DUCKER WORLDWIDE
North America

METALLIC MATERIAL TRENDS FOR NORTH AMERICAN LIGHT VEHICLES

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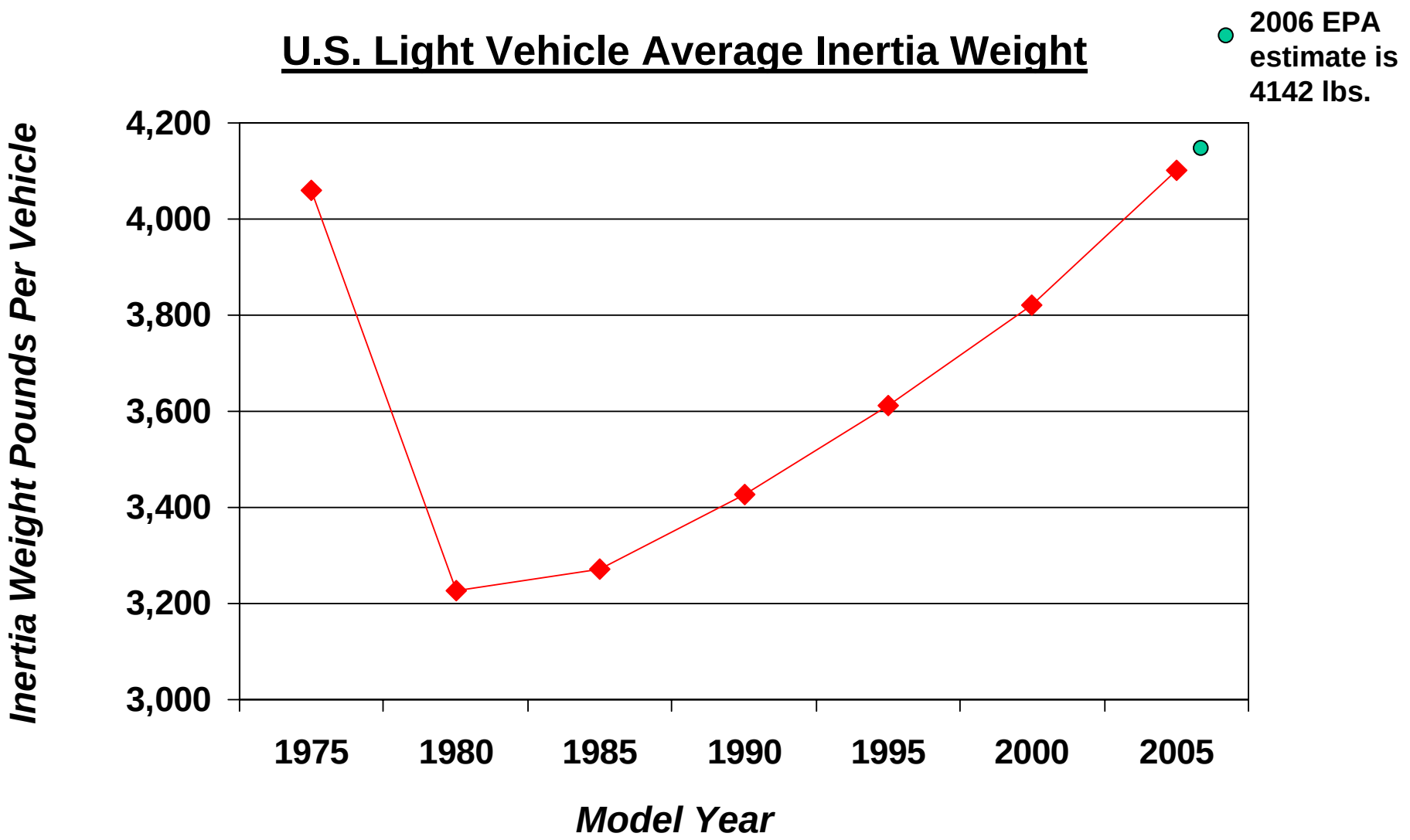
NORTH AMERICAN LIGHT VEHICLE METALLIC MATERIAL TRENDS

- In this presentation we will discuss past, present and future metallic material trends for North American light vehicles. We will concentrate on mild steel, medium and high strength steel, advanced high strength steel, iron, aluminum and magnesium
- We will examine the impact of corporate average fuel economy legislation and other fuel economy regulations on vehicle weight and material trends
- We will examine the value of weight savings compared to other options for reducing light vehicle fuel consumption

NORTH AMERICAN LIGHT VEHICLE METALLIC MATERIAL TRENDS

U.S. Light Vehicle Average Inertia Weight



Source: EPA

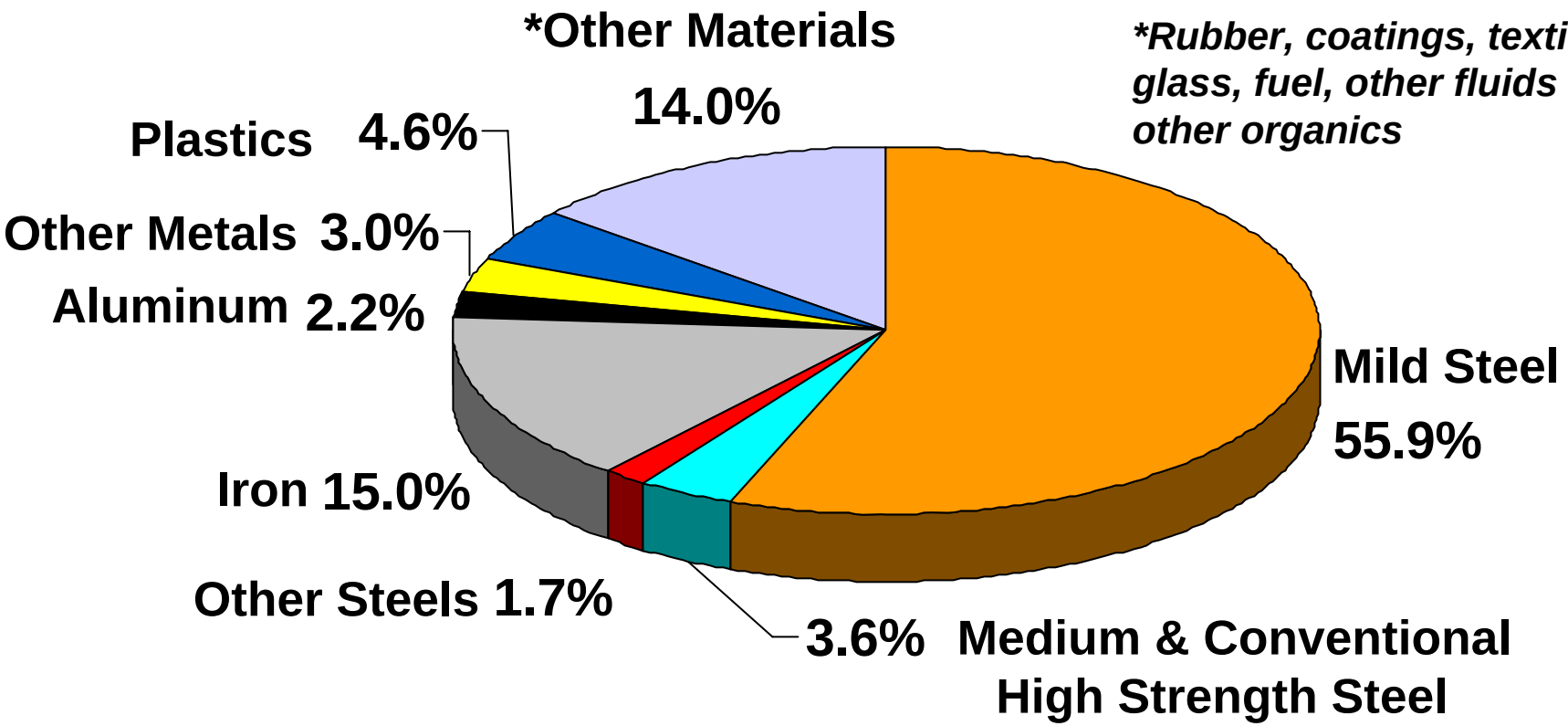
NORTH AMERICAN LIGHT VEHICLE METALLIC MATERIAL TRENDS

Over the past 30-years:

