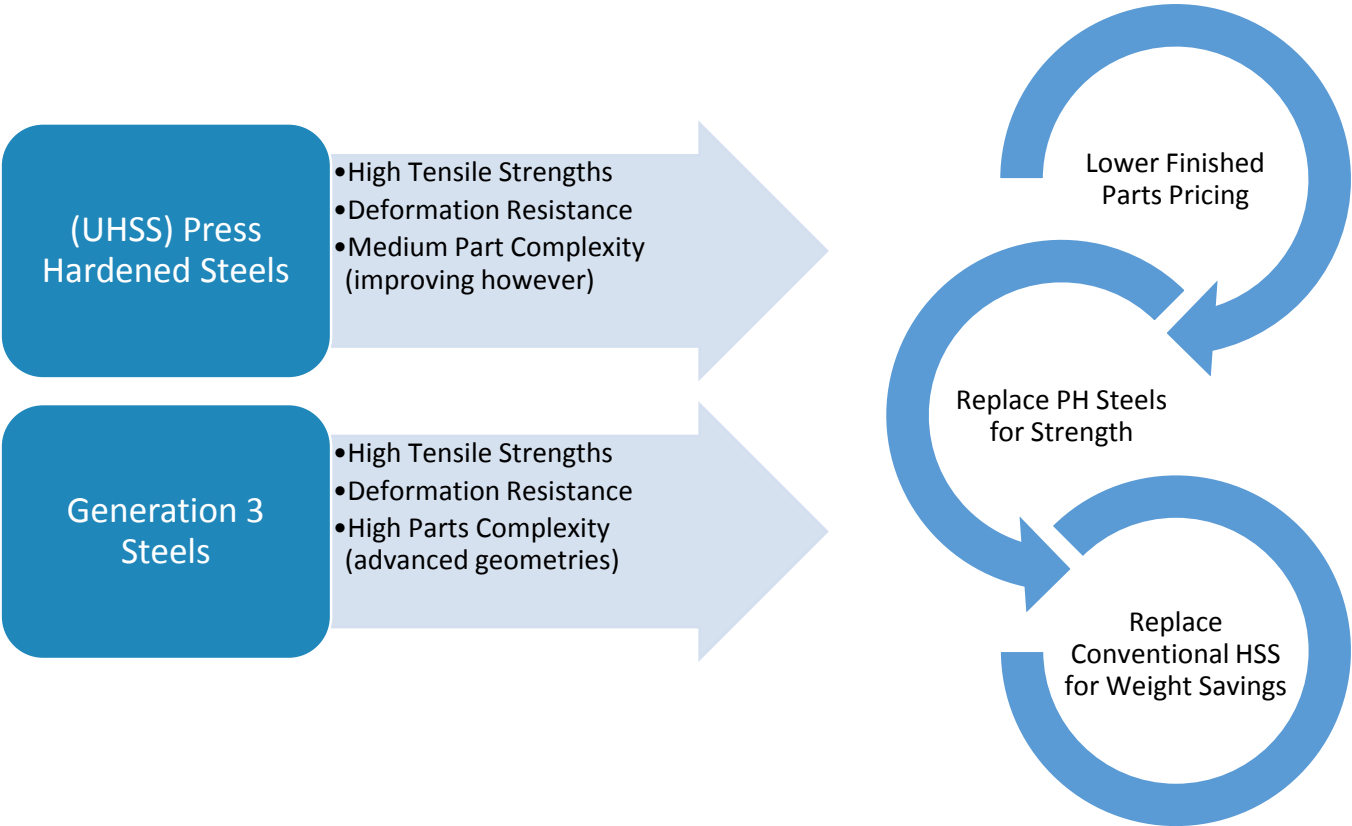
MORE AHSS WILL BE NEEDED



Source: AISI/SMDI, Ducker Analysis

GENERATION 3 STEELS ARE UNDER REVIEW

The steel industry continues to innovate, addressing strength and weight savings requirements



