Our business has the unique ability to deliver superior outcomes throughout all stages and aspects of our clients' growth ambitions.

**COMPREHENSIVE INSIGHTS FOR HIGH-STAKES MARKETS**

The combined business model addresses all stages of a client's growth mandate

- Define Optimal Segments For Growth
- Examine Customer Requirements
- Outline Go-to-market Alternatives
- Support Inorganic Opportunities
- Provide Continuous Monitoring and Decision Support

**END-TO-END RESEARCH AND CONSULTING SOLUTIONS**

- Economic Forecasts
- Market Insights
- Market Monitoring
- Thought Leadership
- Consulting Solutions
- Cloud-based Technology And Data

**EXPANDED GLOBAL FOOTPRINT**

Together Ducker Worldwide and Frontier Strategy Group serve multinational and investment professionals around the world via our nearly 200+ professionals across 9 global offices.

- **AMERICAS**
  - Detroit
  - New York
  - Washington, DC

- **EUROPE**
  - London
  - Paris
  - Berlin

- **ASIA**
  - Bangalore
  - Singapore
  - Shanghai
MOBILITY HAS ITS OWN BUSINESS C.A.S.E. AND MASS OPTIMIZATION IS A COMMON THREAD

1. Understanding disruptions

2. Avoiding the noise

3. Through the new technologies

4. To lead of the road to mobility

**Connected**
- The ability to communicate is a growing need for safety, functionality, revenue and customer experience
- Connectivity is a key enabler for all mobility perspectives and the entry point for existing and new influencers

**Automated**
- Automated driving refers to SAE’s 5 levels of driver’s assistance to prevent crash and release drivers from keeping full attention on the road
- It is expected to impact the industry on several perspectives including the rise of the robotaxis

**Shared**
- Shared services are increasing vehicle usage to improve parc efficiency and people mobility
- It includes car-sharing, car rental, subscription solutions, ride-sharing, ride-hailing, last mile solutions

**Electrified**
- Vehicle electrification is the answer to more stringent emission norms and reduction of tail pipe emissions
- Electrification is improving development costs and also opening the door to newcomers
EVs EMBRACE CONNECTIVITY, AUTONOMOUS SOLUTIONS, AND SHARED EXPERIENCES. OFFSETTING MASS IS CRITICAL

**Trends**

1. Key to the EVs differentiation is its ability to encompass the cutting edge in technology, connectivity and safety
2. Connectivity, ADAS, and Robo-Taxis require incredible amounts of hardware, wiring, and software
3. Battery technology is evolving albeit at a slower rate than anticipated
4. Shared vehicle architectures including skateboard designs for cost sharing and optimization

**Impacts**

1. Investments in new technology R&D and product solutions – new business models and solutions providers emerge
2. New sensors including cameras, radar/lidar arrays, communication hardware, wire-harnesses, mounting hardware – over 300 pounds may be added
3. Aggressive mass savings solutions to offset the energy demand while optimizing the solution for multiple OEMs

**Solutions to consider**

- Follow design evolutions to provide leading solutions required to successfully develop EV architecture and offer
- Provide mass savings solutions to support OEMs and Tier 1s efforts especially as all this technology will reduce the EVs range
- Support efficiency improvement (increase range) of existing technologies with flexible solutions as EV demand might be slow to ramp up

**Technologies**

- [Image of electric vehicle technology]

**Influencers**

- [List of companies: Tesla, NIO, GM, Rivian, Volkswagen, Toyota, Panasonic, LG Chem, ChargePoint, BYTON, Dyson, Polestar, NIKLAS MUNRO INTELLIGENT]
LIGHT VEHICLES WITH A PLUG (BEVS AND PHEVS) WILL GROW FROM LESS THAN 400,000 UNITS IN 2018 TO NEARLY 1.3 MILLION UNITS BY 2025

