Recent Trends and Challenges in Lightweighting for the Automotive Industry

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Presented by/Date
Sanjay Mazumdar, CEO / October 13, 2016
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Lucintel’s Expertise in Market Research & Management Consulting

• Founded in 1998. Team of over 120 full time analysts and consultants.

• Offered advisory services (M & A, market entry, growth consulting, due diligence) to hundreds of clients.

• Over 500 market intelligence reports on various market segments. No learning curve.

• Great networking. Over 20,000 contacts.

• Testimonials demonstrating our capabilities in management consulting.
  – “I was very happy with Lucintel’s work. It helped us in making a confident investment decision. They delivered the project in a timely manner.” – Dave Finley, Managing Director, Sverica International.
  – “Lucintel has its finger on the pulse of the market and drives deep strategic insights.” Andy Schmidt, Managing Partner, MacQuarrie Partners
1000+ Clients in 70 Countries Value Our Service
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Locations Covering Global Market

120+ Analysts/Consultants Worldwide

Lucintel Report Experience: 500+ Published Market Reports

Lucintel Consulting Experience: 500+ Consulting Projects

Aerospace & Defense
Chemical & Composites
Construction
Consumer & Retail
Technology & Telecom
Metals & Mining
Transportation
Healthcare
Energy & Utility

Market Assessments
Target Screening
Due Diligence, M&A
Market Entry Strategy
Partner Search
Opportunity Screening
Strategic Growth Opportunities
Benchmarking
Sanjay Mazumdar, PhD.
CEO, Author, Thought Leader & Strategist

• Offered advisory services (M & A, market entry, growth consulting, due diligence) to hundreds of clients over 15+ yrs.
• Subject matter expert in the chemical and advanced materials market
• Worked for General Motors in ultra-lightweight project and received 2 Record of Inventions
• Awarded two Society of Plastics Engineers Awards and one DuPont Plunkett Award
• Authored the book: "Composites Manufacturing: Materials, Product & Process Engineering"
• Sought-after speaker at conferences and annual board meetings, helping companies with their growth objectives. Panelist at conferences with industry leaders (Airbus, Boeing, Owens Corning, Core Molding, etc.)
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- **Market Disruptions in Composites**

- **Case Study**
Executive Summary

- Lightweight materials market in the global automotive industry is expected to reach 221 billion lbs ($335 billion) in 2025, growing at a CAGR (2015-2025) of 7% from 106 billion lbs ($150 billion) in 2015.
- Use of light weight materials in vehicles creates concerns such as bonding, safety, vibration, cost, and aesthetics.
- Stamping technology dominates in HSS/AHSS and Aluminum, whereas HP-RTM and prepreg is mostly used with carbon composites.
- To get extra 4.5 mpg fuel efficiency, about 25% weight saving (900 lbs) is needed.
- Carbon fiber composites offer good business case for OEMs and Tier 1 suppliers for lightweight solutions – depicted by BMW and Plasan case studies.
- Potential for carbon composites could be huge in automotive industry if the industry is able to drive innovations in materials and technologies.
- There will be market disruption in the composites industry to drive down the cost and leap frog the competition.
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## Key Lightweight Technologies Used to Manufacture Automotive Parts

<table>
<thead>
<tr>
<th></th>
<th>HSS/AHSS</th>
<th>Aluminum</th>
<th>Glass Composites</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key Processes</strong></td>
<td></td>
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<tr>
<td>Stamping</td>
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<td>Stamping</td>
<td>Compression Molding</td>
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<td>Stamping</td>
<td>Injection Molding</td>
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<td></td>
<td></td>
<td>Stamping</td>
<td>RTM</td>
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<tr>
<td><strong>Key Applications</strong></td>
<td></td>
<td>Heat Shield, Bumpers,</td>
<td>Intake Manifold: (Injection Molding)</td>
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<tr>
<td>(Process)</td>
<td></td>
<td>Hoods, and Closure Panels: (Stamping Process)</td>
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<td>Powertrain (Engine Block, Transmission): (Casting Process)</td>
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<td></td>
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<td>Chassis &amp; Suspension, Heat Exchangers: (Extrusion Process)</td>
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<tr>
<td>Usibor (A-pillar,</td>
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<td>Hood (Compression Molding)</td>
</tr>
<tr>
<td>Bumper Beam, B-Pillar, C- Pillar, Door Beam)</td>
<td></td>
<td></td>
<td>Door Module: (Compression Molding)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Radiator End Tank: (Injection Molding)</td>
</tr>
<tr>
<td>Fuel Tank Guard</td>
<td></td>
<td></td>
<td>Oil Pan: (Injection Molding)</td>
</tr>
<tr>
<td>Body in White</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Door Panels</td>
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<td></td>
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<tr>
<td>Axle Carrier</td>
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<tr>
<td>Engine Cradle</td>
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<tr>
<td>Dash Panel</td>
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<td>Crash Box</td>
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<tr>
<td>Side Rail</td>
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<tr>
<td>Seat Frame</td>
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</tbody>
</table>
## Key Lightweight Technologies Used to Manufacture Automotive Parts

