Strategic Growth Opportunities in the Global Composites Industry

PRESENTED BY
Lucintel

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• Future Market Disruptions in Composites

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Executive Summary

- Global composite materials market was estimated at $33.4 billion in 2019
- In terms of end products (wind blade, golf shaft, door panels, etc.) made using composites, market was estimated at $93 billion in 2019 and is likely to grow with a CAGR of 2.4% to reach $107.4 billion in 2025
- Global composites industry has been hit hard in 2020 due to COVID pandemic and is expected to decline by 15% in 2020
- To drive growth in the composites market, industry needs to work in following areas:
  - Cost reduction in composite parts
  - Development of transformative technologies with reduced cycle time for various markets
  - Development of repair and recycling technologies
  - Enhancement of mechanical, chemical, and conductive properties of fibers and resins
  - Development of Green Composites
- To win in various markets, there need to be innovations and partnership to address industry challenges
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### Composite Applications and Competing Materials in Major End Segments

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<thead>
<tr>
<th>Aerospace</th>
<th>Transportation</th>
<th>Wind Energy</th>
<th>Construction</th>
<th>Pipe &amp; Tank</th>
<th>Electrical &amp; Electronics</th>
<th>Consumer Goods</th>
<th>Marine</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fuselage</td>
<td>• Monocoque / Chassis</td>
<td>• Wind blades</td>
<td>• Bathtub</td>
<td>• Oil &amp; Gas</td>
<td>• Printed circuit board</td>
<td>• Golf shafts</td>
<td>• Hull</td>
</tr>
<tr>
<td>• Wings</td>
<td>• Body closures</td>
<td>• Nacelles</td>
<td>• Doors &amp; Windows</td>
<td>• Chemical</td>
<td>• Electrical enclosure</td>
<td>• Bicycles</td>
<td>• Deck</td>
</tr>
<tr>
<td>• Control surfaces</td>
<td>• Under the body</td>
<td>• Spinners</td>
<td>• Pultruded profiles</td>
<td>• Septic</td>
<td>• Fuses</td>
<td>• Tennis rackets,</td>
<td>• Mast</td>
</tr>
<tr>
<td>• Fan blades</td>
<td>• Interiors</td>
<td>• Waste water, etc.</td>
<td>• Swimming pools</td>
<td>• Waste</td>
<td>• Cabinets, etc.</td>
<td>• Fishing rods</td>
<td></td>
</tr>
<tr>
<td>• Tail cones</td>
<td>• Front cabin</td>
<td>• Pole</td>
<td>• Bathtub</td>
<td>• Water, etc.</td>
<td>• Surfboard</td>
<td>• Hockey sticks</td>
<td></td>
</tr>
<tr>
<td>• Interiors</td>
<td>(train)</td>
<td></td>
<td></td>
<td></td>
<td>• Toys</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Materials**
  - • Aluminum
  - • Composites
  - • Steel
  - • Plastics
  - • Steel
  - • Iron
  - • Aluminum
  - • Plastics
  - • Composites
  - • Concrete
  - • Steel
  - • Iron
  - • Plastics
  - • Composites
  - • Steel
  - • Plastics
  - • Concrete
  - • Composite
  - • Plastics
  - • Metals
  - • Composite
  - • Plastics
  - • Aluminum
  - • Steel
  - • Wood
  - • Plastics
  - • Composite
  - • Aluminum
  - • Steel
  - • Wood
  - • Plastics
Composites Consumption in Wind Energy is Expected to Grow at a Healthy Growth Rate in Next Six Years

Key Insights

- Wind energy segment is expected to grow with about 4.1% CAGR followed by E&E with about 3.9% in the next six years
- Increasing demand of lightweight materials in transportation, construction, and E&E sectors will drive the composites growth
- Urbanization in developing nations such as China, India, and Brazil will also help composites to grow
## Composite Materials Have a Low Market Penetration in All the Segments Reflecting Significant Opportunity for Growth