- Production nearly doubled and minivans, SUVs and pickup trucks went from essentially zero to 55 percent of the light vehicle mix
- Fuel economy increased by 60 percent
- Occupant safety improved dramatically
- Horsepower increased by 55 percent
- 0-60 miles per hour time went down 30 percent
- Metallic material content dropped from 81.4 percent to 75.8 percent as plastics and other non metallic materials grew to 24.2 percent of vehicle content

NORTH AMERICAN LIGHT VEHICLE METALLIC MATERIAL TRENDS

- Segmented by Type of Material -
Calendar Year 1975

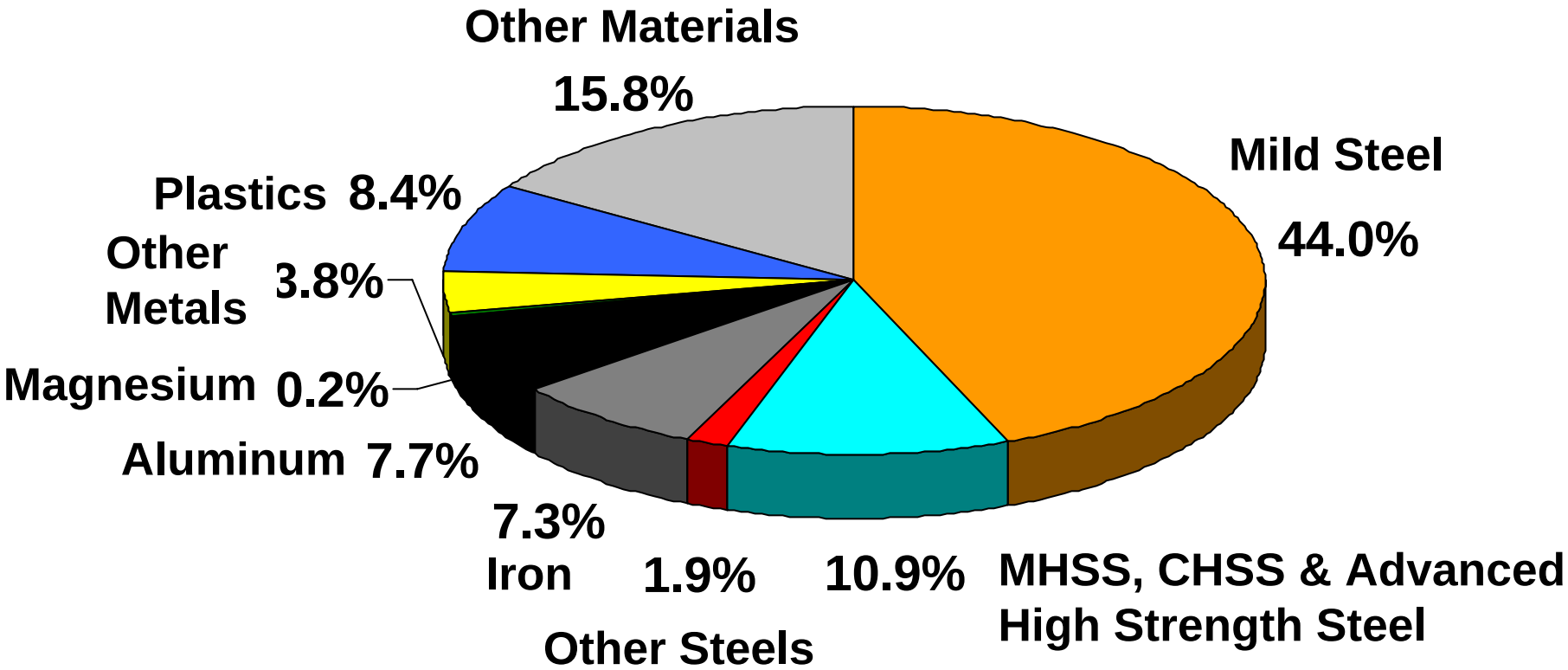


3,900 Pounds of Material Content

Source: Ducker Worldwide

NORTH AMERICAN LIGHT VEHICLE METALLIC MATERIAL TRENDS

- Segmented by Type of Material -
Calendar Year 2005