### Carbon Composites
- Prepreg Layup
- Resin Infusion (HP-RTM)

### Natural Composites
- Compression Molding

### Magnesium
- Casting
- Extrusion

### Key Processes
- Monocoque: (Prepreg & RTM Process)
- Hood: (Prepreg Layup)
- Door Panel: (Prepreg Layup)
- Roof: (Prepreg Layup)
- Body Panels: (Prepreg Layup & RTM Process)

### Key Applications (Process)
- Door Panel
- Seat Back
- Load Floor
- Interior Panels
- Under Body Shields

- Door Inner, Roof Frame, Lift Gate Inner, Pillar: (Casting Process)
- Support Beam, Connectors, Side Rails: (Extrusion Process)
### Lightweight Materials Options in Various Applications

<table>
<thead>
<tr>
<th>Component</th>
<th>Body-in-White (22%-25%)</th>
<th>Closures &amp; Fenders (7%-8%)</th>
<th>Powertrain (24%-28%)</th>
<th>Suspension &amp; Chassis (22%-27%)</th>
<th>Interior &amp; Others (18%-23%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key Applications</strong></td>
<td></td>
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<tr>
<td>Passenger Compartment</td>
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<tr>
<td>Frame</td>
<td></td>
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<tr>
<td>A,B, &amp; C Pillars</td>
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<tr>
<td>Roof Structure</td>
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<tr>
<td>Floor Structure</td>
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<tr>
<td><strong>Key Materials</strong></td>
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<td>Steel</td>
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<tr>
<td>HSS/AHSS</td>
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<td>Aluminum</td>
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<td>GFRP</td>
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<tr>
<td>CFRP</td>
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<tr>
<td>Carbon Fiber Reinforced</td>
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<tr>
<td><em>Steel</em></td>
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<tr>
<td><em>HSS/AHSS</em></td>
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<tr>
<td><em>Aluminum</em></td>
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<td><em>GFRP</em></td>
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<tr>
<td><em>CFRP</em></td>
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<tr>
<td><em>Carbon Fiber Reinforced</em></td>
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</tr>
</tbody>
</table>

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*Images of various parts of a car are shown.*

- **Suspension & Chassis**: Chassis, Wheels, Steering, Brakes
- **Interior & Others**: Seats, Instrument Panel, Insulation, Airbags, Windows, Glazing, Trim

*www.lucintel.com*
Future Automotive Materials Will be Dominated by Lightweight Materials


Source: Lucintel
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Emission Reduction Targets in the Global Automotive Industry

Source: ICCT

97 g/km of CO₂ = 54.5 mpg
OEMs focusing 15% of Fuel Saving Targets from Light Weight Materials. About 900 lbs weight saving required per vehicle

Key Insights

- To meet CAFÉ 2025 regulations automotive OEMs are looking at all different alternatives, such as powertrain improvements, powertrain electrification, design improvement, and weight reduction.
- Reduction in 10% of curb weight can reduce fuel consumption by 7%.
- To get extra fuel efficiency of 4.5 MPG, about 25% weight reduction (900 lbs) is required.
- Carbon fiber will play a vital role in achieving this mark of about 25% weight reduction in future.

Source: Lucintel, NHTSA, EPA
In Highway Driving, 10% Weight Saving Gives about 7% Fuel Saving

![Graph showing the relationship between vehicle curb weight and highway mileage. The graph includes various car models and shows a linear regression equation: \( y = -0.0071x + 55.439 \) with an R-squared value of approximately 0.80. The sample size is 34, and the data source is Lucintel.