### Segments

<table>
<thead>
<tr>
<th>Segments</th>
<th>Global Composite Materials Market in 2019</th>
<th>Global Materials Market in 2019 (Steel, Aluminum, Composites)</th>
<th>Market Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$10.0 Billion</td>
<td>$186 Billion</td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
<td>$0.8 Billion</td>
<td>$31.6 Billion</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td>$2.1 Billion</td>
<td>$15.2 Billion</td>
</tr>
<tr>
<td>Aerospace</td>
<td></td>
<td>$4.3 Billion</td>
<td>$136.4 Billion</td>
</tr>
<tr>
<td>Pipe &amp; Tank</td>
<td></td>
<td>$5.2 Billion</td>
<td>$595.4 Billion</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td>$2.4 Billion</td>
<td>$12.5 Billion</td>
</tr>
<tr>
<td>Wind Energy</td>
<td></td>
<td>$2.4 Billion</td>
<td>$78.6 Billion</td>
</tr>
<tr>
<td>Consumer Goods</td>
<td></td>
<td>$4.7 Billion</td>
<td>$28.9 Billion</td>
</tr>
<tr>
<td><strong>Total of 8 Segments</strong></td>
<td><strong>$31.9 Billion</strong></td>
<td><strong>$1,084.6 Billion</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: Lucintel
Driver in Construction: Increasing Urbanization and Growing Housing Starts Will Drive Composites Market

US Housing Starts (Single and Multi) Trend and Forecast (No. of House in Thousands)

<table>
<thead>
<tr>
<th>Year</th>
<th>2010</th>
<th>2018</th>
<th>2019</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>US housing start</td>
<td>587</td>
<td>1,272</td>
<td>1,320</td>
<td>1,524</td>
</tr>
</tbody>
</table>

Key Insights

- US housing start grew at 10% CAGR from 2010-18 and is expected to register 2.4% CAGR during 2019-25 due to a hit in construction activities and followed financial crises by COVID outbreak.
- China construction industry has started to recover after the downfall for 6 months during the COVID outbreak, the industry is expected to grow at 1.5% during 2020.
- Improving infrastructure development, urbanization and economic development in developing Asian countries are likely to increase composites usage in construction industry.

Source: Export Govt. (China), and Lucintel
Aerospace: High Usage of Composites in Various Aircrafts (B787, A380, A350, etc.) Will Drive Significant Growth

Global Commercial Aircraft Production Deliveries Trend and Forecast (In Units)

Source: Boeing, Airbus and Lucintel estimates

Key Insights

- **High commercial aircraft order backlog**
  - Airbus - 7,557 aircrafts
  - Boeing - 5,733 aircrafts

- **Increasing monthly production rates of commercial aircraft**
  - B737: 52/month in 2019 to low rates in 2020 with slowly increase in production as per the demand
  - B787: Production rate is 10/month plans to reduce to 6/month in 2021
  - A320: 42/month in 2015 to 40/month in 2020
  - A380: 15/month in 2017 to 8/month in 2019 and currently production has been shutdown due to COVID
Driver in Automotive: Automotive Market is Anticipated to Grow at 1.6% in the Next Five Years

Global Automotive Production Trend and Forecast by Vehicle Type (In Million Units)

<table>
<thead>
<tr>
<th>Year</th>
<th>Passenger Car</th>
<th>Commercial Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>67.7</td>
<td>17.9</td>
</tr>
<tr>
<td>2019</td>
<td>69.4</td>
<td>18.0</td>
</tr>
<tr>
<td>2020</td>
<td>53.8</td>
<td>13.5</td>
</tr>
<tr>
<td>2025</td>
<td>76.3</td>
<td>20.1</td>
</tr>
</tbody>
</table>

