



Strategic Growth Opportunity in Composites Industry

Dr. Sanjay Mazumdar

CEO

Lucintel

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- ***Composites Industry Outlook***
- ***Limitations of Composites***
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Executive Summary

- **Composite materials market in North America was estimated at \$7.4 billion in 2013, and is forecast to grow at 7% CAGR in next five years to reach \$11.3 billion in 2019.**
- **Aerospace, automotive, and wind energy have demand pull whereas civil engineering, oil and gas, medical and others require push strategy for market penetration.**
- **Some of the limitations for composites are: high materials cost, lack of high volume processes for structural parts, print thru, lack of better repair, recycling, and joining technologies.**
- **Key innovation areas for driving composites growth are: reduction in fibers and resins cost, improvement in manufacturing processes (low cycle time and high layup rate), property enhancement, and composites recycling.**
- **Major growth strategies for composites are: identification of right applications based on synergy, cost reduction and improved process, development of strategic alliances, and use of data analytics.**
- **There are significant opportunities exist for composite players within US as well as in emerging economies through JV and acquisitions.**

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Composite Applications and Competing Materials in Major End Segments

Aerospace



- Fuselage
- Wings
- Control surfaces
- Fan blades
- Tail cones
- Interiors

- Aluminum
- Steel
- Plastics

Transportation



- Monocoque/ Chassis
- Body closures
- Under the body
- Interiors
- Front cabin (train)