Sample Size: 34

Source: Lucintel

www.lucintel.com
On City Driving, 10% Weight Saving Gives about 11% Fuel Saving

\[ y = -0.0082x + 49.935 \]

\[ R^2 = \sim 0.90 \]

Sample Size: 34

Source: Lucintel
## Challenges in Using Lightweight Materials

<table>
<thead>
<tr>
<th>Category</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Increased Costs</strong></td>
<td>➢ Excessive use of lightweight materials will lead to increase in cost of vehicles</td>
</tr>
</tbody>
</table>
| **Safety Concerns**       | ➢ Replacement of traditional metals with lightweight materials need to pass through various evaluation tests and technical challenges  
                               ➢ Crashworthiness of lightweight materials is still under test                                                                                                                                         |
| **Temperature Resistance**| ➢ Introduction of dissimilar materials may lead to difference in temperature resistance impacting the overall temperature susceptibility of the part                                                                 |
| **Joining Difficulty**    | ➢ Attaching two similar substrates is easier when compared to dissimilar materials as they have different physical and chemical properties. With decrease in material weight, adhesion to lighter surfaces becomes difficult |
| **Noisier Parts**         | ➢ Lighter parts tend to produce higher vibration and noise as compared to traditional steel body panels                                                                                                   |
| **Aesthetics**            | ➢ Changing to different substrates, from metals to plastics or composites, changes the appearance of the part thus creates perception of poor quality                                                                  |
| **Repair Ability**        | ➢ Parts made using multi-material systems increases the complexity of repairing parts of the vehicle                                                                                                      |
# Key Challenges for Lightweight Materials in the Automotive Industry

## AHSS/HSS
- High-cost as compared to traditional steel
- Complexity in stamping due to high strength
- Spring back behavior of AHSS
- HSS possesses challenges for joining
- Low corrosion resistance

## Magnesium
- Formability of magnesium is difficult
- High-cost compared to other materials
- Processing magnesium to sheet requires high cost
- Low corrosion and creep resistance
- Recycling of magnesium alloys
- Low temperature resistance

## Aluminum
- High-cost
- Limited compatibility with existing manufacturing infrastructure
- Aluminum is difficult to process compared to steel
- Joining and welding is difficult
- Higher lifecycle emission than steel

## Plastics & Composites
- Recycling of waste materials after use
- High-cost compared to other lightweight materials
- Lack of mass production technology
- Joining plastics and composites to metallic surfaces can be difficult
- High repair cost
### Advanced Materials Offer Considerable Weight Savings at High Costs

#### Structural Application

<table>
<thead>
<tr>
<th>Relative Part Weight</th>
<th>Steel</th>
<th>Relative Part Cost</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td></td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>75%-90%</td>
<td>AHSS</td>
<td>120%-140%</td>
<td></td>
</tr>
<tr>
<td>50%-60%</td>
<td>Aluminum</td>
<td>150%-230%</td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td>CFRP</td>
<td>700%-900%</td>
<td></td>
</tr>
</tbody>
</table>

#### Non-Structural Application (Fender)

<table>
<thead>
<tr>
<th>Relative Part Weight</th>
<th>Steel</th>
<th>Relative Part Cost</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td></td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>75%-90%</td>
<td>AHSS</td>
<td>110%-130%</td>
<td></td>
</tr>
<tr>
<td>75%-80%</td>
<td>Plastics</td>
<td>100%-110%</td>
<td></td>
</tr>
<tr>
<td>50%-60%</td>
<td>Aluminum</td>
<td>120%-140%</td>
<td></td>
</tr>
<tr>
<td>30%-50%</td>
<td>CFRP (RTM)</td>
<td>500%-700%</td>
<td></td>
</tr>
</tbody>
</table>

#### Drivers

- **CAFÉ Requirement**
- **CO₂ Emission**

**Source:** Lucintel
Opportunity for Lightweight Materials in the Automotive Industry in 2025

- Global Materials Demand in the Automotive Industry: 469 Billion Pounds in 2025
- Global Lightweight Materials Demand in the Automotive Industry: 221 Billion Pounds in 2025
- Global Composites Demand in the Automotive Industry: ~9.0 Billion Pounds in 2025
- Global Carbon Composites Demand in the Automotive Industry: 250 Million Pounds in 2025