- Global automotive production (passenger car & commercial vehicle) grew at 0.4% CAGR from 2014-19 and it is expected to register 1.6% in next five years (2019-25)
- Asia was the largest automotive market in 2019 followed by Europe
- Automotive demand is mainly driven by
  - Low interest rates
  - Rising disposable income of consumer
  - Increasing trend of replacing older cars

Key Insights
# Weight and Fuel Saving Potential in Automotive Industry Utilizing Light Weight Materials

<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></td>
<td>4.9%</td>
<td>$340</td>
<td>8.9</td>
</tr>
<tr>
<td>Aluminum</td>
<td>9.3%</td>
<td>$641</td>
<td>16.8</td>
</tr>
<tr>
<td></td>
<td>18.7%</td>
<td>$1,283</td>
<td>33.6</td>
</tr>
<tr>
<td>Glass Composites</td>
<td>7.5%</td>
<td>$518</td>
<td>13.6</td>
</tr>
<tr>
<td></td>
<td>15.1%</td>
<td>$1,036</td>
<td>27.2</td>
</tr>
<tr>
<td>Carbon Composites</td>
<td>21.0%</td>
<td>$1,443</td>
<td>37.8</td>
</tr>
<tr>
<td></td>
<td>42.0%</td>
<td>$2,887</td>
<td>75.6</td>
</tr>
<tr>
<td>Magnesium</td>
<td>14.0%</td>
<td>$962</td>
<td>25.2</td>
</tr>
<tr>
<td></td>
<td>28.0%</td>
<td>$1,924</td>
<td>50.4</td>
</tr>
</tbody>
</table>

Assumption: Average vehicle weight is 3,962 lbs. Lightweight replacement is considered in 70% of applications excluding non structural applications, such as glass and rubber. 

Source: Lucintel
Wind: Despite Short Term Fluctuations, Wind Energy Market to Grow in Future

Global Annual Wind Turbine Installation Trend and Forecast (in GW)

Key Insights

- Global wind turbine installation grew at 3.5% during 2014-19 and is expected to grow by 2.0% in the next six years (2019-25)
- Asia to remain the largest region in next five years
- China is taking the lead in wind energy with recent developments worth noticing
- Installation of LM Wind Power's first two sets of LM 66.6 blades
- GE Renewable Energy has installed its first Haliade 12MW turbines
- The Fujian Xinghua Gulf multiphase demonstration project will eventually have a total capacity of 79.4MW
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## Automotive Market Needs and its Impact on Composites

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<thead>
<tr>
<th>Market Needs</th>
<th>Impact on Composites</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Light weight:</strong> Stringent policies, such as CAFÉ Standards is pushing the OEMs to reduce the vehicle weight to improve the fuel efficiency</td>
<td>Composites offer significant weight saving over the traditional materials. Increasing emphasis on fuel efficiency is driving the use of composites in automotive. Major OEMs are taking weight reduction initiatives in many platforms</td>
</tr>
<tr>
<td><strong>Cost Reduction:</strong> Lightweight materials are costlier than the traditional material, to be used for mass production there is a need of cost reduction</td>
<td>Carbon fiber composites is one of the promising material with weight saving potential, companies are working together to reduce its price to make it competitive</td>
</tr>
<tr>
<td><strong>Aesthetics:</strong> Superior aesthetics, and ease of driving are some of the other market needs in the automotive</td>
<td>Increasing complexity and styling requirements are driving composites usage</td>
</tr>
</tbody>
</table>
OEMs focusing 15% of Fuel Saving Targets from Light Weight Materials. About 800 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, power-train electrification, design improvement, and weight reduction.
- Reduction in 10% of curb weight can reduce fuel consumption by 6.5%.
- To get extra fuel efficiency of 4.5 MPG, about 25% weight reduction (700 to 900 lbs) is required.
- Carbon fiber will play a vital role in achieving this mark of about 25% reduction in the overall vehicle weight along with other lightweight materials in achieving fuel efficiency targets.