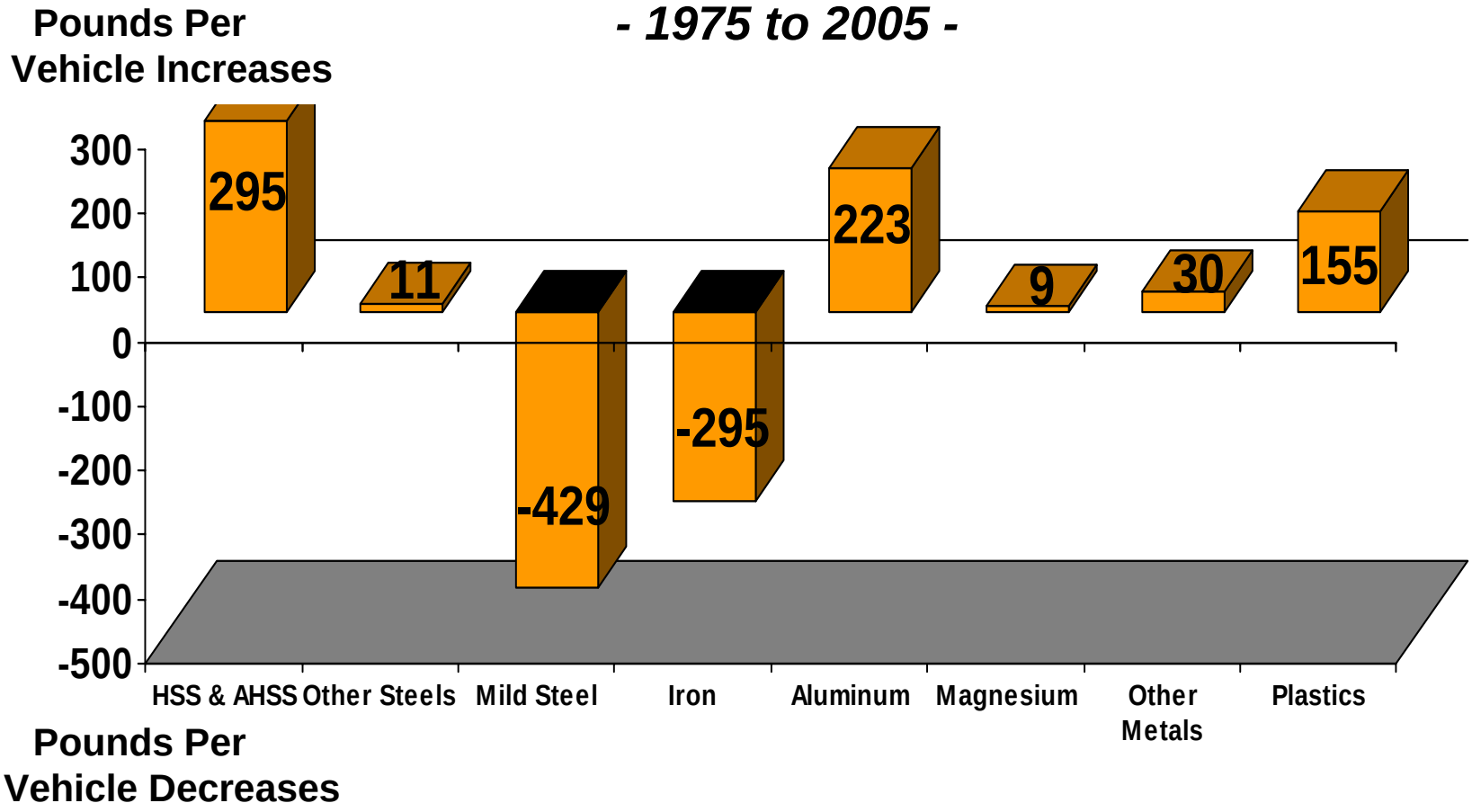


3,982 Pounds of Material Content

Source: Ducker Worldwide

Changes in North American Light Vehicle Material Content

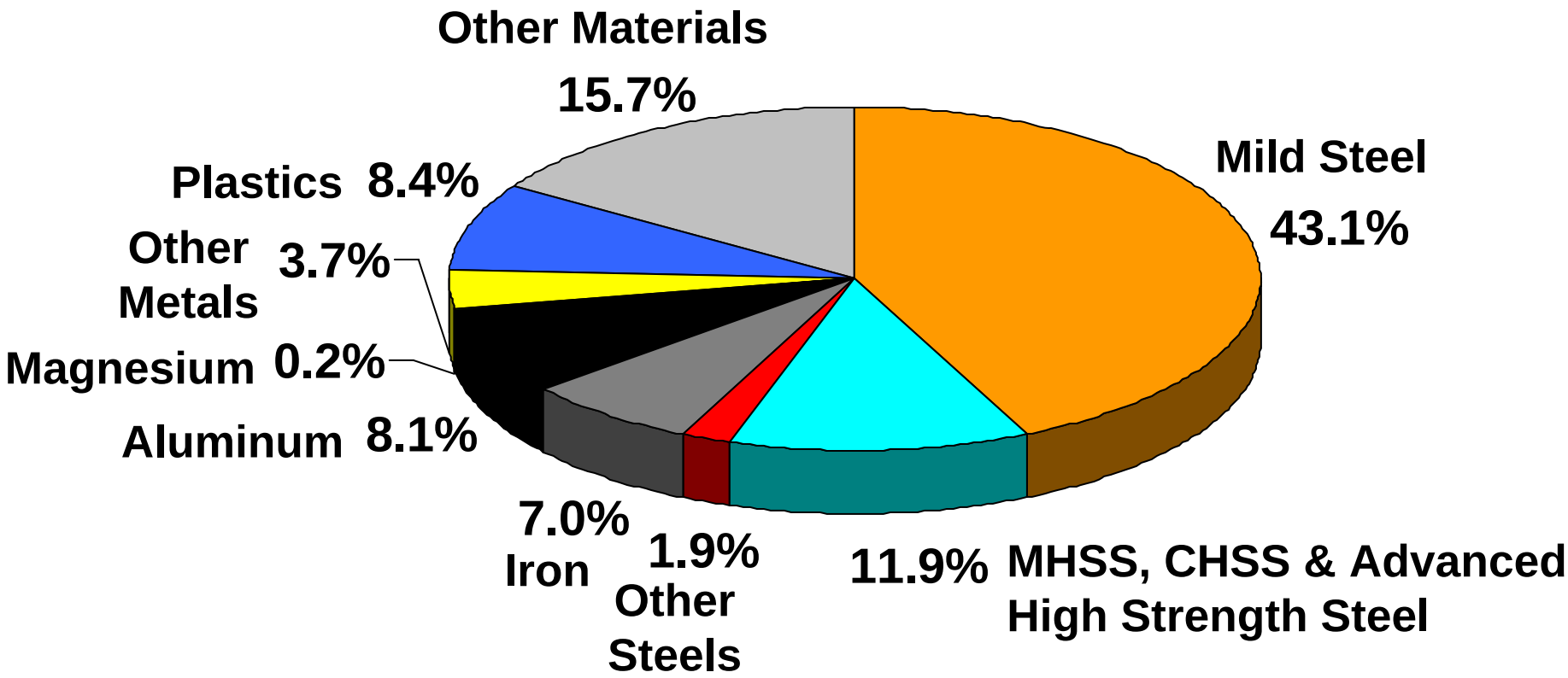
- 1975 to 2005 -



Source: Ducker Worldwide

NORTH AMERICAN LIGHT VEHICLE METALLIC MATERIAL TRENDS

- Segmented by Type of Material -
Calendar Year 2007



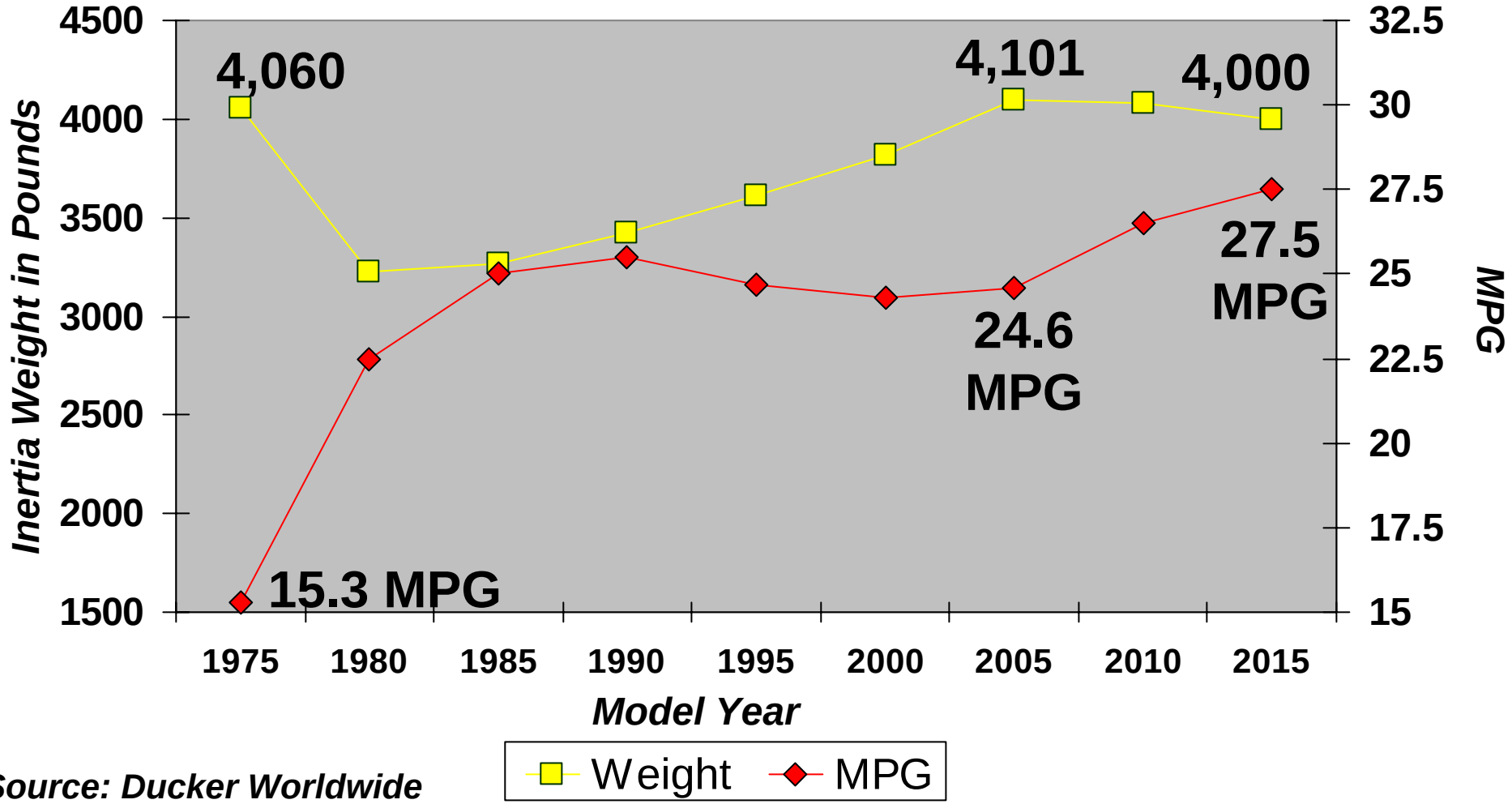
4,050 Pounds of Material Content

Source: Ducker Worldwide

NORTH AMERICAN LIGHT VEHICLE METALLIC MATERIAL TRENDS

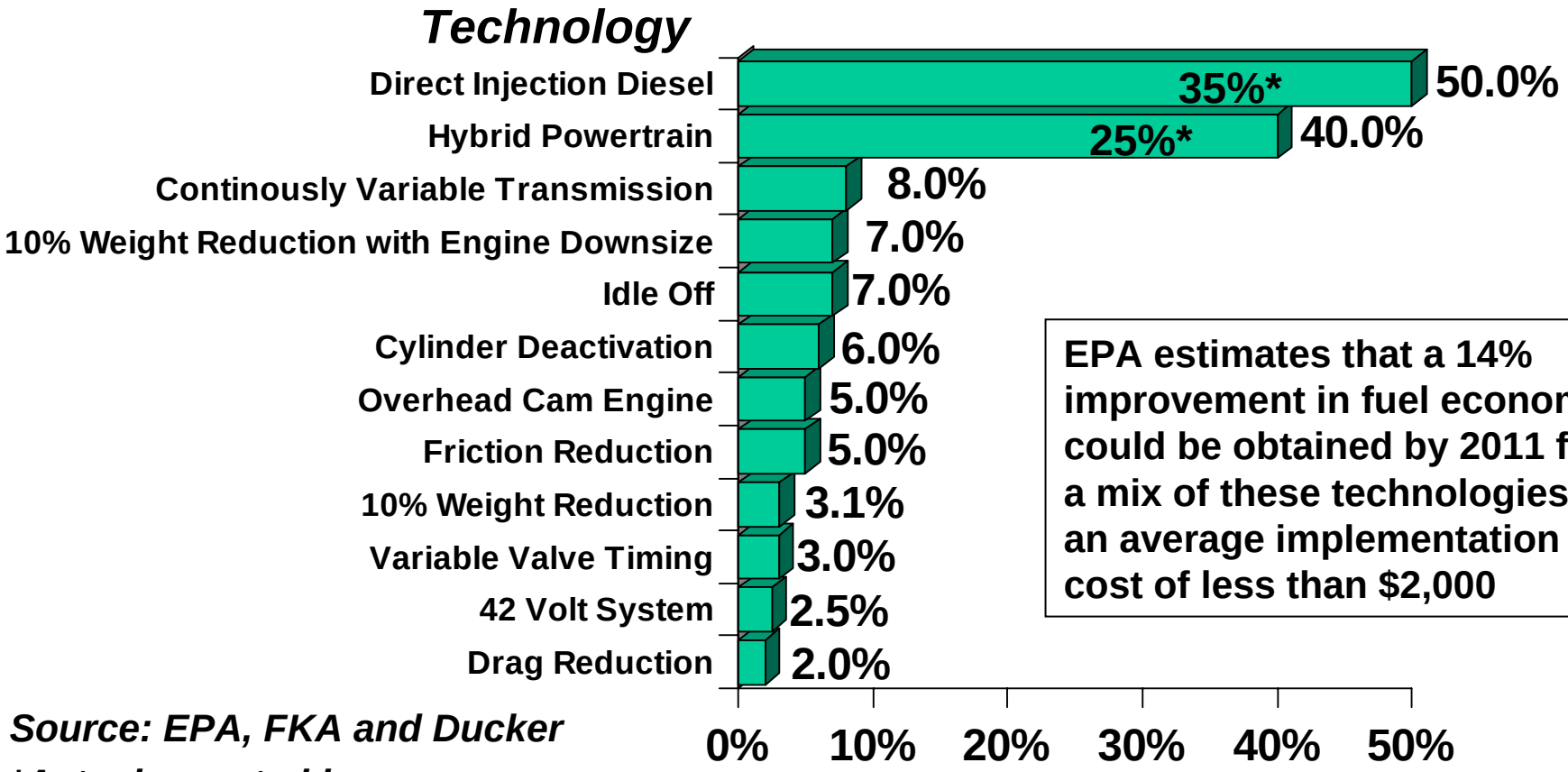
- Light vehicles account for 40 percent of U.S. oil consumption and over one half of this oil is imported
- Light vehicle operation contributes approximately 20 percent of all U.S. carbon dioxide emissions
- New regulations for light trucks have recently been approved and should increase light truck fuel economy by at least 12 percent over the next five years
- Passenger car fuel economy officially remains at 27.5 MPG, but there is tremendous pressure to raise the legislated target to at least 30 MPG by 2011. This could be accomplished by taking the control of passenger car fuel economy away from congress and putting it under NHTSA; possibly leading to regulations based on the passenger car's footprint just like the new regulations for light trucks

U.S. Light Vehicle Inertia Weight Compared to EPA Model Year Unadjusted Fuel Economy



Source: Ducker Worldwide

Examples of Technology to Improve Fuel Economy
Maximum Increase in Fuel Economy from Each Technology with No Decrease in Vehicle Footprint