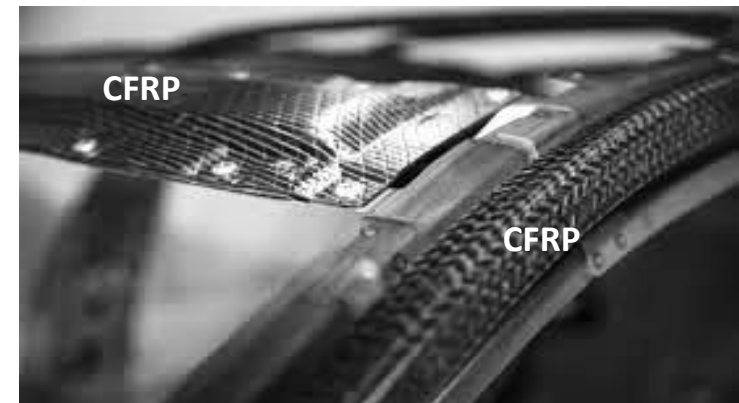
MAKING CARBON FIBER IS VERY ENERGY INTENSE

Future polymer/composite growth is best understood by examining the use of carbon fiber reinforced thermoplastic polymers for the BMW i3 and 7 series



WHERE WILL CFRP BE BEST UTILIZED

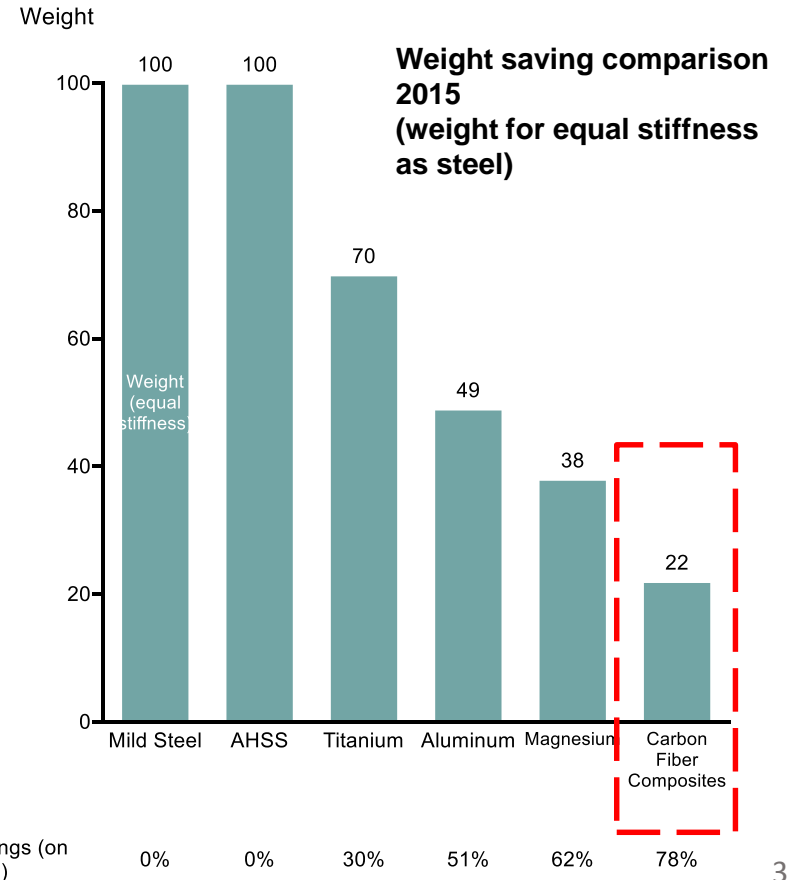
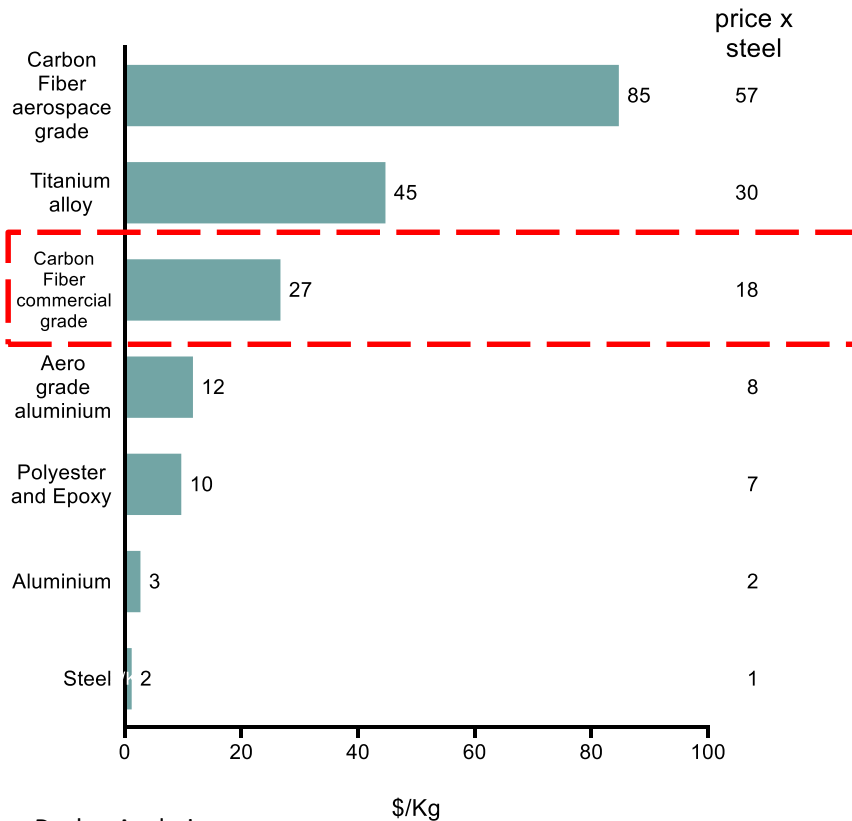
CFRP IS BEST USED AS PATCHWORK REINFORCEMENTS FOR ALUMINUM AND AHSS WROUGHT MATERIALS



