Growth Opportunities in Global Composites Industry

Lucintel Brief

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- **Market Trends and Opportunity**
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Executive Summary

• Global composite materials industry reached $17.7B in 2010, YOY growth of 10.3%
  • Major industries rebounded after 2009 slowdown from economic crises
• End product market made with composites in 2010 was $50.2B
• North American composites industry accelerated by ~13% in 2010, Europe accelerated by ~8% while Asia grew by ~9% in 2010
  • Driven by Government economic stimulus package and increased consumer confidence
• By 2016, composite materials industry expected to reach $27.4B (7.5% CAGR) while end product market made with composite materials expected to reach $78B
• Future market for composites expected to be more fragmented and international due to emerging economies
• Population growth, new infrastructural projects, urbanization, increase in middle class population and green movement will drive composites growth to new horizons
• Companies with innovation capability will sustain and gain market share in future
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# Composites Penetration in Various Market Segments

<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>$2.7 B</td>
<td>$75.7 B</td>
<td>3.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marine</td>
<td>$0.5 B</td>
<td>$0.7 B</td>
<td>68%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerospace</td>
<td>$2.0 B</td>
<td>$19.1 B</td>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe &amp; tank</td>
<td>$2.1 B</td>
<td>$29.6 B</td>
<td>7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>$3.1 B</td>
<td>$78 B</td>
<td>4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Energy</td>
<td>$2.0 B</td>
<td>$5.4 B</td>
<td>38%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumer Goods</td>
<td>$1.1 B</td>
<td>$7.7</td>
<td>14%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Lucintel
Creating the Equation for Growth

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>35.2</td>
<td>1.5</td>
</tr>
</tbody>
</table>

When taking into consideration the density of steel, its relative performance compares well to composites . . . .

Source: Lucintel
### 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>35.2</td>
<td>1.15</td>
</tr>
</tbody>
</table>

For equal volumes, composites outperforms steel and aluminum. Natural fiber composites has additional strong penetration potential.

*Source: Lucintel*
Creating the Equation for Growth

Thermoset and Thermoplastic Composites Market in 2010

<table>
<thead>
<tr>
<th>Resin</th>
<th>$8.8 Bil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibers</td>
<td>$7.7 Bil</td>
</tr>
</tbody>
</table>

Combining process
- Short Fibers
- Continuous fiber
- Fibers mat

Semi Finished product
- Granules
- Short fibers
- Long fibers

Forming process
- Injection molding
- Compression Molding
- Prepreg / GMT
- Impregnation
- Pultrusion & chopping
- RRIM SRIM
- Filament Winding
- RTM
- Pultrusion/Hand layup
- Compression / Inj. Molding
- Press / Autoclave

End Product $50.2 Bil

Finished components for end markets such as Automotive, Aerospace, Construction, etc. = $50.2 Billion
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External Forces Shaping Composites Industry: Future higher market fragmentation expected due to emerging economies. Companies in Developed nations with innovation capability can thrive and gain share.

- Global platforms
- Technical service
- Application Dev.
- Partnership
- Value

- Specialization
- Efficiency
- Power

- Competition from emerging economies
- Consolidation
- Non-traditional/new entrants
- Focus/specialization

- Regulations on (VOCs)
- Tax credits on renewables
- Uncertainty in Government programs for defense projects

- Innovation
- Cost
- Process improvement
- Capital

- Skills
- Availability
- Location
- Needs
- Culture

- Technical Service
- Specialization
- Efficiency
- Value-added

- Global recession
- War
- Political instability
- China asset bubble

Creating the Equation for Growth
Regional Composites Market Trend: 2005-2010

Key Insights

• Composites industry growth outpaced GDP in 2010

• Huge fluctuations in various markets during last 5 years due to economic recession

• Composites industry performed poorly relative to GDP during last 5 years
  
  • However forecasted to continue to grow at a higher rate than GDP over next 5 years
Looking towards the future: The World has become an Urban World with strong growth opportunities across developing nations . . .

