Growth Opportunities in Global Composites Industry, 2012 – 2017

Chuck Kazmierski

Program Manager, Lucintel
Today’s Agenda

• **Executive Summary**

• **Composites Market Analysis**

• **Opportunity in Automotive Market**

• **Growth Opportunities in 2012 and Beyond**

• **Conclusions**

• **About Lucintel**
Executive Summary

- Global composite materials industry reached $19.6B in 2011, marking an annual increase of 8.2% from 2010, and driven by recovering of majority of markets.
- Market value of end use products made with composites was $55.6B in 2011.
- North American composites industry accelerated by ~ 9% in 2011, Europe increased by ~ 8% while Asia grew by ~ 7% in 2011.
- By 2017, composite materials industry is expected to reach $29.9B (~ 7% CAGR) while end products made with composite materials market value is expected to reach $85B.
- Global Automotive composite materials market was estimated to be around $2.8B in 2011, and is forecast to reach $4.3B by 2017 @ CAGR of approx. 7%.
- Significant interest by Automotive OEMs in carbon fiber applications.
- Population growth, new infrastructure projects, urbanization, increase in middle class population, and the green movement will drive composites growth to new horizons in emerging economies.
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Composites Penetration in Various Market Segments – largest markets, including Transportation, have the lowest penetration

<table>
<thead>
<tr>
<th>Market Segment</th>
<th>Composite Materials Market</th>
<th>Structural Materials Market (Steel, Al &amp; Composites)</th>
<th>Composites Penetration</th>
<th>Performance Gap</th>
<th>Price Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>$2.8 B</td>
<td>$77.8 B</td>
<td>3.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marine</td>
<td>$0.5 B</td>
<td>$0.8 B</td>
<td>68%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerospace</td>
<td>$2.3 B</td>
<td>$23.2 B</td>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe &amp; tank</td>
<td>$2.6 B</td>
<td>$37.8 B</td>
<td>7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>$3.4B</td>
<td>$85.1 B</td>
<td>4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Energy</td>
<td>$2.4 B</td>
<td>$6.4 B</td>
<td>38%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumer Goods</td>
<td>$1.3 B</td>
<td>$9.4 B</td>
<td>14%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Composites Penetration Compared to Competing Materials (Steel & Al)
Composites shipmen trend (2006-2011) in various region in $ million

Key Insights

- Composites industry has seen large fluctuations in various markets during the last 5 years due to economic recession.
- Composites industry performed poorly compared to GDP during the last 5 years, however the composites industry is forecast to grow at a higher rate than GDP over the next 5 years.
As developing countries play a larger role in the global economy, their presence in composites manufacturing is also increasing.

- Developing nations (defined as BRIC) have substantially increased their participation in the global economy.
- Developing nations overall have taken a strong role in global composites production.
- Further BRIC increases are not a matter of whether they will happen, but when and by how much.

Key Insights:
Market potential in various countries in 2011 – developed countries have a much larger composite consumption per capita.

**Composite Potential by Country (2011)**

Note: Bubble size represents total composites consumption in respective countries.

- **BRIC Mega Trends**
  - Rapid Growth
  - Rapid Urbanization
  - Emerging Middle Class
  - Global Connectivity
  - Increased OEM Production

- **Potential Challenges**
  - Rising Costs
  - Asset Bubbles/Loose Credit
  - Political Instability

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**Composite Volume Per Capita ($/Capita) (2011)**

**GDP Per Capita US$ (2011)**
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## Composites in Automotive

<table>
<thead>
<tr>
<th>Body Panels/Parts</th>
<th>Key Composites Materials</th>
<th>Key Manufacturing Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior Headliners</td>
<td>Polyurethane, LWRT</td>
<td>RIM, Injection molding</td>
</tr>
<tr>
<td>Air Intake Manifold</td>
<td>SFT</td>
<td>Injection molding</td>
</tr>
<tr>
<td>Front End Carriers</td>
<td>LFT, SMC</td>
<td>Injection molding, Compression Molding</td>
</tr>
<tr>
<td>Bumper Beams</td>
<td>GMT, SMC, Polyurethane</td>
<td>Injection molding, Compression Molding, RIM</td>
</tr>
<tr>
<td>Fenders</td>
<td>SMC, LCM</td>
<td>Compression Molding</td>
</tr>
<tr>
<td>Hoods</td>
<td>SMC, LCM</td>
<td>Compression Molding</td>
</tr>
</tbody>
</table>

