How to Succeed in the Automotive Market with Composites

Presented To:

JEC

Presented By/Date:

Sanjay Mazumdar, CEO, Lucintel / March 15, 2017
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- Lucintel Background
- Executive Summary
- Future Lightweight Technologies
- Business Case for Carbon Composites
- Conclusions
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
About Speaker

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
• 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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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 (2016-2025) of 7%

• Composites offer significant weight saving potential but comes with challenges

• Global opportunity for automotive parts made with composites such as hood, roof, fender, etc. is likely to reach $27.7 Bn in 2021 with a CAGR of 5.8% in the next 6 years

• Carbon fiber composites offer good business case for OEMs and Tier 1 for light weight 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
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## Key Lightweight Technologies Used to Manufacture Automotive Parts

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

### Key Applications

- **HSS/AHSS**
  - Usibor (A-pillar, Bumper Beam, B-Pillar, C-Pillar, Door Beam)
  - Fuel Tank Guard
  - Body in White
  - Door Panels
  - Axle Carrier
  - Engine Cradle
  - Dash Panel
  - Crash Box
  - Side Rail
  - Seat Frame

- **Aluminum**
  - Heat Shield, Bumpers, Hoods, and Closure Panels: (Stamping Process)
  - Powertrain (Engine Block, Transmission): (Casting Process)
  - Chassis & Suspension, Heat Exchangers: (Extrusion Process)

- **Glass Composites**
  - Compression Molding
  - Injection Molding
  - RTM
  - Intake Manifold: (Injection Molding)
  - Hood (Compression Molding)
  - Door Module: (Compression Molding)
  - Radiator End Tank: (Injection Molding)
  - Oil Pan: (Injection Molding)
### Key Lightweight Technologies Used to Manufacture Automotive Parts

<table>
<thead>
<tr>
<th>Carbon Composites</th>
<th>Natural Composites</th>
<th>Magnesium</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Prepreg Layup</td>
<td>• Compression Molding</td>
<td>• Casting</td>
</tr>
<tr>
<td>• Resin Infusion (HP-RTM)</td>
<td></td>
<td>• Extrusion</td>
</tr>
<tr>
<td>• Monocoque: (Prepreg &amp; RTM Process)</td>
<td></td>
<td>• Door Inner, Roof Frame, Lift Gate Inner, Pillar: (Casting Process)</td>
</tr>
<tr>
<td>• Hood: (Prepreg Layup)</td>
<td></td>
<td>• Support Beam, Connectors, Side Rails: (Extrusion Process)</td>
</tr>
<tr>
<td>• Door Panel: (Prepreg Layup)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Roof: (Prepreg Layup)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Body Panels: (Prepreg Layup &amp; RTM Process)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Door Panel</td>
<td>• Seat Back</td>
<td></td>
</tr>
<tr>
<td>• Load Floor</td>
<td>• Interior Panels</td>
<td></td>
</tr>
<tr>
<td>• Under Body Shields</td>
<td>• Load Floor</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

**Key Applications (Process):**

- Cont’d
Future Automotive Materials Will be Dominated by Lightweight Materials


Source: Lucintel
Emission Reduction Targets in the Global Automotive Industry

97 g/km of CO₂ = 54.5 mpg

Source: ICCT
OEMs focusing 15% of Fuel Saving Targets from Light Weight Materials. About 900 lbs weight saving required per vehicle

Technologies to Meet CAFÉ 2025 Regulations

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

\[ y = -0.0071x + 55.439 \]

\[ R^2 = 0.80 \]

Sample Size: 34 (Data from recent OEM makes)

Source: Lucintel
On City Driving, 10% Weight Saving Gives about 11% Fuel Saving

\[ y = -0.0082x + 49.935 \]

\[ R^2 = \sim 0.90 \]

Sample Size: 34 (Data from recent OEM makes)

Source: Lucintel
Advanced Materials Offer Considerable Weight Savings at High Costs

<table>
<thead>
<tr>
<th>Structural Application</th>
<th>Non Structural Application (Fender)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Relative Part Weight</strong></td>
<td><strong>Relative Part Weight</strong></td>
</tr>
<tr>
<td>100% Steel</td>
<td>100% Steel</td>
</tr>
<tr>
<td>75%-90% AHSS</td>
<td>120%-140% AHSS</td>
</tr>
<tr>
<td>50%-60% Aluminum</td>
<td>150%-230% Aluminum</td>
</tr>
<tr>
<td>25% CFRP</td>
<td>700%-900% CFRP</td>
</tr>
<tr>
<td>30%-50% CFRP (RTM)</td>
<td>500%-700% CFRP (RTM)</td>
</tr>
</tbody>
</table>