Source: LMC July 2019
TESLA’S ACHIEVEMENTS (AND FAILURES) PROVIDE A ROADMAP FOR ALL OTHERS ENTERING THE BEV SPACE

2020 NA OEM Share of 384,373 BEV Units

- Tesla Model 3 & Y: 59%
- Tesla Model S & X: 15%
- GM: 6%
- Ford: 6%
- Nissan: 6%
- Toyota: 5%
- All Other: 3%

2025 NA OEM Share of 931,201 BEV Units

- Tesla Models 3, Y & P: 39.7%
- Ford: 14.4%
- VW: 7.9%
- GM: 6.5%
- Nissan: 6%
- Toyota: 4.3%
- Audi: 2.7%
- Daimler: 2.5%
- Honda: 2.5%
- Rivian: 1.5%
- All Other: 4.90%

Source: LMC July 2019
MATERIAL CONTENT FOR ALUMINUM, STEEL AND OTHERS VARY SIGNIFICANTLY. THE TESLA MODEL S HAS 1,457 POUNDS OF ALUMINUM WHILE THE VW E GOLF IS STEEL INTENSIVE

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>BEV</th>
<th>Pounds</th>
<th>Wheelbase</th>
<th>Track</th>
<th>Footprint</th>
<th>Wheelbase</th>
<th>Track</th>
<th>Footprint</th>
<th>Pounds</th>
<th>Body</th>
<th>Closures</th>
<th>Bumpers</th>
<th>Source: DuckerFrontier Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tesla Model S (75D)</td>
<td>E-large</td>
<td></td>
<td>4,608</td>
<td>117</td>
<td>66</td>
<td>54</td>
<td>85.3</td>
<td></td>
<td></td>
<td></td>
<td>Aluminum</td>
<td>Aluminum</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>2018 Nissan Leaf</td>
<td>C-compact</td>
<td></td>
<td>3,433</td>
<td>106</td>
<td>61</td>
<td>45</td>
<td>76.3</td>
<td></td>
<td></td>
<td></td>
<td>Steel</td>
<td>AL Hood</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>NIO ES8</td>
<td>SUV-large</td>
<td></td>
<td>5420</td>
<td>118.5</td>
<td>66</td>
<td>55</td>
<td>99.5</td>
<td></td>
<td></td>
<td></td>
<td>Aluminum</td>
<td>Aluminum</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>*BMW i3</td>
<td>C-compact</td>
<td></td>
<td>2,961</td>
<td>101.2</td>
<td>62</td>
<td>44</td>
<td>68.0</td>
<td></td>
<td></td>
<td></td>
<td>Mixed (CFRP)</td>
<td>CFRP</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Toyota Prius Prime</td>
<td>C-compact</td>
<td></td>
<td>3,365</td>
<td>106</td>
<td>60</td>
<td>45</td>
<td>75.5</td>
<td></td>
<td></td>
<td></td>
<td>steel</td>
<td>Steel</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Chevy Bolt</td>
<td>B-sub compact</td>
<td></td>
<td>3,519</td>
<td>102</td>
<td>59</td>
<td>42</td>
<td>83.8</td>
<td></td>
<td></td>
<td></td>
<td>Steel</td>
<td>Aluminum</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Chevy Volt</td>
<td>C-compact</td>
<td></td>
<td>3,519</td>
<td>106</td>
<td>61</td>
<td>45</td>
<td>78.3</td>
<td></td>
<td></td>
<td></td>
<td>Steel</td>
<td>Steel</td>
<td>Steel</td>
<td></td>
</tr>
</tbody>
</table>
NA BEV ALUMINUM CONTENT RANGES FROM A LOW OF 350 LBS TO A HIGH OF 1,500 LBS

Source: DuckerFrontier
THE AVERAGE 2025 NA BEV WILL CONTAIN 152 MORE LBS OF ALUMINUM THAN ITS ICE COUNTERPART