- Aluminum
- Steel
- Iron
- Plastics

Wind Energy



- Wind blades
- Nacelles
- Spinners

- Steel
- Iron

Construction



- Bathtub
- Doors & Windows
- Extruded profiles
- Swimming pools
- Pole

- Concrete
- Steel
- Plastics

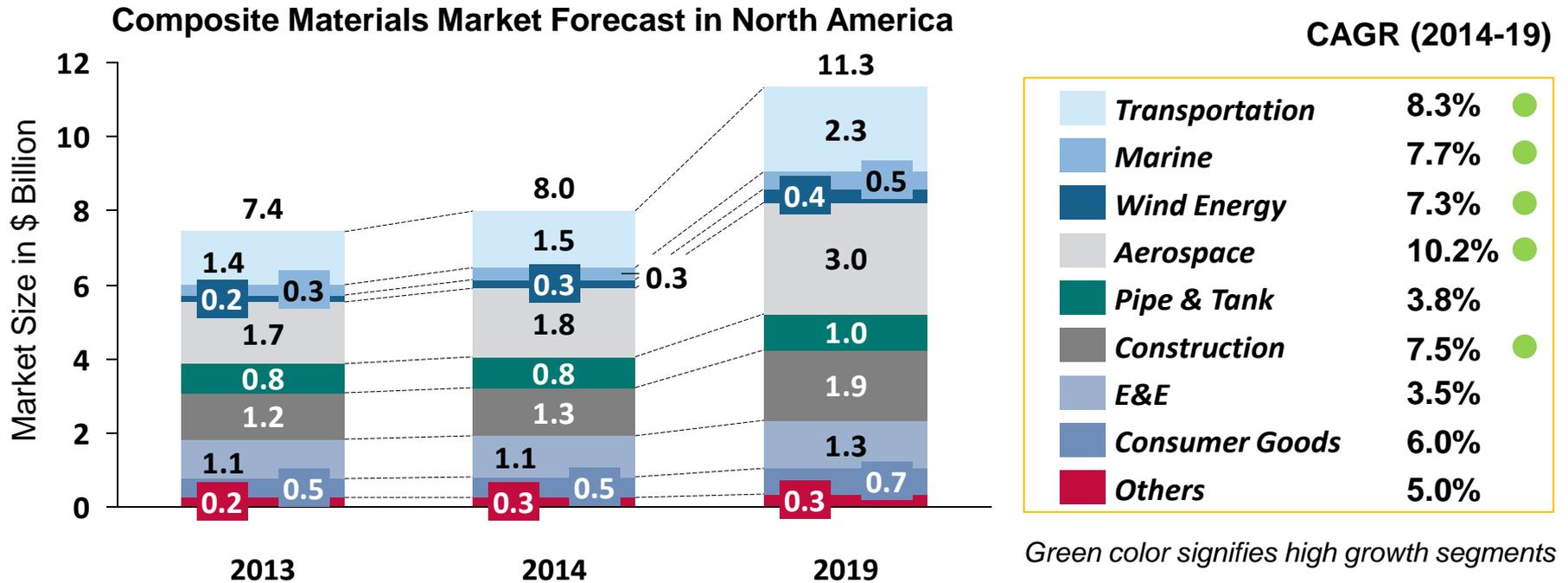
Marine



- Hull
- Deck
- Mast

- Aluminum
- Wood
- Steel
- Plastics

Composite Materials Market in North America is Expected to Register over 7% CAGR in Next Five Years

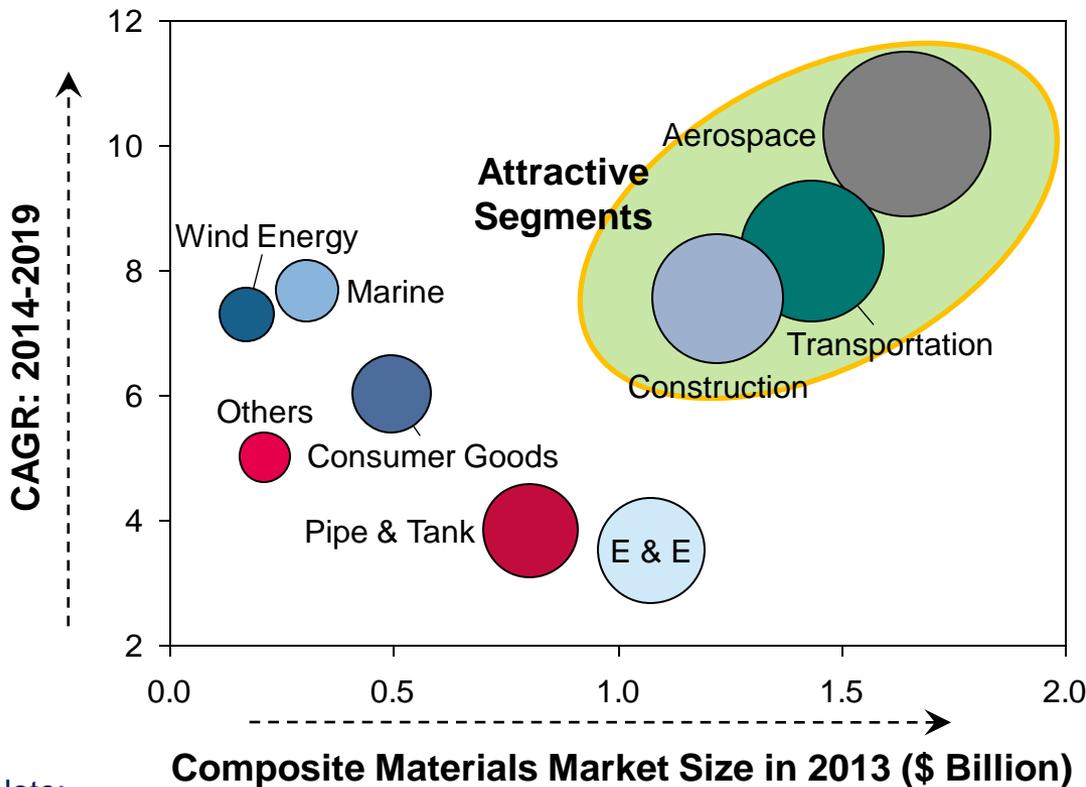


Key Insights

- Aerospace, Transportation, Marine, Wind energy, and Construction segments are expected to grow with more than 7% growth in next five years
- Recovery of housing market is likely to drive the construction market in coming years
- Despite short-term fluctuations, Wind energy segment is expected to register fair growth in coming years