Global Urban & Non Urban Population (Millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Urban Population</th>
<th>Non Urban Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>2,519</td>
<td>1,788</td>
</tr>
<tr>
<td>1980</td>
<td>4,435</td>
<td>2,701</td>
</tr>
<tr>
<td>2000</td>
<td>6,070</td>
<td>3,000</td>
</tr>
<tr>
<td>2005</td>
<td>6,454</td>
<td>3,235</td>
</tr>
<tr>
<td>2010</td>
<td>6,790</td>
<td>3,311</td>
</tr>
<tr>
<td>2030</td>
<td>8,309</td>
<td>3,324</td>
</tr>
</tbody>
</table>

Global Population by Region (Millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Africa</th>
<th>Asia</th>
<th>Europe</th>
<th>Latin America</th>
<th>North America</th>
<th>Oceania</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>13</td>
<td>59%</td>
<td>9%</td>
<td>8%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>1980</td>
<td>13</td>
<td>59%</td>
<td>9%</td>
<td>8%</td>
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<td>9%</td>
<td>8%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>2030</td>
<td>13</td>
<td>59%</td>
<td>9%</td>
<td>8%</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>
...where the largest urban cities are in developing countries

<table>
<thead>
<tr>
<th>Rank</th>
<th>Largest Urban Areas 1900</th>
<th>Largest Urban Areas 1950</th>
<th>Largest Urban Areas 2000</th>
<th>Largest Urban Areas 2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>London, UK</td>
<td>New York US</td>
<td>Tokyo- Yokohama, Japan</td>
<td>Tokyo- Yokohama, Japan</td>
</tr>
<tr>
<td>2</td>
<td>New York, US</td>
<td>London, UK</td>
<td>Mexico City, Mexico</td>
<td>Mumbai, India</td>
</tr>
<tr>
<td>3</td>
<td>Paris, France</td>
<td>Tokyo, Japan</td>
<td>New York, United States</td>
<td>Delhi, India</td>
</tr>
<tr>
<td>4</td>
<td>Berlin, Germany</td>
<td>Paris, France</td>
<td>São Paulo, Brazil</td>
<td>Dhaka, Bangladesh</td>
</tr>
<tr>
<td>5</td>
<td>Chicago, US</td>
<td>Shanghai, China</td>
<td>Mumbai, India</td>
<td>São Paulo, Brazil</td>
</tr>
<tr>
<td>6</td>
<td>Vienna, Austria</td>
<td>Moscow, Russia</td>
<td>Shanghai, People's Republic of China</td>
<td>Mexico City, Mexico</td>
</tr>
<tr>
<td>7</td>
<td>Tokyo, Japan</td>
<td>Buenos Aires, Argentina</td>
<td>Kolkata, India</td>
<td>New York, United States</td>
</tr>
<tr>
<td>8</td>
<td>St. Petersburg, Russia</td>
<td>Chicago, US</td>
<td>Seoul–Incheon, South Korea</td>
<td>Kolkata, India</td>
</tr>
<tr>
<td>9</td>
<td>Manchester, UK</td>
<td>Ruhr, Germany</td>
<td>Buenos Aires, Argentina</td>
<td>Shanghai, People's Republic of China</td>
</tr>
<tr>
<td>10</td>
<td>Philadelphia, US</td>
<td>Kolkata, India</td>
<td>Los Angeles-Long Beach-Santa Ana, USA</td>
<td>Karachi, Pakistan</td>
</tr>
</tbody>
</table>


Creating the Equation for Growth
As Developing Countries Play a Larger Role in the Global Economy, their presence in composites manufacturing is also increasing.

**Key Insights**

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

Source: Lucintel
Creating the Equation for Growth

Composites potential in different countries (2010)

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

Composites potential by country

Source: Lucintel
US wind market Fell in 2010 with future recovery in the works

Challenges as overall wind market expected to decline in 2010

- 3-4% drop 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
- Forecasted 7% CAGR in natural gas prices in 5 yrs
- Texas is leading way with new connectivity
- Political support for renewable energy expected to remain

Forecast of cumulative wind capacity installation (MW) - 2010-2015

<table>
<thead>
<tr>
<th>Year</th>
<th>Capacity (MW)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>40.659</td>
<td>Lucintel</td>
</tr>
<tr>
<td>2015</td>
<td>81.659</td>
<td>Lucintel</td>
</tr>
</tbody>
</table>

+15% growth
Why Wind: Even in highly developed wind markets such as Germany, penetration relative to potential remains low. Large markets such as USA have very low penetration levels.

