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.

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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
REGULATORY ENVIRONMENT

NEW DRAFT TAR 2016 FROM THE EPA INDICATES 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-sipping SUVs anytime soon.

54.5-mpg rules expected to stick

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

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 Hueter on July 27, 2016
EPA CO2 GREENHOUSE GAS EMMISION REDUCTIONS

Clean Air Act

EPA 2018 Final Ruling for 2022-2025 GHG

EPA 2012-2016 250 grams/mile

PLANNED SAVINGS OF SIX BILLION TONS* OF GHG EMISSIONS

*NHTSA/EPA DOCUMENTS

California Air Resource Board (CARB) requires 11% of light vehicles sold in CA in 2025 to be EVs or PHEVs

EPA Mid-Term Proposal of 175 grams/mile for 2025

EPA 2025 163 grams/mile

Non Fuel Economy GHG Credits*

• *Air Conditioning Improvement Credits
• Off-Cycle Credits
• Incentives for Electric Vehicles and PHEVs
• Allowances for intermediate and low volume manufacturers
• Credit Banking and Trading

Thirteen OEMs & UAW Support

7.4% change

7
REGULATIONS
STILL REQUIRE CO2 TO BE CUT BY ONE HALF AND MPG TO BE DOUBLED BY 2025
REGULATIONS

OEMs have demonstrated they can meet higher CAFE targets when presented with the challenge.

- **Draft TAR 2016**
- **Meeting Light Truck CAFE is More Difficult Than Meeting Car CAFE**

<table>
<thead>
<tr>
<th>Year</th>
<th>Car</th>
<th>Truck</th>
<th>Fleet</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>60.3</td>
<td>43.2</td>
<td>50.8*</td>
</tr>
<tr>
<td></td>
<td>55.2</td>
<td>39.9</td>
<td>46.7</td>
</tr>
<tr>
<td></td>
<td>42.6</td>
<td>30.8</td>
<td>36.0</td>
</tr>
</tbody>
</table>

*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

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

REGULATIONS WILL BE MET BY:

LOWER VEHICLE WEIGHT

LOWER AERODYNMAIC DRAG

IMPROVED PROPULSION SYSTEMS
**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

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Weight Reduction (Pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>175</td>
</tr>
<tr>
<td>60%</td>
<td>263</td>
</tr>
<tr>
<td>12%</td>
<td>350</td>
</tr>
<tr>
<td>8%</td>
<td>700</td>
</tr>
</tbody>
</table>

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

### Light Truck Weight Savings

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Weight Reduction (Pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16%</td>
<td>210</td>
</tr>
<tr>
<td>23%</td>
<td>315</td>
</tr>
<tr>
<td>19%</td>
<td>420</td>
</tr>
<tr>
<td>13%</td>
<td>629</td>
</tr>
<tr>
<td>29%</td>
<td>839</td>
</tr>
</tbody>
</table>

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

Source: Draft TAR Chapter 13
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.
AERODYNAMIC IMPROVEMENTS

Source: Fueleconomy.gov
PROPULSION

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

[Graph showing trends in gasoline prices from 2000 to 2025, with labels for 2012 FR price projection and TAR price projection.]

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

- 2012 Base for 2025: Light Truck Share 67%, Car Share 33%
- 2016 Base for 2025: Light Truck Share 52%, Car Share 48%
- 2016 High for 2025: Light Truck Share 62%, Car Share 38%
- 2016 Low for 2025: Light Truck Share 52%, Car Share 48%

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

IC ENGINES HAS CLOSED THE GAP AT A FASTER RATE THAN EXPECTED. MPG HAS INCREASED AS HAS HORSEPOWER.
PROPULSION
LEADS TO AN ALTERED PROJECTION FOR POWERTRAIN TECHNOLOGIES

2025 Powertrain Technology Penetration Estimates
(2012 vs. 2016)

- Fuel Direct Injection: 79% (2016) vs. 70% (2012)
- 8+Speed & CVT: 80% (2016) vs. 83% (2012)
- Turbo Downsized Engines: 53% (2016) vs. 44% (2012)
- High Compression System: 23% (2012)
- Stop-Start: 75% (2016) vs. 29% (2012)
- Mild HEV: 16% (2012)
- Strong HEV: 9% (2012)
- EV & PHEV: 3% (2012)

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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

Weight savings can be achieved through the use of new steels, aluminum, Mg and carbon fiber components.