Source: Lucintel, NHTSA, EPA
## Weight Saving Initiatives by OEMs

<table>
<thead>
<tr>
<th>S.No.</th>
<th>OEMs</th>
<th>Model Name</th>
<th>Vehicle Type</th>
<th>Year</th>
<th>Vehicle Weight</th>
<th>Lightweight Material Used</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BMW</td>
<td>7 Series</td>
<td>Sedan</td>
<td>2015</td>
<td>2633 lbs.</td>
<td>CFRP</td>
<td>B Pillar</td>
</tr>
<tr>
<td>2</td>
<td>Audi</td>
<td>R8 Spyder</td>
<td>Super Car</td>
<td>2017</td>
<td>3572 lbs.</td>
<td>CFRP</td>
<td>B Pillar &amp; Rear Wall</td>
</tr>
<tr>
<td>3</td>
<td>Audi</td>
<td>A8</td>
<td>Sedan</td>
<td>2017</td>
<td>4673 lbs.</td>
<td>CFRP</td>
<td>Chassis</td>
</tr>
<tr>
<td>4</td>
<td>Porsche</td>
<td>911 Turbo S</td>
<td>Sports Car</td>
<td>2017</td>
<td>3527 lbs.</td>
<td>CFRP</td>
<td>Wheel</td>
</tr>
<tr>
<td>5</td>
<td>Audi</td>
<td>R8</td>
<td>Sport Sedan</td>
<td>2018</td>
<td>3205 lbs.</td>
<td>CFRP</td>
<td>Engine Bay Brace</td>
</tr>
<tr>
<td>6</td>
<td>Audi</td>
<td>A8</td>
<td>Luxury Car</td>
<td>2018</td>
<td>4673 lbs.</td>
<td>CFRP</td>
<td>Rear Wall Panel</td>
</tr>
<tr>
<td>7</td>
<td>Honda</td>
<td>FIT</td>
<td>Passenger Car</td>
<td>2015</td>
<td>2573 lbs.</td>
<td>AHSS</td>
<td>Body Structure, Doors, Front Panel</td>
</tr>
<tr>
<td>8</td>
<td>Hyundai</td>
<td>RM19</td>
<td>Motor Sports</td>
<td>2020</td>
<td>3120 lbs.</td>
<td>Carbon fiber</td>
<td>Front Lip, Rear Diffuser, &amp; Spoiler, Side Mirror Cover</td>
</tr>
</tbody>
</table>
## Wind Energy Market Needs and its Impact on Composites

<table>
<thead>
<tr>
<th><strong>Market Needs</strong></th>
<th><strong>Impact on Composites</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blade Length and Design:</strong> OEMs are targeting to increase blade length so that maximum energy can be produced from single wind turbine whereas designing decides its desired performance.</td>
<td>Increasing demand of composites as it provides significant weight saving and ease in achieving increased length and complex design over the traditional materials.</td>
</tr>
<tr>
<td><strong>Cost Reduction:</strong> Technology used to manufacture composite parts are costlier than the other traditional process. There is a significant requirement of cost reduction in this industry.</td>
<td>Increasing demand of pultrusion in wind energy market. Pultrusion technology helps in reducing cost compared to prepreg technology without compromising its mechanical properties.</td>
</tr>
</tbody>
</table>
Govt. Across the Globe is taking Initiative to build Renewable Energy as Main Source of Energy and Setting Good Targets

**Canada**
- Canadian government has invested $30M towards wind generation project
- Government projected to reach a wind installation capacity of 55GW by 2025

**USA**
- Under CARES Act, a $2.2 Trillion of economic revival package has been announced by the US Gov.
- USA Offers 40% production tax credit for installation of wind turbine from 2019-2023
- DOE is working with six leading wind turbine manufacturer to achieve 20% wind power in US by 2030

**UK**
- UK Government target to consume 30% of electricity by offshore wind energy in 2030
- Offshore wind sector industry agreed to invest £250m over the next 11 years in exchange for participation in £557m of state subsidies for renewable energy
- £ 330 B for loan guarantees to businesses
- £42.0 B for job retention scheme