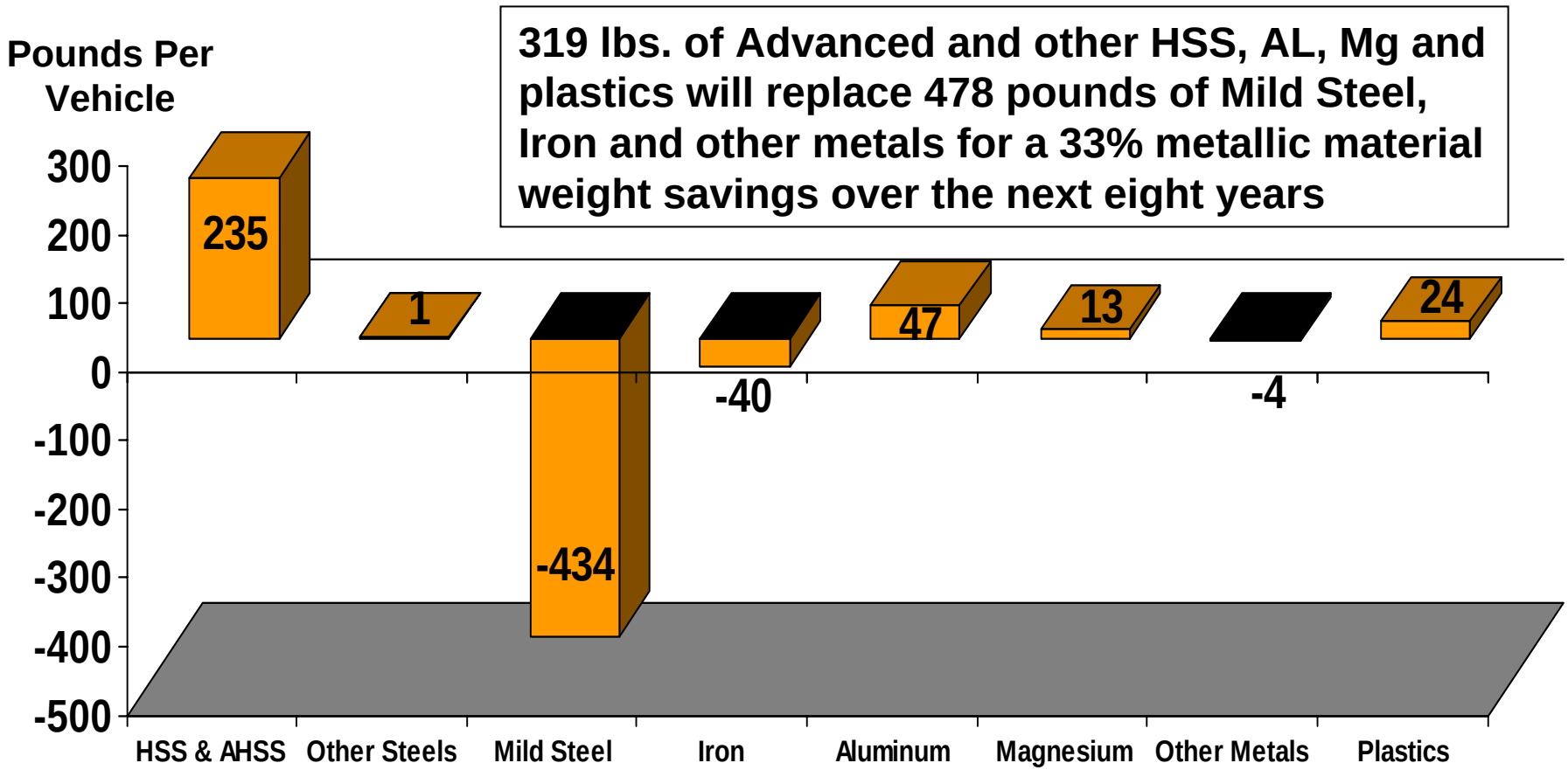


EPA estimates that a 14% improvement in fuel economy could be obtained by 2011 from a mix of these technologies at an average implementation cost of less than $2,000

Source: EPA, FKA and Ducker

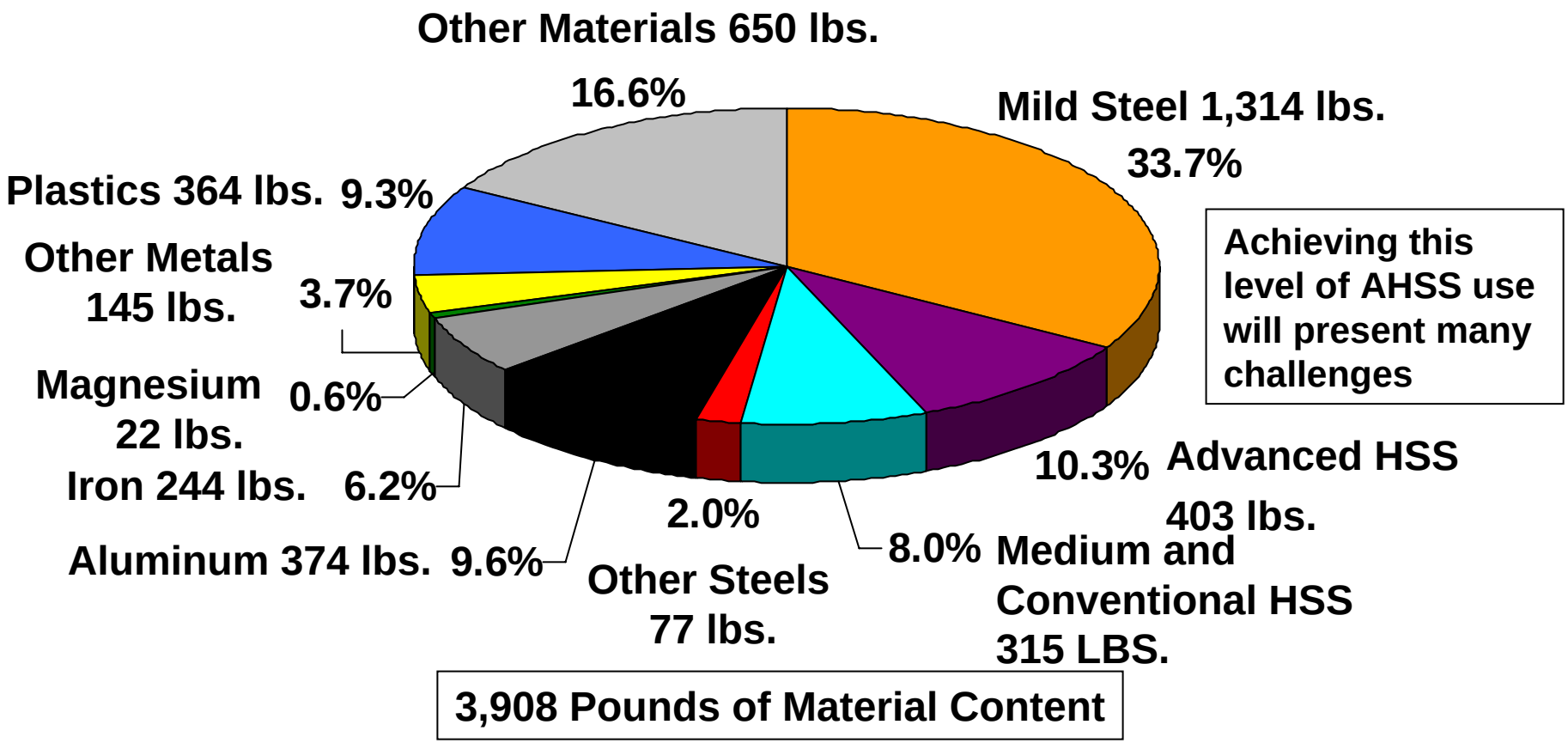
**Actual reported increases*

Changes in North American Light Vehicle Material Content 2007-2015



Source: Ducker Worldwide

North American Light Vehicle Material Content
Segmented by Type of Material
Calendar Year 2015



Source: Ducker Worldwide

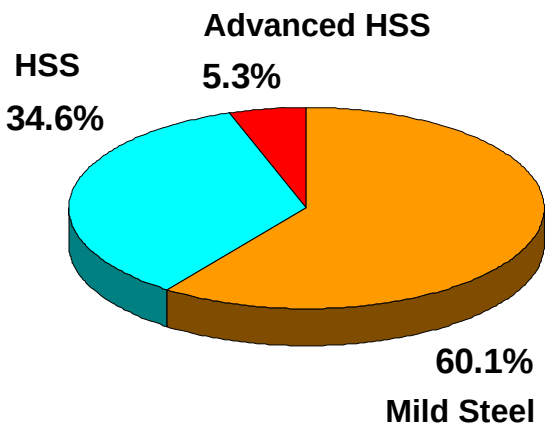
What is needed for AHSS growth?

- Enabling Technologies
  - Welding AHSS
  - Stamping AHSS
  - Modeling with AHSS
- New Steel Product Development
  - New steel grades with even higher strength and formability than current AHSS grades at little or no increase in cost

Source: U.S. Steel

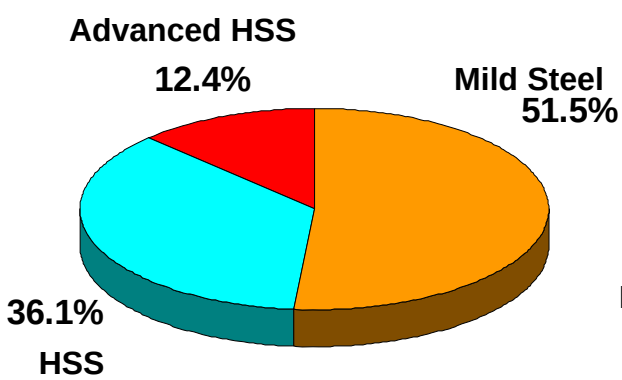
2007 Body and Closure Steel Content by Type