Source: Lucintel

Note: Lightweight materials includes HSS (>550 Mpa), Aluminum, CFRP, GFRP, Natural Fiber Composites, Magnesium, and Plastics

www.lucintel.com
## Opportunities for Lightweight Materials in terms of Fuel Saving and CO2 emission Saving Potential

<table>
<thead>
<tr>
<th>Material</th>
<th>Weight Reduction (of Total Vehicle Weight)</th>
<th>Fuel Saving ($) (Life Time Saving Per Vehicle)</th>
<th>CO2 Emission Saving (Gram/km Per Vehicle)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>@20% Use of Lightweight Materials</td>
<td>@40% Use of Lightweight Materials</td>
<td></td>
</tr>
<tr>
<td>HSS/AHSS</td>
<td>2.5% / 4.9%</td>
<td>$170 / $340</td>
<td>4.4 / 8.9</td>
</tr>
<tr>
<td>Aluminum</td>
<td>9.3% / 18.7%</td>
<td>$641 / $1,283</td>
<td>16.8 / 33.6</td>
</tr>
<tr>
<td>Glass Composites</td>
<td>7.5% / 15.1%</td>
<td>$518 / $1,036</td>
<td>13.6 / 27.2</td>
</tr>
<tr>
<td>Carbon Composites</td>
<td>21.0% / 42.0%</td>
<td>$1,443 / $2,887</td>
<td>37.8 / 75.6</td>
</tr>
<tr>
<td>Magnesium</td>
<td>14.0% / 28.0%</td>
<td>$962 / $1,924</td>
<td>25.2 / 50.4</td>
</tr>
</tbody>
</table>

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Voice of the Market: Need for Light Weight Options with Good Business Case

We are evaluating all material options such as AHSS, Aluminum, Magnesium, Glass Composites and Carbon Composites for making automotive parts. Any material option should have a good business case without sacrificing safety, part count, and other requirements.

Manager, GM

Our top management is asking us to reduce weight by almost 50% in various platforms. We are looking into various material options. Significant weight saving potential is available in closure panels such as door panels, deck lids, and hood. We encourage component and material suppliers to come up with better solutions for our vehicle.

Product Manager, Chrysler

Cost is a challenge with bio-composites as most users are not willing to pay a premium. Scale-up is needed for bio-composite materials for better economics.

Materials Research, Ford Motors

There is an increasing demand for low density materials in automotive and commercial vehicle market. We are continuously working to develop products with lower density using different combinations of raw materials. We are closely working with Tier 1 players and also OEMs to identify the future of new materials in structural and semi structural automotive applications.

Director, Menzolit
Voice of the Market: Material and Component Suppliers Need to Develop Better Lightweight Solutions

Government in North America has passed mandatory regulations, i.e. CAFÉ standards to improve the fuel economy. In order to improve the fuel economy, we need to work on the weight reduction in our trucks. We are looking into composites and other material options for making of our truck components.

Director, Peterbilt

We have been using composite on our components for a long time and are satisfied with its performance, though we are open to opt a newer materials offering better mechanical and aesthetic properties with light weight. We tend to depend on component suppliers and material manufacturer for new applications for our vehicles.

Engineer, Mercedes-Benz Trucks

We use many SMC components such as bumper, roof cap, cabin structure, door extensions and fenders for our Trucks. For our Bus, we use hand lay-up and RTM process to manufacture composites parts. We are looking for new materials and technologies to make various components.

Engineer, MAN SE
Reduction in Carbon Fiber Cost would Bring 100% More Revenue ($2.7 Bil) from the Automotive Industry

<table>
<thead>
<tr>
<th>Car Type</th>
<th>Global Light Vehicles Production in 2025</th>
<th>Expected Demand of CF @ Current Price in 2025</th>
<th>Expected Demand of CF @ $5/lb in 2025</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CF Usage in % of cars</td>
<td>Demand in Mlbs</td>
</tr>
<tr>
<td>Super Cars</td>
<td>8,000</td>
<td>100%</td>
<td>1.6</td>
</tr>
<tr>
<td>Super Luxury Cars</td>
<td>800,000</td>
<td>95%</td>
<td>60.8</td>
</tr>
<tr>
<td>Luxury Cars</td>
<td>5.5 Million</td>
<td>55%</td>
<td>75.6</td>
</tr>
<tr>
<td>Other/Regular Cars</td>
<td>112 Million</td>
<td>3%</td>
<td>5.0</td>
</tr>
<tr>
<td>Global Light Vehicles</td>
<td>118 Million</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                 |                                        | 143.1                      | 1,430         | 554.0       | 2,770                     |