**Key Insights**

- Both the US and China show strong potential and low current penetration.
- Russia has high potential but oil dependence points to limited wind development.
- PROFINA program is expected to drive wind power sector in Brazil targeting 5,000 MW by 2015.
- Germany, widely considered a leading economy in adopting wind energy currently at 30% penetration.

Source: Lucintel
China wind market expected to witness robust cumulative growth rate in next 5 years

- Total installed capacity is 860 GW (2009)
  - 30 GW contributed by renewable energy (excluding hydro)
  - Solar contributed 1% of the total renewable energy installation
- Wind is expected to remain dominant renewable source in next 10 years
  - Chinese government made commitment for 15% non-fossil fuel in total energy use by 2020 (currently at 8.5%)
- Major challenge is lack of grid capacity
  - About 30% of wind power capacity was not connected to the electrical grid

Forecast of wind cumulative capacity installation (MW) - 2010-2015

<table>
<thead>
<tr>
<th>Year</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>39,805</td>
</tr>
<tr>
<td>2011</td>
<td>54,805</td>
</tr>
<tr>
<td>2012</td>
<td>68,805</td>
</tr>
<tr>
<td>2013</td>
<td>82,805</td>
</tr>
<tr>
<td>2014</td>
<td>95,805</td>
</tr>
<tr>
<td>2015</td>
<td>112,105</td>
</tr>
</tbody>
</table>

+23% growth from 2010 to 2015

Source: Lucintel
Wind Market Insights: Increasing blade length requires better blade design, improved blade materials, lower process and life cycle cost

### Current Focus areas of Wind Blade

- **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:**
  - Improving reliability
  - Reducing manufacturing cost
  - Lower Operation and maintenance cost

---

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Blade length (Meter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>23</td>
</tr>
<tr>
<td>2008</td>
<td>63</td>
</tr>
<tr>
<td>2015</td>
<td>94</td>
</tr>
</tbody>
</table>

Source: Lucintel
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Global Composite Materials Market by Segment

Key Insights

- Global composite materials market is expected to see a CAGR of 7.5% from 2010-2016.
  - Positive sign of healthy growth on account of gradual bounce back of automotive, construction, electronics and consumer goods market
- Asia will drive future growth of composite materials. Europe to see moderate growth.
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>
<td></td>
<td></td>
<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

High • Medium • Low-Medium • Low • No
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### Composites Market Potential Analysis in 2016 at Different Price Points

<table>
<thead>
<tr>
<th>Applications</th>
<th>Composites Potential in 2016</th>
<th>Composites Part Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>US$ 230 B</td>
<td>@ 0.7x current price</td>
</tr>
<tr>
<td>FRP Wind Blade</td>
<td>US$ 160 B</td>
<td>@ 0.85x current price</td>
</tr>
<tr>
<td>Auto Parts</td>
<td>US$ 78 B</td>
<td>@ current price level</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>

- **FRP Utility**
- **Swimming Pool**
- **Residential**
- **FRP Wind Blade**
- **Auto Parts**
- **FRP Door**
- **FRP Grating**
- **FRP Window**

Creating the Equation for Growth
Conclusions

- Composites industry is sustainable with +30,000 composites applications
- Strong Growth Expected in the foreseeable future, led by accelerated BRIC 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 re-invented to address fast changing complex world
  - Quarterly demands on composites shipment monitored by Lucintel show significant changes (up to 40% change Quarter by Quarter) in various market segments
- Companies driven by innovations in developing nations will maintain and gain market share
- Population growth, new infrastructural projects, urbanization, increase in middle class population, green movement will drive composites growth to new horizons
- Innovations towards lowering cost of end products by 30% has potential to 3X composites 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 1000 clients in 70+ countries worldwide.

Creating the Equation for Growth

### Market Reports
- Aerospace
- Transportation
- Marine
- Construction
- Renewable Energy
- Recreational
- Composite Materials

### Consulting
- Growth and Strategic Consulting
- Benchmarking
- Opportunity Screening
- Partner Search and Evaluation
- Due Diligence and M&A
- Market Entry Strategy
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?
- Markets are 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
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For your business requirements and cutting edge consulting solutions, contact Lucintel at helpdesk@Lucintel.com or Tel. +1-972-636-5056 or call one of the following.

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