Lucintel Identified Aerospace, Transportation, and Construction as the Most Attractive Segments

Growth Attractiveness: Composite Materials Market in North America



Key Insights

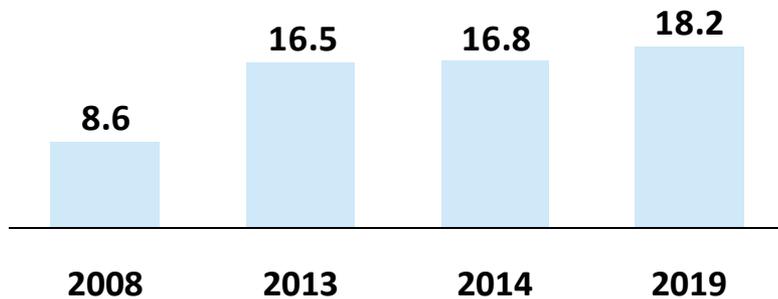
- High use of composites in newer aircrafts such as B787, A350XWB, and C Series
- Government regulations on fuel efficiency are putting pressure on auto OEMs to make their vehicles lighter. Automakers such as BMW, Mercedes, Ford, and GM are putting efforts into incorporation of carbon composites in mass volume cars
- Recovering housing starts to drive construction market growth for next 2 years

Note:

- The bubble size represents the value of composite materials market in the North America in 2019
- Y axis depicts CAGR from 2014--19

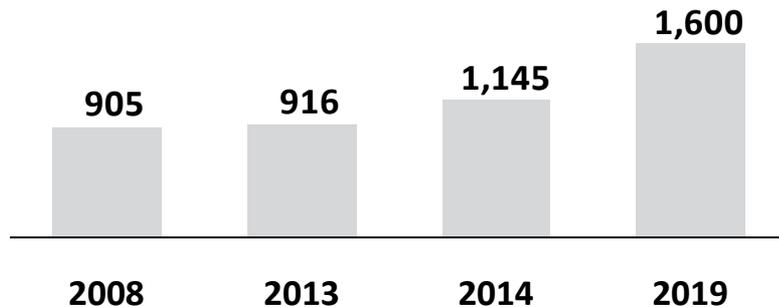
North American Automotive Production and US Housing Starts Projections

North American Automotive Production Trend and Forecast (In Million Units)



- In 2013, North American automotive production grew by 4.4% from 2012. This is the first time since 2005 to cross the 16 million mark.
- Growth in automotive demand is mainly driven by low interest rates, increasing consumer confidence, and increasing trend of replacing older cars

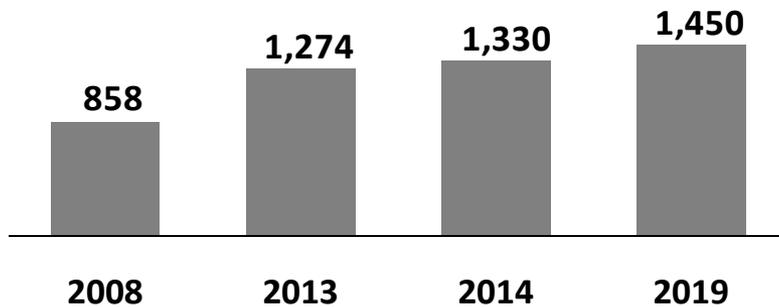
US Housing Starts (Single and Multi) Trend and Forecast (No. of House in Thousands)



- US housing starts is forecast to grow at 25% in 2014 and 20% in 2015 (source: NAHB, Freddie Mac, Conference Board)
- These two years (2014, 2015) growth momentum will help US housing starts to cross 2007 level (1,355 thousands)