Each of these technologies comes with a different cost for a 1% improvement in fuel economy.

Source: Ducker Analysis
VEHICLE MANUFACTURING COST VS. WEIGHT SAVINGS

Body and Closure Weight Savings Cost Curve
Excludes Cost Savings from Engine Resize and other Weight Reduction Compounding

- CFRP Body Parts
- Magnesium Castings
- Magnesium Sheet

HSLA = High strength, low-alloy steel | AHSS = Advanced high-strength steel | UHSS = Ultra high-strength steel
LIGHT VEHICLE MATERIALS TODAY
In 2015, steel in its various forms account for over 55% of the curb weight, with aluminum at 11%.

![Pie chart showing the 2015 material mix of curb weight](chart)

- **Mild Steel Sheet & Other Steel**: 36%
- **HSS/BH Sheet**: 13%
- **A high-strength steel (AHSS) Sheet**: 6%
- **UHSS Sheet**: 1%
- **Other Aluminum**: 9%
- **Aluminum Structural Parts**: 2%
- **Other Materials**: 12%
- **Conventional SMC**: <1%
- **Polymers**: 9%
- **Magnesium**: <1%
- **Iron**: 8%

**3776 POUNDS**
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

3776 POUNDS
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

These redesigns after 2025 will be needed for the entire fleet to reach compliance with the 2025 CAFÉ targets

Source: Draft TAR Chapter 13
THE FUTURE
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.

Source: Ducker Analysis
WHAT DO WE KNOW ABOUT ALUMINUM LONG TERM?

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

North American Aluminum Net Pounds per Vehicle 4Q2015

6%-7% CAGR

Under Review

500 lbs.

Source: Aluminum Association, Ducker Analysis

50 Years of Uninterrupted Growth
MOST OF THE ALUMINUM GROWTH WILL BE IN STRUCTURAL PARTS

NORTH AMERICAN LIGHT VEHICLE ALUMINUM CONTENT IN NET POUNDS PER VEHICLE HISTORY & FORECAST

Source: Ducker Analysis
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)

- Good Assembled Parts: 67%
- Stamping Scrap: 23%
- Blanking Scrap: 8%
- Other Scrap: 2%

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

- Stamping Scrap: 70%
- Blanking Scrap: 23%
- Bad Stampings: 7%
- Bad Assemblies: 1%
- Other Scrap: 3%

Source: Ducker Analysis

Ford Dearborn Aluminum Stamping Scrap Recovery System

Courtesy of Compass Systems Akron, Ohio
MORE AHSS WILL BE NEEDED
The steel industry continues to innovate, addressing strength and weight savings requirements.

**GENERATION 3 STEELS ARE UNDER REVIEW**

- **(UHSS) Press Hardened Steels**
  - High Tensile Strengths
  - Deformation Resistance
  - Medium Part Complexity (improving however)

- **Generation 3 Steels**
  - High Tensile Strengths
  - Deformation Resistance
  - High Parts Complexity (advanced geometries)

- Lower Finished Parts Pricing
- Replace PH Steels for Strength
- Replace Conventional HSS for Weight Savings
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)**

<table>
<thead>
<tr>
<th>Material</th>
<th>$/Kg</th>
<th>Weight saving comparison 2015 (weight for equal stiffness as steel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Fiber aerospace grade</td>
<td>85</td>
<td>30%</td>
</tr>
<tr>
<td>Titanium alloy</td>
<td>45</td>
<td>18%</td>
</tr>
<tr>
<td>Carbon Fiber commercial grade</td>
<td>27</td>
<td>14%</td>
</tr>
<tr>
<td>Aero grade aluminium</td>
<td>12</td>
<td>12%</td>
</tr>
<tr>
<td>Polyester and Epoxy</td>
<td>10</td>
<td>10%</td>
</tr>
<tr>
<td>Aluminium</td>
<td>3</td>
<td>3%</td>
</tr>
<tr>
<td>Steel</td>
<td>2</td>
<td>2%</td>
</tr>
</tbody>
</table>

**Source:** Ducker 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

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*

Source: Ducker Analysis, Public Information, CapIQ, BakerTilly
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THANK YOU.

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