### Key Insights

- Global Automotive composites material market was worth $2.8 B in 2011
- Glass-fiber-reinforced polymer composites (SMC, GMT, etc.) are cost effective in volume around 100K per annum due to low tooling cost
- High cost of materials and lack of suitable manufacturing processes for high volume applications continue to be limiting factors for future growth
- Carbon fiber usage will remain limited to high end & premium segment cars
- Advent of lower cost carbon fiber could open a new era for composites in high-volume applications

### Applications

- Chassis
- Roof
- Hood panels
- Front Bumper
- Leaf Spring
Weight savings, fuel economy and other performance benefits will lead to the growth of composite consumption in Automotive applications.

Global Automotive Composite Materials Market (2011-17) in $B

- **2011**: 2.8
- **2017**: 4.3
- **Growth Rate**: +7%

**Key Insight**
- EU has a significant share of composite usage in automotive applications, followed by the US.
- Emerging economies from APAC & ROW will substantially drive composites usage in automotive applications in the future.
- Global Automotive Composite Materials market is estimated to grow @ CAGR ~7% to 2017.

**Drivers**
- Light Weight: GFRP reduces fabricated part weight by 20-30% whereas CFRP can reduce by 40-60%.
- Excellent corrosion resistance.
- Superior fatigue strength.
- Styling & system cost saving.

**Challenges**
- High material cost.
- Lack of efficient manufacturing process.

H= High, M= Medium, L= Low.
### Price Performance Comparison of Competing Materials for Automotive Applications

<table>
<thead>
<tr>
<th>Materials</th>
<th>Average amount per car (lbs)</th>
<th>Performance / Price ratio (Strength/$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>2000</td>
<td>1.1</td>
</tr>
<tr>
<td>Aluminum</td>
<td>600</td>
<td>0.2</td>
</tr>
<tr>
<td>FRP</td>
<td>77</td>
<td>0.7</td>
</tr>
<tr>
<td>Natural Fiber Comp.</td>
<td>35</td>
<td>1.5</td>
</tr>
</tbody>
</table>

While taking into consideration the density of steel, its relative performance compares well to composites . . . .
Price Performance Comparison of Competing Materials for Automotive Applications

<table>
<thead>
<tr>
<th>Materials</th>
<th>Average amount per car (lbs)</th>
<th>Performance/Price ratio (Specific strength/$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>2000</td>
<td>0.15</td>
</tr>
<tr>
<td>Aluminum</td>
<td>600</td>
<td>0.08</td>
</tr>
<tr>
<td>FRP</td>
<td>77</td>
<td>0.36</td>
</tr>
<tr>
<td>Natural Fiber Comp.</td>
<td>35</td>
<td>1.15</td>
</tr>
</tbody>
</table>

.... but for equal volumes, glass fiber composites outperform steel and aluminum; while natural fiber composites have additional strong penetration potential.
Emerging applications will be a driving factor in the growth of Composites in the Automotive Market