### NA 2025 Aluminum Pounds for Light Vehicles

<table>
<thead>
<tr>
<th>Base ICE Total</th>
<th>Engine</th>
<th>Heat Transfer</th>
<th>Wheels</th>
<th>Structural Parts</th>
<th>Non Structural Parts</th>
<th>Body, Bumper &amp; Closure</th>
<th>Suspension &amp; Steering</th>
<th>EV Driveline &amp; Battery Box</th>
<th>BEV Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>480</td>
<td></td>
<td>-120</td>
<td>-88</td>
<td>-23</td>
<td>65</td>
<td>142</td>
<td>42</td>
<td>187</td>
<td>150</td>
</tr>
</tbody>
</table>

### 2025 Wrought Products (Rolled, Extruded & Forged)

<table>
<thead>
<tr>
<th>ICE Deductions</th>
<th>Additions</th>
<th>BEV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>185</td>
<td>252</td>
</tr>
</tbody>
</table>

### 2025 Cast Products

<table>
<thead>
<tr>
<th>ICE Deductions</th>
<th>Additions</th>
<th>BEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>-193</td>
<td>131</td>
<td>233</td>
</tr>
</tbody>
</table>

Source: DuckerFrontier
EVs WILL INCREASE ALUMINUM WROUGHT PRODUCTS CONTENT BY 204 M LBS IN 2025. PRIMARY BASED CASTINGS WILL CONTINUE TO DEMONSTRATE SIGNIFICANT GROWTH, WHILE SECONDARY CASTINGS DECLINE FURTHER.

**2025 Increased Aluminum Content from Electric Vehicles**
- Millions of Pounds -

<table>
<thead>
<tr>
<th>Type</th>
<th>Content Increase/Decline (M LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEV Wrought</td>
<td>234.7</td>
</tr>
<tr>
<td>BEV Wrought</td>
<td>-35.4</td>
</tr>
<tr>
<td>BEV Primary Cast</td>
<td>58.7</td>
</tr>
<tr>
<td>BEV Secondary Cast</td>
<td>63.3</td>
</tr>
<tr>
<td>BEV Secondary Cast</td>
<td>-179.7</td>
</tr>
<tr>
<td>PHEV Wrought</td>
<td>5.0</td>
</tr>
<tr>
<td>PHEV Secondary Cast</td>
<td>20.8</td>
</tr>
<tr>
<td>BEV/PHEV Total</td>
<td>167.3</td>
</tr>
</tbody>
</table>

**2025 Vehicle Production**
- 18 Million Units -

- PHEV: 2%
- BEV: 5%
- ICE No Plug: 93%

**2025 Aluminum Content**
- 8.8 Billion Pounds -

- ICE No Plug: 91%
- BEV: 7%
- PHEV: 2%

Source: DuckerFrontier
BY 2025, THE AVERAGE BEV WILL CONTAIN TWICE AS MUCH ALUMINUM WROUGHT PRODUCTS AS ICE AND PHEV UNITS

### 2020 Light Vehicle Aluminum Content
- **Pounds per Vehicle**

<table>
<thead>
<tr>
<th></th>
<th>Wrought Products</th>
<th>Cast Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICE Only</td>
<td>170</td>
<td>290</td>
</tr>
<tr>
<td>PHEV</td>
<td>180</td>
<td>358</td>
</tr>
<tr>
<td>BEV</td>
<td>482</td>
<td>228</td>
</tr>
</tbody>
</table>

### 2025 Light Vehicle Aluminum Content
- **Pounds per Vehicle**

<table>
<thead>
<tr>
<th></th>
<th>Wrought Products</th>
<th>Cast Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICE Only</td>
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<td>295</td>
</tr>
<tr>
<td>PHEV</td>
<td>195</td>
<td>363</td>
</tr>
<tr>
<td>BEV</td>
<td>399</td>
<td>233</td>
</tr>
</tbody>
</table>

*Source: DuckerFrontier*
THANK YOU

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