Source: Lucintel
Business Case: BMW and Plasan
Major Factors Driving the Usage of Carbon Composites by BMW in its Electric Vehicles

Factors Driving the Use of Carbon Composites by BMW

- **A.** Weight Saving
- **B.** Emission Reduction
- **C.** Part Consolidation
- **D.** Strength and Safety gains
- **E.** Efficiency Improvement

Strategies Adopted by BMW to Ensure Effective Usage of CF Materials

Challenges to adopt Carbon Fiber

- High Cost of carbon fiber restricts its usage in high volume vehicles
- Continuous availability
- High cycle time

Solutions

- BMW & SGL jointly invested to establish carbon fiber manufacturing plant at Moses Lake
- The facility supplies CF and preforms for BMW i vehicles & 7 series
- This strategy helps BMW to have control over CF prices
Increasing Usage of Carbon Fiber will Significantly Cut Vehicle Mass

Weight Saving in BMW Cars with Increasing Usage of Carbon Fiber

<table>
<thead>
<tr>
<th>Vehicle Mass (lbs.)</th>
<th>BMW M3</th>
<th>BMW M4</th>
<th>BMW i8</th>
<th>BMW i3</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,350</td>
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<td></td>
<td>2,634</td>
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<td>3,299</td>
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<tr>
<td>3,273</td>
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</tbody>
</table>

Note: 5% weight reduction in new BMW M3 and M4 model over its predecessors with the use of CF

CF Applications in BMW Car Models

- Driveshaft-M4
- Roof-BMW M3
- Trunklid-BMW M4
- Life Module-BMW i3 & i8

Source: Lucintel
High Usage of Carbon Fiber in EVs Offers Significant Weight Saving and Improved Mileage

**Mileage Comparison**

<table>
<thead>
<tr>
<th></th>
<th>Tesla Model S</th>
<th>Nissan Leaf</th>
<th>BMW i3</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPGe</td>
<td>~23%</td>
<td>~9%</td>
<td>~23%</td>
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</table>

**Price Comparison**

<table>
<thead>
<tr>
<th></th>
<th>Tesla Model S</th>
<th>Nissan Leaf</th>
<th>BMW i3</th>
</tr>
</thead>
<tbody>
<tr>
<td>($)</td>
<td>~45%</td>
<td>~19%</td>
<td>~45%</td>
</tr>
</tbody>
</table>

**Weight Comparison**

<table>
<thead>
<tr>
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<th>Tesla Model S</th>
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<th>BMW i3</th>
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<tr>
<td>lbs.</td>
<td>~45%</td>
<td>~19%</td>
<td>~45%</td>
</tr>
</tbody>
</table>

- High CF content in BMW i3 has improved its mileage.
- CF has reduced the weight of i3 by 45% and 19% respectively compared to Model S and Leaf.

Note: MPGe (Miles per gallon gasoline equivalent)

Source: Lucintel
In Two Years, BMW i3 Gained Share of ~8% in the Electric Vehicle Market and is Still Expected to Gain Share in Future

In launched year BMW i3 accounted for 1.2% market share in Global EVs market and gained ~8% share in just two years affecting the market share of its competing vehicles.
Business Case 2: Plasan Revenue Increased 20 Times in Five Years from Carbon Composites

Company Introduction

- **Plasan Carbon Composites** is a carbon fiber component manufacturer, mainly for the automotive industry.
- Company transformed itself from low volume producer of composites components to high volume carbon composites part supplier in 10 years.
- Company targeting to achieve $150 million in 2020 from $5 million in 2011.
- Company is continuously developing carbon composites parts for OEMs offering weight saving solutions.