<table>
<thead>
<tr>
<th>Application</th>
<th>OEM-Model</th>
<th>Composites Type</th>
<th>Driver for Use of Composites</th>
<th>Launch Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Compartment Cover, Trunk Lid</td>
<td>BMW M6 Convertible</td>
<td>Glass Composites</td>
<td>Weight Reduction</td>
<td>2013</td>
</tr>
<tr>
<td>Wheel Rims</td>
<td>Daimler Smart’s Third-Generation Electric Drive</td>
<td>Glass Composites</td>
<td>Light Weight, Stunning Look</td>
<td>2012</td>
</tr>
<tr>
<td>Instrument Panel, Inner Door Modules</td>
<td>Land Rover – Evoque</td>
<td>Glass Composites</td>
<td>Light Weight &amp; Fuel Economy</td>
<td>2011-12</td>
</tr>
<tr>
<td>Engine-mounted Oil-filter Module</td>
<td>Chrysler Pentastar Engines</td>
<td>Glass Composites</td>
<td>Thermal Requirements for Cooling-System Components</td>
<td>2010-11</td>
</tr>
<tr>
<td>Door Module</td>
<td>Faurecia’s Jeep Liberty SUV</td>
<td>Glass Composites</td>
<td>Weight Reduction</td>
<td>2010</td>
</tr>
<tr>
<td>air-intake manifold system</td>
<td>General Motors V6 Engine</td>
<td>Glass Composites</td>
<td>Weight Saving, Better Acoustic Performance</td>
<td>2010</td>
</tr>
<tr>
<td>air-intake manifold system</td>
<td>Volkswagen Gasoline Engines</td>
<td>Glass Composites</td>
<td>Weight Saving, Better Acoustic Performance</td>
<td>2009-10</td>
</tr>
<tr>
<td>Fluid Filter Module</td>
<td>Daimler AGT- Mercedes</td>
<td>Glass Composites</td>
<td>38% Weight and 16% Cost Reductions</td>
<td>2009-10</td>
</tr>
</tbody>
</table>
### Increased Interest in Carbon Fiber by Automotive OEMs will significantly drive the growth of the Composites Industry over the next 10 Years

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<thead>
<tr>
<th>Application</th>
<th>OEM-Model</th>
<th>Composites Type</th>
<th>Driver for Use of Composites</th>
<th>Launch Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite Passenger Cell</td>
<td>BMW i3</td>
<td>Carbon Composites</td>
<td>Light Weight</td>
<td>2013</td>
</tr>
<tr>
<td>Car Roof</td>
<td>McLaren MP4-12C Spider</td>
<td>Carbon Composites</td>
<td>Light Weight</td>
<td>2013</td>
</tr>
<tr>
<td>Car Roof</td>
<td>BMW M6 Coupe</td>
<td>Carbon Composites</td>
<td>Light Weight</td>
<td>2012</td>
</tr>
<tr>
<td>Body Aerodynamics Kit</td>
<td>Callaway Corvette RPO B2K</td>
<td>Carbon Composites</td>
<td>Light Weight</td>
<td>2012</td>
</tr>
<tr>
<td>Cabin Frame, Floor Panel, Roof Pillars, Hood, Transmission Tunnel, and Rear Floor</td>
<td>Lexus LFA</td>
<td>Carbon Composites</td>
<td>Light Weight</td>
<td>2012</td>
</tr>
<tr>
<td>Body Aerodynamics Kit</td>
<td>Lamborghini Aventador LP700-4 LE-C</td>
<td>Carbon Composites</td>
<td>Light Weight</td>
<td>2012</td>
</tr>
<tr>
<td>Front and Rear Bumpers, Bumper Grilles, Side Skirts, and Mirror Covers</td>
<td>Lamborghini Aventador LP700-4</td>
<td>Carbon Composites</td>
<td>Light Weight</td>
<td>2012</td>
</tr>
<tr>
<td>Panels on Interior Door</td>
<td>Lamborghini Murcielago SP670-4 SV Twin Turbo</td>
<td>Carbon Composites</td>
<td>Light Weight, Stunning Look</td>
<td>2012</td>
</tr>
<tr>
<td>Front &amp; Rear Fenders, Trunk Lid and Door Sills</td>
<td>Aston Martin V12 Zagato</td>
<td>Carbon Composites</td>
<td>Light Weight</td>
<td>2012</td>
</tr>
</tbody>
</table>
Joint ventures with Carbon Fiber Suppliers by Automotive OEM’s to drive innovation and fuel economy

<table>
<thead>
<tr>
<th>Carbon Fiber Supplier</th>
<th>Company</th>
<th>Year</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toray</td>
<td>Daimler</td>
<td>2011</td>
<td>Joint Venture</td>
<td>Manufacturing of automotive CFRP parts</td>
</tr>
<tr>
<td>SGL Carbon</td>
<td>BMW</td>
<td>2010</td>
<td>Joint Venture</td>
<td>Manufacturing of automotive CFRP parts</td>
</tr>
<tr>
<td>Toho Tenax</td>
<td>General Motors</td>
<td>2011</td>
<td>Partnership</td>
<td>Co-develop technology to improve fuel economy</td>
</tr>
</tbody>
</table>