CFRP CAN OFFER NEARLY 80% WEIGHT SAVINGS - HOWEVER AT ~20X THE PRICE OF MILD STEEL

Carbon fiber is a light weighting enabler, however at a high price

**Materials cost comparison 2015
(\$/Kg)**



FINAL ANALYSIS

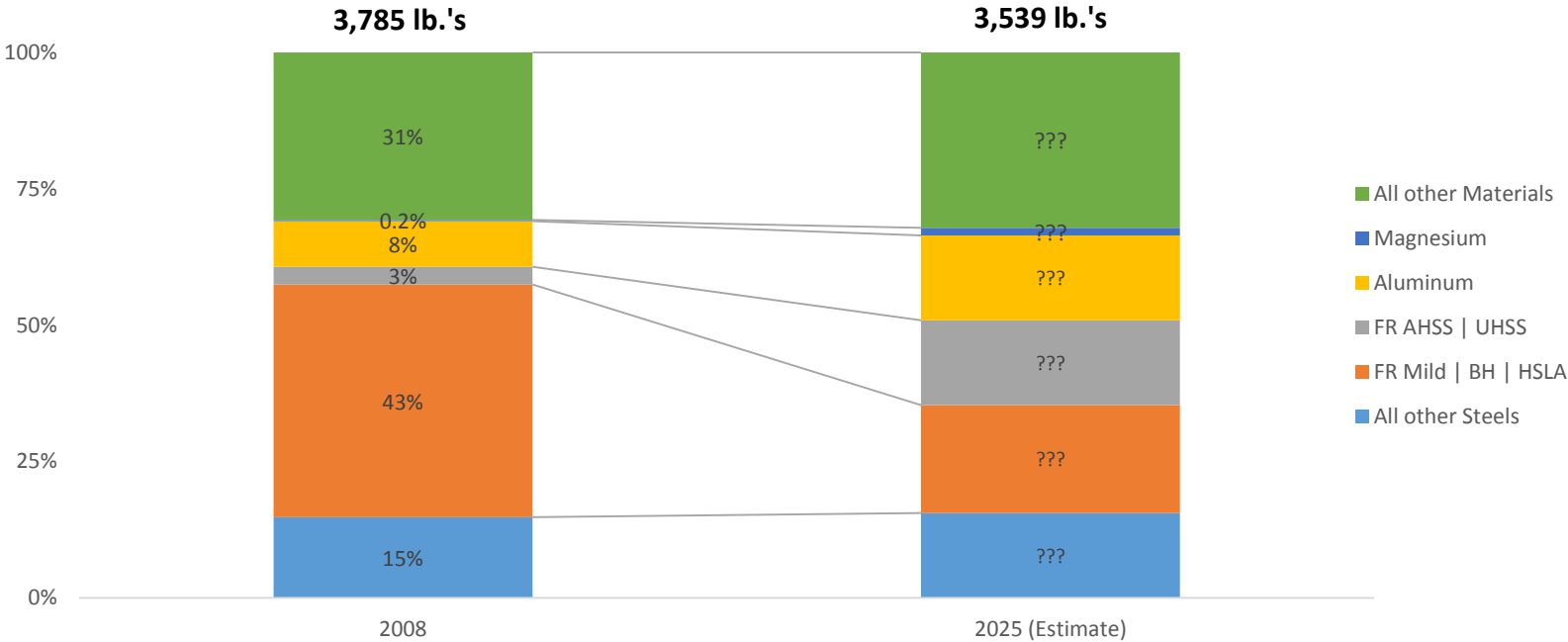


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FINAL ANALYSIS

Ducker will be determining the most likely material mix for 2025 through OEM interviews and analysis over the next six to nine months

~250 Pounds Needs to be Saved!



Source: Ducker Analysis

FINAL ANALYSIS: THE VEHICLE OF THE FUTURE

OEM'S APPROACH WEIGHT SAVINGS ON A PLATFORM BY PLATFORM BASIS, WHAT WORKS FOR ONE OEM MAY NOT WORK FOR ANOTHER OEM



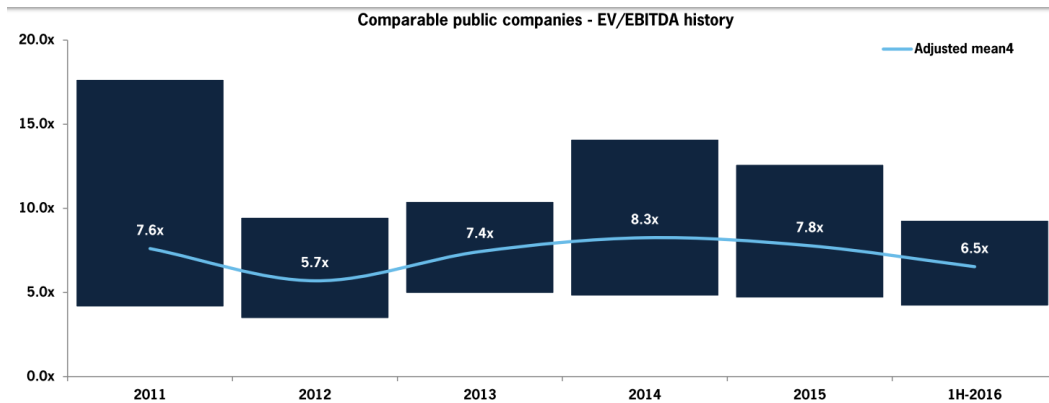
FORD F-150 ALL ALUMINUM



Source: Ducker Analysis, Ford, GM

FINAL ANALYSIS: CONSOLIDATION AND M&A DRIVING THE PLAYING FIELD

Over 25 deals closed in the 1st Half of 2016 with average EBITDA multiples of 6.5X!



Linamar ties up with Europe's Georg Fisher
July 2015

UACJ Acquires Aluminum Extrusion Manufacturer Whitehall Industries
March 2016

Zhongwang's U.S. Business to Buy Aluminum Company Aleris
August 2016



THANK YOU.

This concludes our presentation. Today's presentation was prepared by Ducker Worldwide LLC. Opinions and estimates constitute judgment as of the date of this material and are subject to change without notice. Any interpretations derived from this document are the sole responsibility of the client. Reproduction without the explicit consent of Ducker Worldwide LLC is strictly prohibited.

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