**Plasan: Revenue Analysis (2011-2020)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenue (in $ Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>5</td>
</tr>
<tr>
<td>2015</td>
<td>100</td>
</tr>
<tr>
<td>2020</td>
<td>180</td>
</tr>
</tbody>
</table>

Source: Lucintel
Table of Content

• Lucintel Background
• Executive Summary
• Future Lightweight Technologies
• Challenges & Opportunities
• Business Case for Carbon Composites

• Market Disruptions in Composites
• Case Study
## Major Future Disruptions in the Composites Industry

<table>
<thead>
<tr>
<th>Major Disruptions</th>
<th>Enablers</th>
<th>Impacted Industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Reduction in</td>
<td>Alternative precursors, such as lignin, olefin, textile PAN, etc. Someone will launch low cost carbon fiber ($3 - $6 per lb) in future</td>
<td>• Automotive</td>
</tr>
<tr>
<td>Carbon fiber</td>
<td>Low cure resins and faster and dependable technologies. Part manufacturing process with cycle time of 1 to 2 minutes for mass production</td>
<td>• Industrial</td>
</tr>
<tr>
<td></td>
<td>3D printing for different composites applications especially in automotive and healthcare</td>
<td>• Construction</td>
</tr>
<tr>
<td>Improvement in</td>
<td></td>
<td>• Aerospace</td>
</tr>
<tr>
<td>Productivity</td>
<td></td>
<td>• Automotive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Industrial</td>
</tr>
<tr>
<td>Mass Customization</td>
<td></td>
<td>• Aerospace</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Automotive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Healthcare</td>
</tr>
</tbody>
</table>

“Mobile phones disrupted landlines, Apple iPod disrupted music industry. Similarly, composites will disrupt traditional materials in various industries. Shift to composites will potentially help the environment, OEMs, and end users”
Disruption 1: Development of Low Cost Carbon Fiber Using Alternative Precursors and Manufacturing Process

Carbon Fiber Commercial Grade

- Carbon Fiber Precursor Cost
- Manufacturing Process
- Others

Current carbon fiber price is very high. Auto Industry is looking for price in the range of $5-$6/lbs

Major Areas of Carbon Fiber Cost Reduction

Alternative Precursors
- Textile grade PAN
- Lignin based
- Polyolefin based

Manufacturing Process
- Advanced Oxidative Stabilization
- MAP Carbonization
- Advanced Surface Treatment & Sizing
- Tow Splitting

Zoltek (Now Toray) Commercial grade carbon fiber=$9/lb

Cost Reduction Potential
- Alternative Precursors: 20%-30%
- Manufacturing Process: 40%-60%

Source: Lucintel
Disruption 2: Major Players are Developing Shorter Cure Time Epoxy Resins to Reduce the Production Cycle Time

<table>
<thead>
<tr>
<th>Product</th>
<th>Resin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HexPly® M77</td>
</tr>
<tr>
<td>1</td>
<td>CYCOM 823 RTM</td>
</tr>
<tr>
<td>2</td>
<td>XMTR50</td>
</tr>
<tr>
<td>3</td>
<td>XMTR750</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product</th>
<th>Resin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VORAFORCE 5300 ultra-fast epoxy resin</td>
</tr>
<tr>
<td>2</td>
<td>Araldite MY 0610</td>
</tr>
<tr>
<td>1</td>
<td>Araldite LY 3585</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Product</th>
<th>Resin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EPIKOTE 05475</td>
</tr>
<tr>
<td>2</td>
<td>EPIKOTE 04695-1</td>
</tr>
<tr>
<td>3</td>
<td>EPIKOTE Resin 06465</td>
</tr>
<tr>
<td>4</td>
<td>EPIKOTE TRAC 06170</td>
</tr>
</tbody>
</table>

**Aerospace and Defense**
- Spars
- Fan Blades
- Interior parts
- Drone Rotor Support Arm
- Hollow composite parts
- Propellers, etc.

**Automotive**
- Car Body
- Air Intake
- Airfoil
- Roof parts, etc.

**Healthcare**
- Orthopedic implants
- Prosthetics
- Hearing aids, etc.

**Impact on Industries**
- Improved customization
- Parts on demand
- Little to no scrap
- Short lead time
- Possibility to use new materials
- Part count reduction

So far, 3D printing has emerged as a viable process for prototypes, demonstration units and small volume production.