**Germany**
- Germany has pledge to exit coal based plant fully by 2038
- Plan to fulfill 65% of electricity through renewable energy by 2030
- Chinese government set a wind power capacity up to 400GW by 2030
- 1000 GW by 2050 by Zero Subsidy
- Liquidity injection into the banking system of RMB 3 Trillion
- Waivers on VAT and Enterprise Income Tax to boost local business

**Denmark**
- Denmark government has pledge to phase out coal by 2030
- Plan to set up three new offshore wind projects of 2.3 GW by 2030
- €564 million government support for onshore wind

**France**
- French government has pledge to increase its renewables budget to €71bn from 2019 to 2028
- Plan to triple onshore wind capacity by 2030

**China**
- Chinese government set a wind power capacity up to 400GW by 2030
- 1000 GW by 2050 by Zero Subsidy
- Liquidity injection into the banking system of RMB 3 Trillion
- Waivers on VAT and Enterprise Income Tax to boost local business
### Major OEMs are Incorporating Carbon Fiber for Larger Wind Blades (1/2)

<table>
<thead>
<tr>
<th>OEMs</th>
<th>MW</th>
<th>Blade Size (M)</th>
<th>Blade Supplier</th>
<th>CF Usage</th>
<th>Off-Shore/On-Shore</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siemens Gamesa</td>
<td>5.0</td>
<td>62.5</td>
<td>In-house</td>
<td>Yes</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Siemens Gamesa</td>
<td>2.0</td>
<td>43.0</td>
<td>In-house</td>
<td>Yes</td>
<td>Onshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Siemens Gamesa</td>
<td>7.0</td>
<td>75.0</td>
<td>In-house</td>
<td>No</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Siemens Gamesa</td>
<td>6.0</td>
<td>75.0</td>
<td>In-house</td>
<td>No</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Areva</td>
<td>5.0</td>
<td>66.0</td>
<td>In-house</td>
<td>Yes</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Guodian United</td>
<td>6.0</td>
<td>66.5</td>
<td>In-house</td>
<td>Yes</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
<tr>
<td>GE Energy</td>
<td>4.8</td>
<td>77.0</td>
<td>LM Wind</td>
<td>Yes</td>
<td>Onshore</td>
<td>Launched</td>
</tr>
<tr>
<td>GE Energy</td>
<td>5.3</td>
<td>77.0</td>
<td>LM Wind</td>
<td>Yes</td>
<td>Onshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Vestas</td>
<td>8.0</td>
<td>80.0</td>
<td>In-house</td>
<td>Yes</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Vestas</td>
<td>3.45</td>
<td>57.2</td>
<td>In-house</td>
<td>Yes</td>
<td>Onshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Vestas</td>
<td>3.45</td>
<td>66.7</td>
<td>In-house</td>
<td>Yes</td>
<td>Onshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Vestas</td>
<td>4.2</td>
<td>73.7</td>
<td>In-house</td>
<td>Yes</td>
<td>Onshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Samsung</td>
<td>7.0</td>
<td>83.5</td>
<td>SSP</td>
<td>Yes</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Alstom (GE Energy)</td>
<td>6.0</td>
<td>73.5</td>
<td>LM Wind</td>
<td>No</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
</tbody>
</table>
## Major OEMs are Incorporating Carbon Fiber for Larger Wind Blades (2/2)