Total Body on Frame



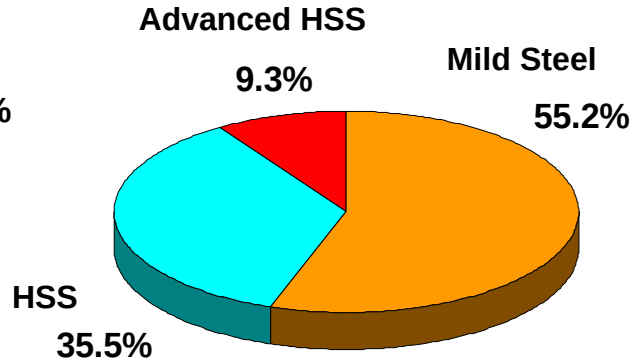
977 Pounds

Total Unibody



769 Pounds

Total

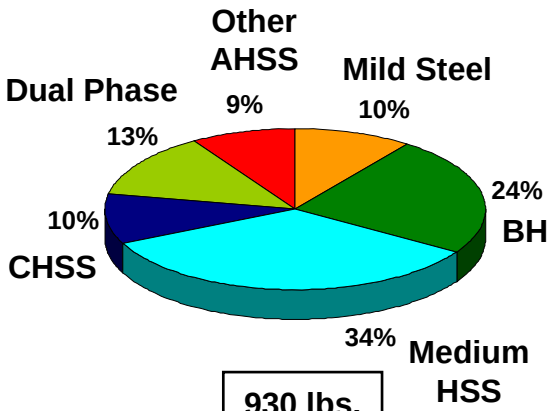


847 Pounds

Source: Ducker Worldwide

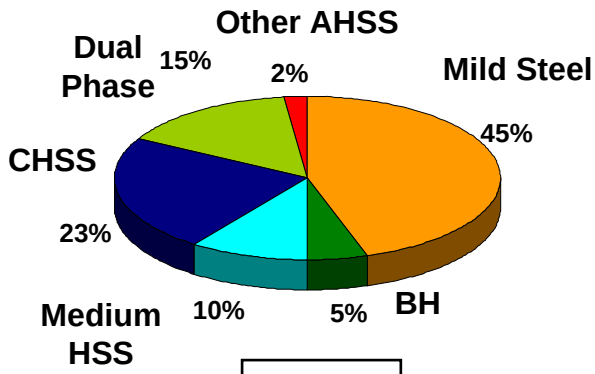
2007 Body and Closure Steel Content by Type

GMC Acadia



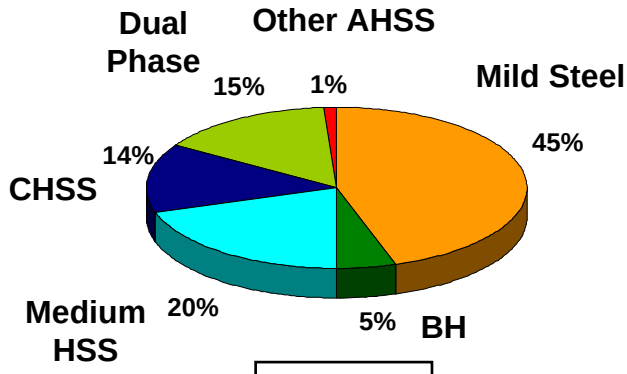
930 lbs.

DCX M Class



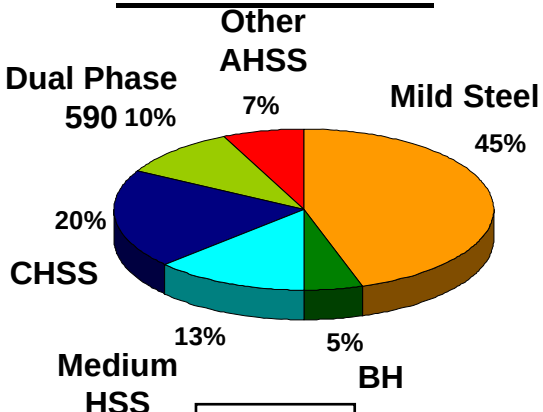
969 lbs.

Ford Expedition



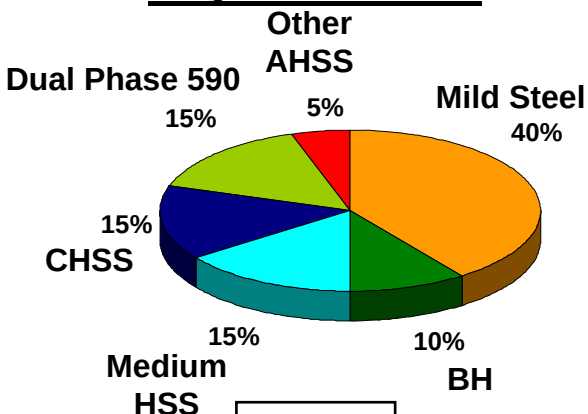
1080 lbs.

Nissan Altima



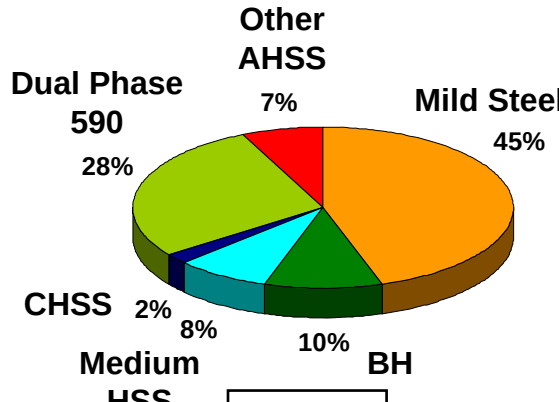
700 lbs.

Toyota Tundra



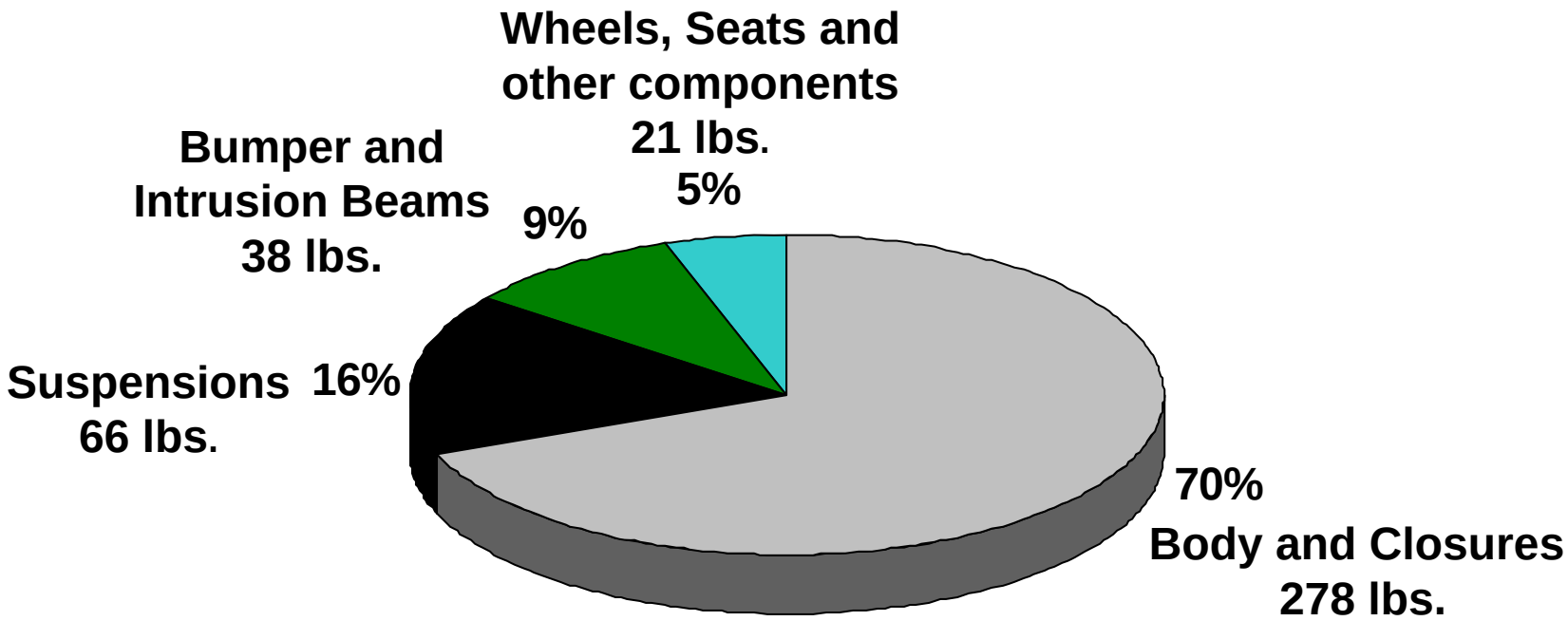
968 lbs.