**Major Barriers**
- Cost, skill requirements, and access to specialized machinery

Source: Lucintel
Table of Content

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- Case Study
Case Study 1: Growth Opportunity for a Leading Prepreg Manufacturer

Challenge
- A leading prepreg supplier wanted to know about the opportunity for glass and carbon fiber prepreg in Europe and North America across various sectors

Objectives
- To estimate growth opportunities for glass and carbon fiber prepreg across sectors including rail, marine, construction, automotive, defense, infrastructure, and sporting goods in NA and Europe
- Find out prepreg consumption by molders in each sector by application and prepreg type
- Conduct Voice of Market analysis and Go To Customer List in North America and Europe

Solutions
- Lucintel identified the most attractive target applications in each region for the client based on the client’s core competency
- Lucintel conducted interviews with >700 companies to find out their prepreg consumption patterns and provided Go To Customer List of >250 molders
- Lucintel developed short, medium & long term strategy in the most attractive markets with action plan

Results
- The company’s sales for the relative growth segments grew by 25% over 2 years
Case Study 2: Growth Opportunity for a Leading Pipe Manufacturer in Composite Pipes

**Challenge**
- A leading FRP pipe manufacturer in the US wanted to know about the opportunity existing for them in composite pipes applications in the US and Canada

**Objectives**
- To identify total opportunity for FRP pipe and steel pipes
- Identify the addressable market (new/replacement) for FRP pipes for the client based on their core competencies (Diameter, pressure rating, etc.)
- Conduct market share analysis, price vs performance analysis with competing materials, customer identification, and customer requirement analysis in various diameter ranges

**Solutions**
- Lucintel identified addressable market opportunity based on client core competencies and looked into competing materials performance over the last 10 years
- Lucintel provided Go To Customer List with **$50 million dollar sales opportunity in next 10 years**
- Lucintel developed short, medium, and long term strategy with detail actionable plan

**Results**
- The company’s sales grew by **35% over 2 years**
Lucintel 360 Market Research Tool: Guaranteed to Keep you Competitive and Innovative

- **Innovation Center** – 400+ innovations. Monitor innovations in materials, applications, etc. of the composites industry
- **Opportunity Center** – Identify opportunities in thousands of composites, steel and aluminum applications
- **Suppliers Dashboard** - Monitor latest activities of major players
- **What’s Trending** – Find, what’s hot in strategic moves, etc.

Write to us at helpdesk@lucintel.com or call us at +1 972 636 5056 for a demo on 360. You can also visit http://360.lucintel.com/innovations-in-materials/innovations.aspx for a short demo.
Monitor innovations in various materials and markets: Continuously updated

300+ emerging composite innovations. Updated regularly. Identify emerging innovations in various markets you serve?

Innovation Trends in Materials
- Innovation Trends in Epoxy Resin
- Innovation Trends in Unsaturated Polyester Resin (UPR)
- Innovation Trends in Glass Fiber
- Innovation Trends in Steel for the Automotive Industry
- Innovation Trends in Carbon Fiber

Innovation Trends in Composite Innovations

In Last 3 years

Technology: 33
Automotive: 30
Aerospace & Defense: 15
Sporting Goods: 15
Compounds: 12
Core Material: 11
Other Resin: 11
Prepreg: 9
Textile: 9
Consumer Goods: 8

Innovations by Application
- Automotive (47)
- Sporting Goods (17)
- Transportation (7)
- Marine (7)
Explore opportunities for your product from thousands of listed opportunities

Over 1100 composite applications. Find, what's new opportunities are available for your materials and products.

Applications of Composites by Industry

- Aerospace (403)
- Transportation (325)
- Construction (198)
- Consumer Goods (75)
- Pipe and Tank (63)
- Marine (42)
- Electrical and Electronics (19)
- Oil and Gas (15)
- Energy (9)
- Others (6)

Applications of Composites by Material Type

- Glass Fiber (678)
- Epoxy (596)
- Carbon Fiber (575)
- Polyester (501)
- Vinylester (117)
- Phenolic (64)
- Polyamide (63)
- Polypropylene (50)
- Polyurethane (8)
- Natural Fiber (11)

Applications of Composites by Manufacturing Process

- Autoclave (410)
- Prepreg Layup (402)
- Compression Molding (283)
- Pultrusion (143)
- Injection Molding (134)
- Hand Layup (133)
- Filament Winding (70)
- RTM (53)
- Resin infusion (44)
- Spray-up (28)
- Panel Lamination (26)
- VARTM (12)
- Bladder molding (9)
- Vacuum Infusion (8)
- Roll wrapping (6)

Composite Wind Blade
Wind Blade is an essential part of wind turbine to... Read More
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