<table>
<thead>
<tr>
<th>OEMs</th>
<th>MW</th>
<th>Blade Size (M)</th>
<th>Blade Supplier</th>
<th>CF Usage</th>
<th>Off-Shore/On-Shore</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goldwind</td>
<td>6.0</td>
<td>77.7</td>
<td>Sinoma</td>
<td>Yes</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
<tr>
<td>MingYang</td>
<td>6.0</td>
<td>69.0</td>
<td>In-house</td>
<td>Yes</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Suzlon</td>
<td>2.6 – 2.8</td>
<td>64.0</td>
<td>In-house</td>
<td>Yes</td>
<td>Onshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Nordex</td>
<td>4.0 - 4.5</td>
<td>73.0</td>
<td>In-house</td>
<td>Yes</td>
<td>Onshore</td>
<td>Launched</td>
</tr>
<tr>
<td>Siemens Gamesa</td>
<td>10</td>
<td>94</td>
<td>In-house</td>
<td>No</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
<tr>
<td>MHI Vestas</td>
<td>9.5</td>
<td>85</td>
<td>MHI Vestas</td>
<td>Yes</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
<tr>
<td>MHI Vestas</td>
<td>10</td>
<td>80</td>
<td>MHI Vestas</td>
<td>Yes</td>
<td>Offshore</td>
<td>Launched</td>
</tr>
<tr>
<td>GE Energy</td>
<td>12</td>
<td>107</td>
<td>LM Wind</td>
<td>Yes</td>
<td>Offshore</td>
<td>Under Development</td>
</tr>
</tbody>
</table>
Aerospace Market Needs and its Impact on Composites

Market Needs

**Light Weight:** Airbus and Boeing are trying to reduce weight of their aircrafts. There are various stringent certification and qualification are required in the aerospace industry.

**Safety:** Passenger safety or human safety is the major critical factor. Demand for the stronger and lighter materials are high.

Impact on Composites

Increasing demand of composites with increasing demand of light weight and fuel efficiency as it provides 40%-50% structural weight saving with required strength and performance.

Increasing emphasis on safety concern drive the composites usage as composite materials are not only light weight but also the strongest material which can be used to light weight without effecting its safety measures.
Evolution of Composite Materials in Aerospace Industry
Global Commercial Aircraft Delivers Projection from 2010 to 2050

![Graph showing the projection of commercial aircraft deliveries from 2010 to 2050, with a steady increase and a +2.2% growth rate.](image-url)
Construction Market Needs and its Impact on Composites

**Market Needs**

**Corrosion Resistance and Durability**: Corrosion resistivity and long life cycle are the main criteria for the construction industry for selecting any material.

**Impact on Composites**

Increasing demand of corrosion resistance and durability is one of the major driving factor for composites growth in construction. Composites offer better corrosion resistance and life cycle durability than competing materials such as steel and aluminum.
US Housing Starts from 1990 to 2030

Housing Starts (000)

- 1990: 1,193
- 1995: 1,354
- 2000: 1,569
- 2005: 2,068
- 2010: 609
- 2015: 1,112
- 2020: 1,169
- 2025: 1,310
- 2030: 1,420

The chart shows an overall trend of +0.4% growth in housing starts from 1990 to 2030.
Govt. Across the Globe are Spending more on Infrastructure which will drive the Demand of Composites

USA
In 2019, US Government planned to invest around $2 trillion for infrastructure upgradation

Germany
Germany government has planned an investment of $44.7 billion in the areas of infrastructure and housing by 2020

UK
UK government has planned an investment of £100bn in infrastructure by 2020-21

Brazil
Brazilian Government has planned an investment of $7.08 billion to develop the infrastructure

Dubai
The Dubai Government has dedicated $2.5 billion for infrastructure projects in 2019

India
Indian Government targets $1.4 trillion of capital investment in infrastructure development by 2024

China
China invested $162.2 billion in infrastructure projects in 2019

Australia
Australian Government has planned a $100 billion infrastructure spending in 2019

Russia
The Russian government is pursuing a $96 billion modernization plan to revamp the country’s infrastructure through 2024
Innovation Areas to Drive Composites Growth