Honda CR-V



717 lbs.

2015 Advanced High Strength Steel Content Per Light Vehicle

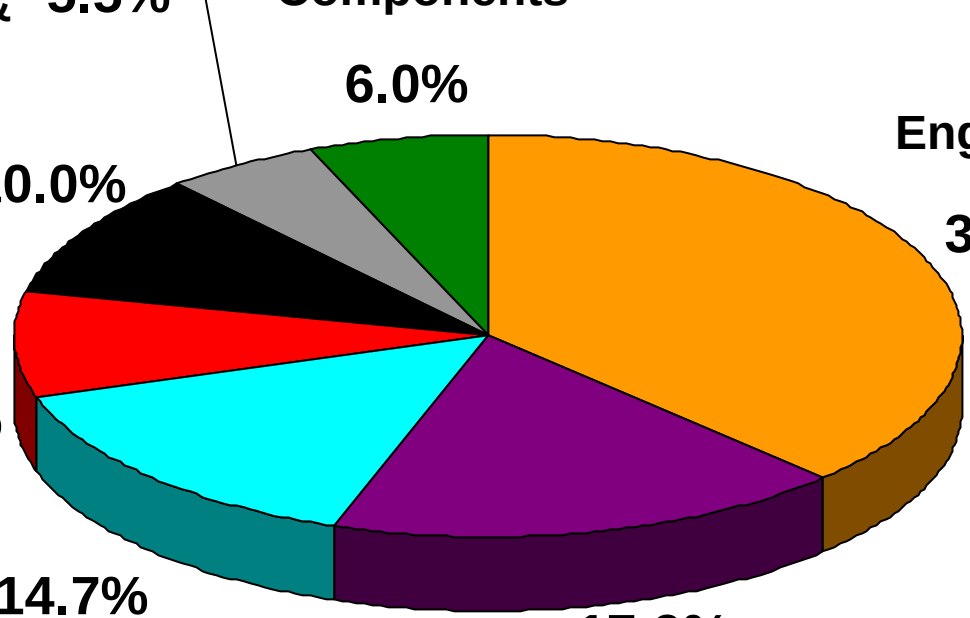


Total AHSS = 403 Pounds Per Vehicle

Source: Ducker Worldwide

2015 Light Vehicle Aluminum Content Segmented by Application

21 lbs. of aluminum per vehicle for body, bumper and closures in 2015, 2.5 times today's amount

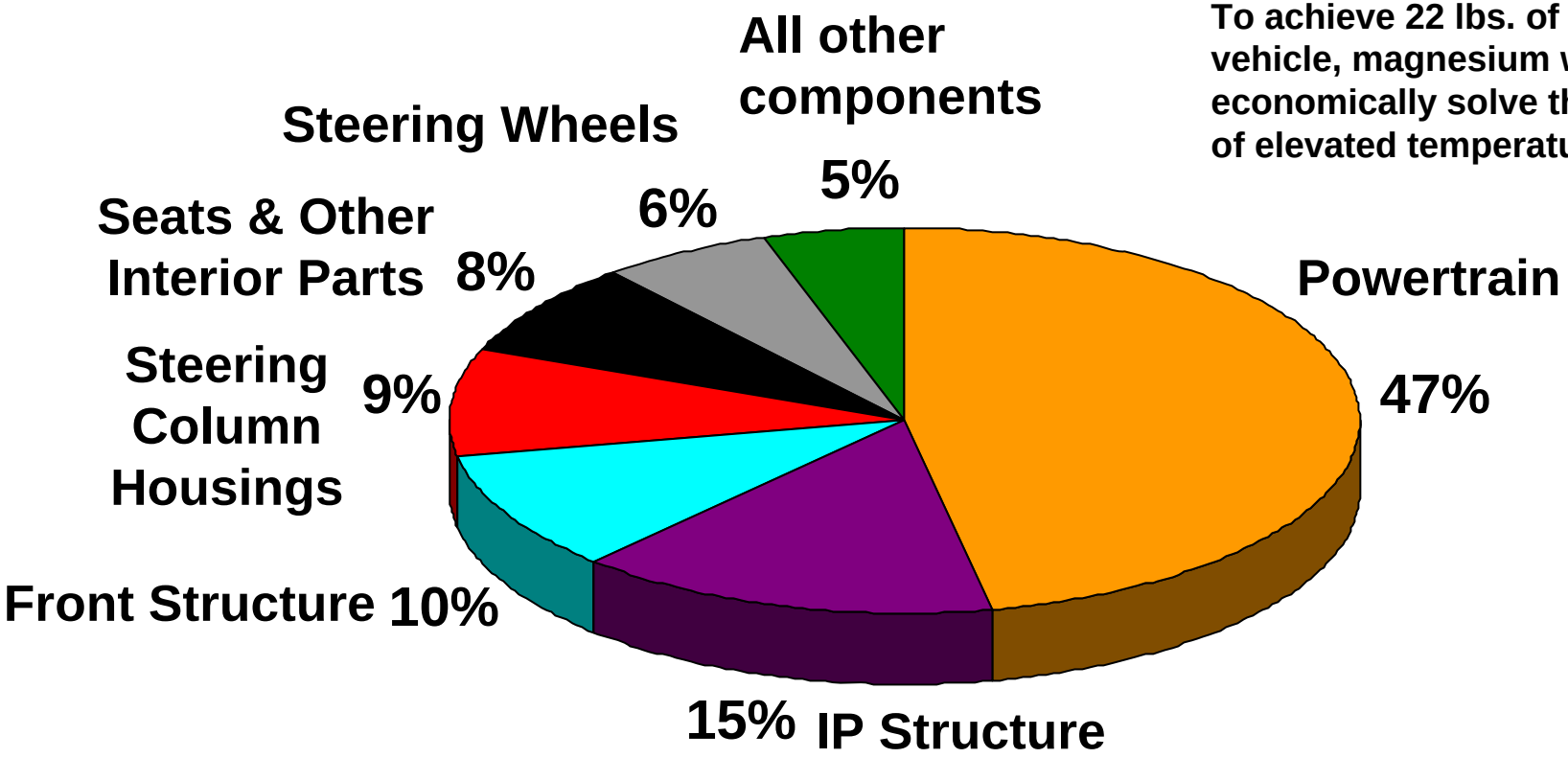


Power train applications will represent over 55% of the aluminum content in 2015

374 Pounds Per Vehicle

Source: Ducker Worldwide

2015 Light Vehicle Magnesium Content Segmented by Application



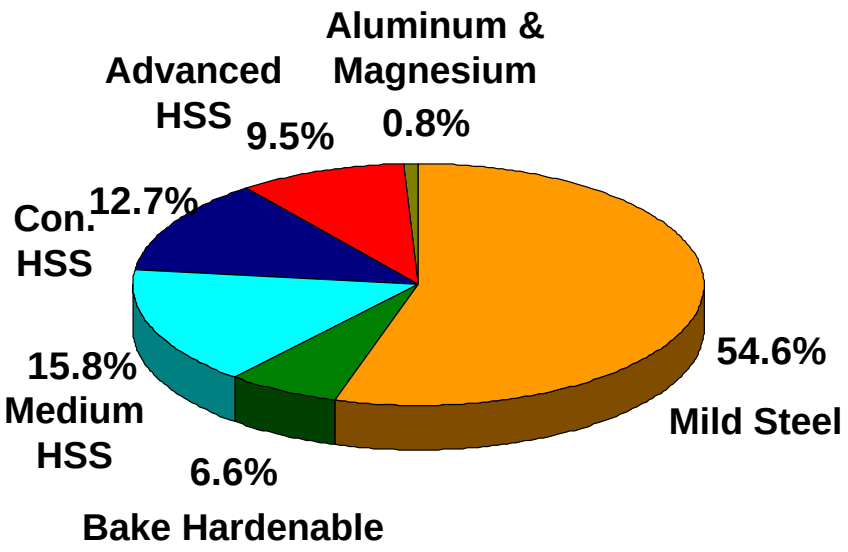
To achieve 22 lbs. of Mg per vehicle, magnesium will have to economically solve the problem of elevated temperature creep