Creating the Equation for Growth
Carbon Fiber Potential in 2017 at 50% current Carbon Fiber Price – Advent of Low Cost Carbon Fiber Would Open New Opportunities

<table>
<thead>
<tr>
<th>Global Automotive Production by Car Type in 2017</th>
<th>Expected Vehicle Production in 2017</th>
<th>Expected use of CF in Cars</th>
<th>Carbon Fiber Demand (M lbs) @ 0.50 X current price</th>
<th>Carbon Fiber Demand ($ M) @ 0.50 X current price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Super Luxury Cars</td>
<td>600K</td>
<td>10%</td>
<td>101.2 M lbs</td>
<td>$506 M</td>
</tr>
<tr>
<td>Luxury Cars</td>
<td>4 Million</td>
<td>10%</td>
<td>101.2 M lbs</td>
<td>$506 M</td>
</tr>
<tr>
<td>Other/Regular Cars</td>
<td>92 Million</td>
<td>1%</td>
<td>202.4 M lbs</td>
<td>$1,012 M</td>
</tr>
<tr>
<td>Global Automotive Production in 2017</td>
<td>97 Million</td>
<td>100% of cars</td>
<td>1.3 M lbs</td>
<td>$7 M</td>
</tr>
</tbody>
</table>

Creating the Equation for Growth
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Global Composite Materials Market by Segment in 2017

Key Insights

- Lucintel forecasts global composite materials market to grow by 8.2% in 2012
- Global composites end product market is expected to grow at 7.4% CAGR to 2017
  - Improved financing and availability of credit
  - Positive sign of healthy growth with gradual bounce back of automotive, construction, electronics and consumer goods markets
- Asia will drive future growth of composite materials to 2017. Europe to see moderate growth.

Global Composites Market Opportunity

* Size of the bubble describes size of the market in Million lbs
Relative Market Attractiveness by Region: Aerospace and Wind Energy Segments show most attractive markets for growth

<table>
<thead>
<tr>
<th>Market Segment</th>
<th>North America</th>
<th>Europe</th>
<th>Asia</th>
<th>Rest of World</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerospace</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe &amp; tank</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumer Goods</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Attractiveness comparison is analyzed among different market segments of the same region
- Attractiveness is analyzed by taking different parameters such as current and future market potentials

![Attractiveness Symbol Legend](image)

Creating the Equation for Growth
US Wind Energy market improved in 2011, cumulative installations grew by more than 30% over 2010.

**Forecast of cumulative wind capacity installation (MW) - 2011-2017**

- **2011**: 46,990
  - **+16%**
  - **2017**: 112,098

**Challenges as overall wind market in Current Scenario**

- Slow growth in energy demand has a multiplier effect on new capacity projects which are 50% renewable
- Fall of natural gas prices affecting wind competitiveness
- Connectivity issues impacting new projects
- Lack of robust long term federal targets for renewable energy continues to impact investor confidence and credit availability
  - State level RPS targets are main driver

**Solutions**

- Demand to grow with renewed economic vigor with EIA forecasting 2% CAGR in next 5 years for overall demand in energy
- Forecast 7% CAGR in natural gas prices in 5 yrs
- Texas is leading way to new connectivity
- Political support for renewable energy expected to remain
Why Wind: Even in highly developed wind markets such as Germany, penetration relative to potential is low, while larger markets such as the US have very low penetration levels.

Key Insights

- Both the US and China show strong potential and low current penetration.
- Russia has high potential but current share of wind is <1 percent due to availability of alternate energy sources.
- PROFINA program is expected to drive wind power sector in Brazil, targeting 5,000 MW installation by 2015.
- Germany, widely considered a leading economy in adopting wind energy, is currently at 30% penetration.
Wind Market Insights: increasing blade length requires better blade design, improved blade materials, lower process and life cycle cost

Current Focus areas for Wind blades

• Design:
  • Improved Aerofoil design for better load distribution across the blade cross section area which increases reliability and performance

• Improved Materials:
  • With increasing length, need for higher strength-to-weight ratio material
  • Mixture of fiber glass and carbon fiber to improve the stiffness and tensile strength in the fiber direction