**A. Cost Reduction**
- Cost reduction in composites, especially in carbon composites parts

**B. Light Weighting**
- Light weighting trends driven by government regulations on fuel efficiency

**C. Low Cycle Time**
- Development of transformative technologies with low cycle time for mass production vehicles

**D. Hybrid Composites**
- Parts made with a mix of metals and composites enabling best property utilization of both
- Development of environmental friendly resin and fiber systems and betterment of mechanical properties of natural composites

**E. Green Composites**
- Development of repair and recycling technologies for composites

**F. Cradle to Grave**

**Impacts on Composites Growth**

- Huge growth opportunity in mass volume vehicles
- Increased usage of CFRP and CNRP in Automotive, Aerospace, & Wind Energy
- Huge growth opportunity in mass volume vehicles
- Increased penetration hybrid composites applications in Automotive, A&D, Construction
- Increased usage of natural composites in Automotive
- Huge opportunity for recycled composites in Automotive, Aerospace, Construction
# Issues of Composites to Deliver Better Solutions

<table>
<thead>
<tr>
<th>Issues</th>
<th>Industry Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Materials Cost</td>
<td>• Carbon fiber price reduction by 50%-60% (~$5/lb)</td>
</tr>
<tr>
<td></td>
<td>• Glass fiber price reduction by 10%-30%</td>
</tr>
<tr>
<td></td>
<td>• Resin price reduction by 10%-40%</td>
</tr>
<tr>
<td>Lack of High Volume Process for Structural Parts</td>
<td>• More than 30,000 parts annually using continuous fiber composites</td>
</tr>
<tr>
<td></td>
<td>• Part manufacturing cycle time 1-2 minutes</td>
</tr>
<tr>
<td></td>
<td>• Materials layup rate up to 150 kg/hr</td>
</tr>
<tr>
<td>Print Thru</td>
<td>• Class A surface finish for exterior applications</td>
</tr>
<tr>
<td>Machining &amp; Joining</td>
<td>• Improved machining and joining technologies for composites</td>
</tr>
<tr>
<td>Repair and Recyclability</td>
<td>• Improved technologies for composite part repairing and recycling</td>
</tr>
</tbody>
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• Future Market Disruptions in Composites
• Case Studies for Growth
## 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 Carbon fiber</td>
<td>Alternative precursors, such as lignin, olefin, textile PAN, etc.</td>
<td>• Automotive</td>
</tr>
<tr>
<td></td>
<td>Someone will launch low cost carbon fiber ($3 - $6 per lb) in future</td>
<td></td>
</tr>
<tr>
<td>Improvement in Productivity</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>• Automotive</td>
</tr>
<tr>
<td>Mass Customization - 3D Printing Enabler</td>
<td>3D printing for different composites applications especially in automotive and healthcare</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

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**
- Commercial grade PAN
- Textile grade PAN
- Lignin based
- Polyolefin based

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

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

Zoltek (Now Toray) Commercial grade carbon fiber=$9/lb
Reduction in Carbon Fiber Costs could double Revenues from the Automotive Industry

<table>
<thead>
<tr>
<th>Car Type</th>
<th>Global Light Vehicles Production in 2025</th>
<th>Forecast</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></td>
<td>CF Usage in % of cars</td>
<td>Demand in M lbs</td>
</tr>
<tr>
<td>Super Cars</td>
<td>9,700</td>
<td></td>
<td>100%</td>
<td>2.4</td>
</tr>
<tr>
<td>Super Luxury Cars</td>
<td>855,000</td>
<td></td>
<td>95%</td>
<td>65.0</td>
</tr>
<tr>
<td>Luxury Cars</td>
<td>4.7 Million</td>
<td></td>
<td>55%</td>
<td>65.1</td>
</tr>
<tr>
<td>Other/Regular Cars</td>
<td>91.9 Million</td>
<td></td>
<td>3%</td>
<td>4.1</td>
</tr>
<tr>
<td>Global Light Vehicles</td>
<td>97.5 Million</td>
<td></td>
<td>136.1</td>
<td>1,366.5</td>
</tr>
</tbody>
</table>