**Drivers**

- CAFÉ Requirement
- CO₂ Emission

*Source: Lucintel*
## 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>HSS/AHSS</td>
<td>2.5%</td>
<td>$170</td>
<td>4.4</td>
</tr>
<tr>
<td>aluminum</td>
<td>9.3%</td>
<td>$641</td>
<td>16.8</td>
</tr>
<tr>
<td>glass composites</td>
<td>7.5%</td>
<td>$518</td>
<td>13.6</td>
</tr>
<tr>
<td>carbon composites</td>
<td>21.0%</td>
<td>$1,443</td>
<td>37.8</td>
</tr>
<tr>
<td>magnesium</td>
<td>14.0%</td>
<td>$962</td>
<td>25.2</td>
</tr>
</tbody>
</table>

- @20% Use of Lightweight Materials
- @40% Use of Lightweight Materials

Source: Lucintel
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Reduction in Carbon Fiber Cost would Bring 100% More Revenue ($2.7 Bil) from the Automotive Industry

<table>
<thead>
<tr>
<th>Global Light Vehicles Production Forecast by Car Type 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>CF Usage in % of cars</td>
<td>Demand in Mlbs</td>
</tr>
<tr>
<td>Super Cars</td>
<td>100%</td>
<td>1.6</td>
</tr>
<tr>
<td>Super Luxury Cars</td>
<td>95%</td>
<td>60.8</td>
</tr>
<tr>
<td>Luxury Cars</td>
<td>55%</td>
<td>75.6</td>
</tr>
<tr>
<td>Other/Regular Cars</td>
<td>3%</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Global Light Vehicles Production in 2025: 118 Million

Source: Lucintel
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

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

Strategies Adopted by BMW to Ensure Effective Usage of CF Materials

Cont’d
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>
<td></td>
<td>3,300</td>
<td>3,274</td>
<td>2,634</td>
</tr>
</tbody>
</table>

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

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

Mileage Comparison

- Tesla Model S
- Nissan Leaf
- BMW i3

Price Comparison

- Tesla Model S
- Nissan Leaf
- BMW i3

Weight Comparison

- Tesla Model S
- Nissan Leaf
- BMW i3

Note: MPGe (Miles per gallon gasoline equivalent)

High CF content in BMW i3 has improved its mileage.

~19% in Tesla Model S
~9% in Nissan Leaf
~19% in BMW i3

BMW i3 price lies in between the two models & offers high weight saving and mileage which makes it more competitive.

Source: Lucintel
In the Last Three Years, Carbon Fiber Composites in Automotive Industry was Driven by BMW i3 and i8 Model

Global BMW i3 and i8 Sales: 2014-2016

Key Insights

- High cost of carbon fiber impact the profitability of BMW i3 and i8 models, but its make the vehicle light weight
- In last three years, carbon fiber composites in automotive industry was driven by BMW i3 and i8 models
- BMW recently is facing cost pressure from other electric vehicle suppliers, which is likely to impact the carbon fiber demand
- BMW is working on ways to reduce the cost of carbon components

Source: Lucintel
Business Case 2: Plasan Revenue Increased 20 Times in Five Years from Carbon Composites

Plasan: Revenue Analysis (2011-2020)

$ Million

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

*Source: Lucintel*
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
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# Major Future Disruptions in the Composites Industry

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<th>Major Disruptions</th>
<th>Enablers</th>
<th>Impacted Industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Reduction in Carbon fiber</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></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 Productivity</td>
<td></td>
<td>• Automotive</td>
</tr>
<tr>
<td>Mass Customization</td>
<td></td>
<td>• Industrial</td>
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<td>• Aerospace</td>
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<td></td>
<td>• Aerospace</td>
</tr>
<tr>
<td></td>
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<td>• Healthcare</td>
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“*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*”
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• Market Disruptions in Composites
• 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 Glass Fiber
- Innovation Trends in Carbon Fiber
- Innovation Trends in Unsaturated Polyester Resin (UPR)
- Innovation Trends in Steel for the Automotive Industry

Trends: What’s the Focus Areas of Composite Innovations

<table>
<thead>
<tr>
<th>Technology</th>
<th>Automotive</th>
<th>Aerospace &amp; Defense</th>
<th>Sporting Goods</th>
<th>Composites</th>
<th>Core Material</th>
<th>Other Resin</th>
<th>Prepreg</th>
<th>Textile</th>
<th>Consumer Goods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>15</td>
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<td>12</td>
<td>11</td>
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<td>9</td>
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<td>8</td>
</tr>
</tbody>
</table>

What’s Trending in Composite Innovations

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)
- Natural Fiber (11)
- Polyurethane (8)

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... Read More
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