• Process:
  • Process improvement to reduce total production time

• Lower Life cycle cost:
  • Improved reliability
  • Reduced manufacturing cost
  • Lower operation and maintenance cost
Composite End Products Market Potential Analysis in 2017 at Different Price Points

<table>
<thead>
<tr>
<th>Applications</th>
<th>Composites Potential in 2017</th>
<th>Composites Part Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>US$ 85 B</td>
<td>@ current price level</td>
</tr>
<tr>
<td>FRP Wind Blade</td>
<td>US $ 100 B</td>
<td>@ 0.85x current price</td>
</tr>
<tr>
<td>Auto Parts</td>
<td>US$ 260 B</td>
<td>@ 0.7x current price</td>
</tr>
<tr>
<td>FRP Door</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRP Grating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRP Window</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRP Utility pole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swimming Pool</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Conclusions

• Composites industry is sustainable with over 30,000 known applications
• Strong growth expected in the foreseeable future, led by accelerated BRIC growth
• Weight savings, fuel economy and other performance benefits will fuel the growth of composites consumption in Automotive
• High cost of materials and lack of competitive manufacturing processes for high volume automotive applications continue to be limiting factors for future growth
• New reality in various emerging countries will change geo-political and geo-economical elements of market. . . .players must react accordingly
• New business models need to be developed to address fast changing complex world
  – Quarterly demand for composites shipments monitored by Lucintel show significant changes (up to 40% change Quarter by Quarter) in various market segments
• Companies driven by innovation in developing nations will gain and maintain market share
• Innovations aimed at lowering cost of end products by 30% have potential to grow composites market by a factor of 3x
• Significant interest in carbon fiber applications in Automotive Market
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About Lucintel

- Lucintel is the **leading global management consulting & market research firm**.

- Lucintel **creates your equation for growth** and is committed to **actionable results** that **deliver significant value and long term growth** to our clients.

- Lucintel has been creating measurable value for over 10 years and for more than thousands of clients in 70 + countries worldwide.

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Thank You
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- Aerospace
- Transportation
- Marine
- Construction
- Renewable Energy
- Recreational
- Composite Materials

**Consulting**
- Strategic Growth Consulting
- Benchmarking
- Opportunity Screening
- Partner Search and Evaluation
- M & A
- Market Entry Strategy
Creating the Equation for Growth

... with Project Teams with an appropriate mix between technical and business expertise for results that drive the bottom line

- Senior level consultants and analysts
- PhDs and MBAs
- Masters level engineers
- Scientists and Industry experts
- Past projects ranging from start up to multi-national Fortune 500 companies.
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Lucintel offers following benefits for your project:

- No Learning Curve - Deep industry knowledge and insight
- Quality, Accuracy & Depth
- Speed to Market - Time Savings
- Cost Savings
- Neutral Third Party Position for better market info access and interpretation

Continuous networking with whole value chain including customers, suppliers and competitors

Access to vital, hard to find insights through detailed primary and secondary research and analysis. Incomparable data accuracy and integrity
Lucintel has an extensive toolkit to address key strategic questions for increasing your company’s profitability and market presence.

Key Questions

- Is market space / opportunity of current product offerings sufficiently robust?
- Market is focus for many: how can my company profitably differentiate?
- Based on our core skills, where should we focus?
- Should we build or buy? Is build even an option?
- What game changer actions exist and/or is a more incremental approach best?
- What is the order sequence of market entry segments / products?
Clients around the world value our services
Here is What Our Customers Say:

From our work with demanding customers like 3M, Carlyle, Dow Chemical, Henkel, Airbus, here are a few glowing statements from our customers:

“We found great value in Lucintel’s work, both from a commercial and technology standpoint. Lucintel helped us better align our products with the needs of the market.”

Genaro Gutierrez, PhD, Business Dev. Manager – Dow Chemical

“We bought the Lucintel market report because it is the best report about our industry…a complete and appropriate analysis.”

Cesare Andrenacci, V.P. – Ferretti Group

“The insights we gained from Lucintel’s work helped us with our future business plan…a wonderful professional job…”

Mike Jackson, Stahlin

“Lucintel has its finger on the pulse of the market and drives deep Strategic Insight”

Andy Schmidt, MacQuarie Partners, Managing Partner
THANK YOU!