22 Pounds Per Vehicle

Source: Ducker Worldwide

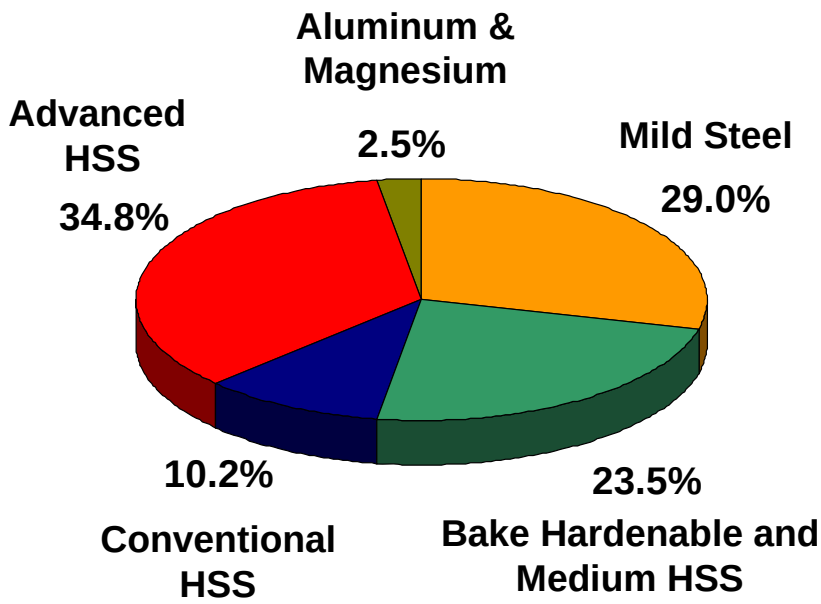
Body and Closure Metallic Material Content by Type

2007



850 Pounds

2015



800 Pounds with an Equal Footprint to 2007

Source: Ducker Worldwide

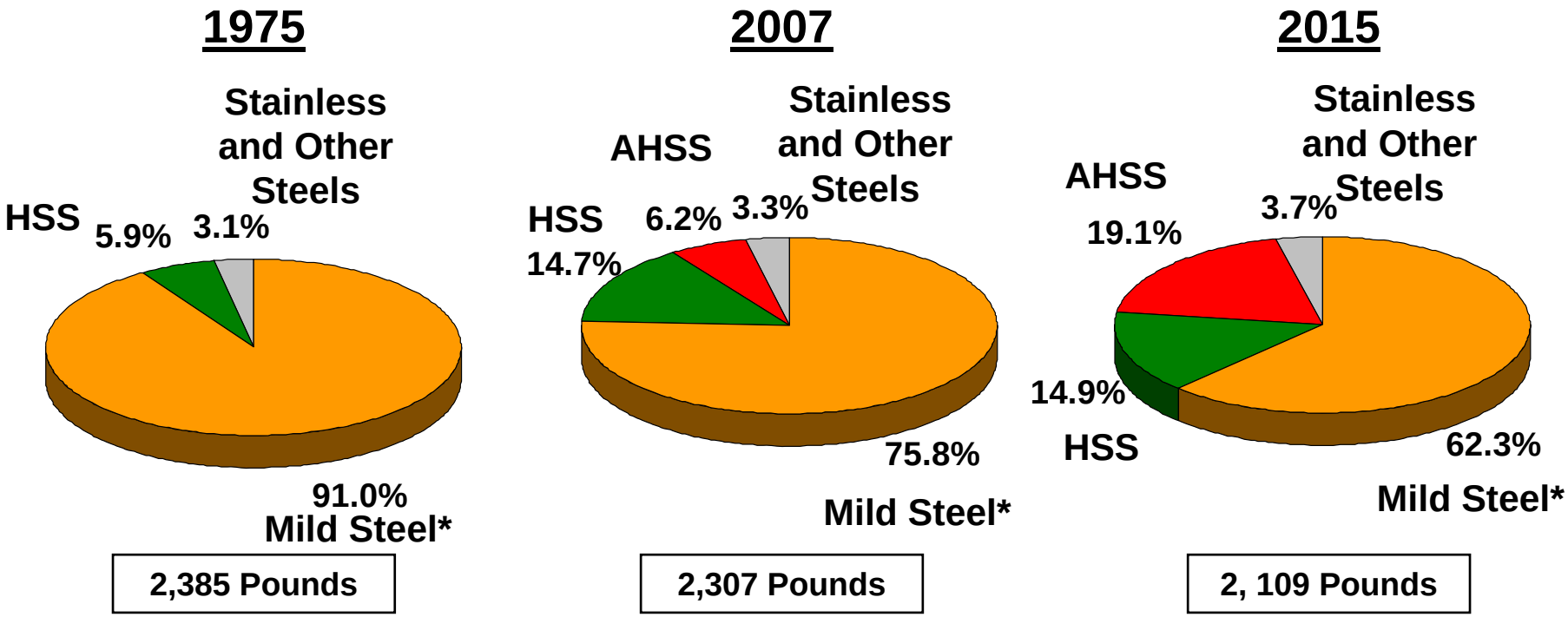
North American Light Vehicle Material Content Per in Pounds

	1975	2005	2007	2015	Change From 1975 to 2015
Mild Steel	2,180	1,751	1,748	1,314	Down 866 lbs.
High Strength Steel	140	324	334	315	Up 175 lbs.
Advanced HSS	--	111	149	403	Up 403 lbs.
Other Steels	65	76	76	77	Up 12 lbs.
Iron	585	290	284	244	Down 341 lbs.
Aluminum	84	307	327	374	Up 290 lbs.
Magnesium	--	9	9	22	Up 22 lbs.
Other Metals	120	150	149	145	Up 25 lbs.
Plastic/Composites	180	335	340	364	Up 184 lbs.
Other Materials	546	629	634	650	Up 104 lbs.
Total Pounds	**3,900**	**3,982**	**4,050**	**3,908***	**Up 8 lbs.**

Source: Ducker Worldwide

** Same vehicle mix and average footprint as 2007*

North American Light Vehicle Steel Content By Type



**Mild steel has a tensile strength of 270 Mpa or less in this analysis*

Note: Total steel weights per light vehicle are plus or minus 100 pounds. Medium and heavy trucks would add as much as 250 pounds to the overall average steel content per vehicle in North America if they were included in the calculations.

Conclusions

- Advanced high strength steels will grow at a 14 percent CAGR and reach over 400 pounds per vehicle by 2015
- Advanced high strength steels in the body structure will increase from 11 percent of the body weight today to 40 percent of the body weight by 2015
- The total amount of steel content per light vehicle will decline from 2,300 pounds in 2007 to 2,100 pounds in 2015, as Advanced High Strength Steels replace other steels to save weight and improve performance
- Aluminum and magnesium will only increase from seven pounds per vehicle in the body and closures today to 20 pounds in the body and closures by 2015

Conclusions

- Vehicle weights are likely to decrease by only four percent by 2015 with no significant change in vehicle interior volume or average footprint over the next eight years
- A variety of technologies including weight savings are likely to improve fuel economy by at least 12 percent by 2015 while maintaining or improving vehicle performance
- Changes in the mix of materials will be used primarily to improve vehicle performance and increase content with only a small contribution to improving fuel economy (less than 2 percent of the fuel savings out of 12 percent is likely to come from material substitution)

Thank you for your attention!

Dick Schultz - Project Consultant

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