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

Product | Resin
---|---
1 | HexPly® M77
1 | CYCOM 823 RTM
2 | XMTR50
3 | XMTR750

Product | Resin
---|---
1 | VORAFORCE 5300 ultra-fast epoxy resin
2 | VORAFORCE 5300
3 | Araldite MY 0610
4 | Araldite LY 3585

Product | Resin
---|---
1 | EPIKOTE 05475
2 | EPIKOTE 04695-1
3 | EPIKOTE Resin 06465
4 | EPIKOTE TRAC 06170

Source: Lucintel
Composites Industry is Targeting on HP-RTM and CFRTP Processes for Reaching the Desired Cycle Time of 1-2 Minutes

<table>
<thead>
<tr>
<th>Process</th>
<th>Cycle Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP-RTM</td>
<td>&lt;10 Minutes</td>
</tr>
<tr>
<td>HP-RTM</td>
<td>&lt;10 Minutes</td>
</tr>
<tr>
<td>Forged Composites, RTM</td>
<td>6 to 10 Minutes</td>
</tr>
<tr>
<td>Prepreg Layup, RTM, SMC</td>
<td>Unknown</td>
</tr>
<tr>
<td>CFRTP</td>
<td>Unknown</td>
</tr>
<tr>
<td>CFRTP</td>
<td>1 Minute</td>
</tr>
<tr>
<td>HP-RTM</td>
<td>&lt;3 Minutes</td>
</tr>
</tbody>
</table>
Disruption 3: Evolution of Designing and Manufacturing of 3D Printing Allows Mass Customization in Composites Applications

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

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

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

**Impact on Industries**
- So far, 3D printing has emerged as a viable process for prototypes, demonstration units and small volume production.
- Improved customization
- Parts on demand
- Little to no scrap
- Short lead time
- Possibility to use new materials
- Part count reduction

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

*Source: Lucintel*
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Growth Opportunity Analysis Seeks Focus on the Right Applications, and Technologies in the Right Markets….

Your Core Strength
- Your company’s core competencies – technology, application, and region
- Skill set: problems your company best at solving?

Addressable Opportunity
- Addressable market based on your company core competencies
- Growth prospects
- Attractive markets for your company (e.g. rail, automotive, construction)
- Sustainability
- Competitive Intensity

Attractive Applications
- Develop screening criteria
- Identify opportunities based on your company core competencies
- Rank opportunities
- Identify attractive regions, technologies and applications in select markets

Partnership Opportunity
- List potential companies in attractive applications
- Rank companies using screening criteria
- Adjacent technology acquisition potential
- Recommend top targets for potential JV / acquisition

How can Your Company Drive Competitive Advantage?
Which Segments / Markets to focus?
Which are the best opportunities for your company?
Why and how a partnership improve your company position?
Carefully Identify Addressable Market for Your Business

- Total Market Opportunity including competing materials (steel and aluminum): $AA \text{ Billion}$
- Total Composites Related Market Opportunity in your Market Segments: $BB \text{ Billion}$
- Total addressable market for Your Company based on core competency: $CC \text{ Billion}$
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 - At a Glance

• Premier management consulting and market research firm. Founded in 1998.
• Deep global insights into major industries. Team of over 120 analysts/consultants across globe.
• Management comprised of PhDs, MBAs, and subject matter experts. Head quarter in Dallas, USA.

Conducted 500+ consulting projects across industries for 3M, Audi, Dupont, Carlyle, GE, etc.

Consulting Services

- Opportunity screening
- Market entry strategy
- Supply chain analysis
- Growth finance
- Strategic consulting
- Competitive assessment
- Due diligence
- M & A services

Why Lucintel


Clients we serve: Over 1000 clients from 70 countries – Fortune 500 companies

Strategic advice: Over 20 years of proven global strategic management consulting experience

Industries Served
1000+ Clients in 70 Countries Value Our Service
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