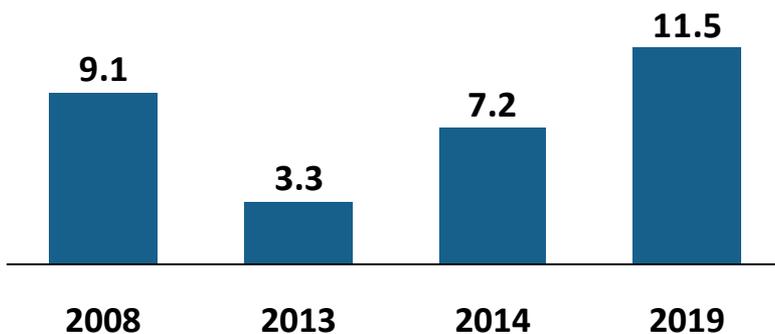
Global Commercial Aircrafts Deliveries and North American Wind Energy Growth Projections

Global Commercial Aircraft Deliveries Trend and Forecast (In Units)



- **High commercial aircrafts order backlog**
 - Airbus 5,559 and Boeing 5,080 aircrafts
- **Increasing production rates of aircrafts**
 - B737: 35 in 2012 to 42 per month in 2019
 - B787: 5 in 2012 to 14 per month in 2019
 - A320: 42 in 2012 to 44 per month in 2019
 - A350: 1 in 2013 to 10 per month in 2019
 - C Series: 2 in 2014 to 10 per month in 2019

North American Annual Wind Turbine Installation Trend and Forecast (In GW)



- **Despite short-term fluctuations due to uncertain wind energy policies such as PTC, Lucintel expects fair growth in wind energy installation in next five years**
- **Year 2014 will be a good year for wind energy market with 7.2 GW installation. Significant capacities are under construction in the US**

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Limitations of Composites to Deliver Better Solutions

Limitations

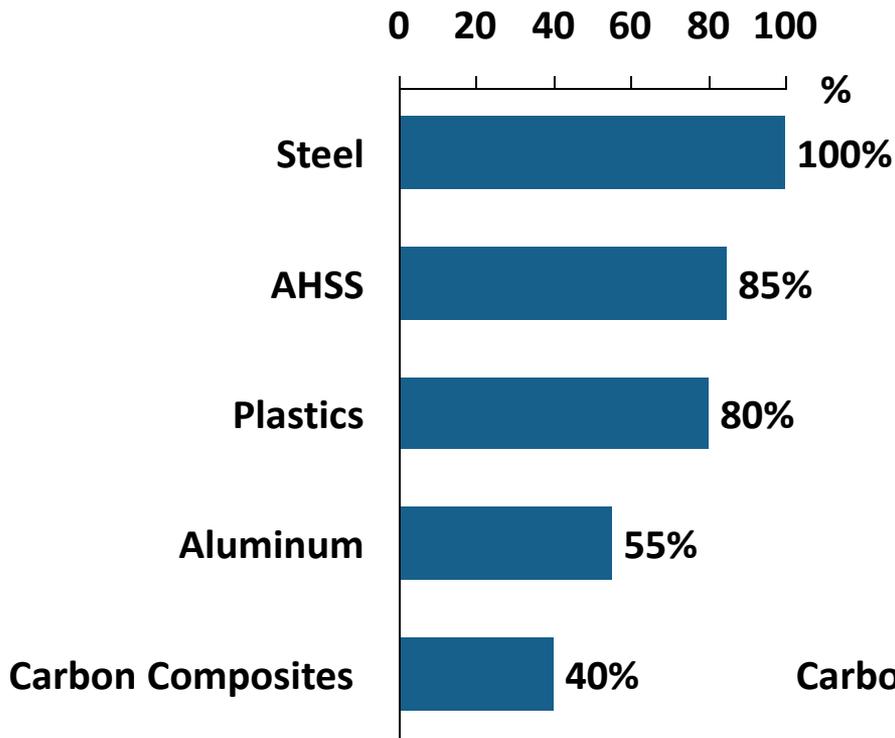
- **High Materials Cost**
- **Lack of High Volume Process for Structural Parts**
- **Print Thru**
- **Machining & Joining**
- **Repair and Recyclability**

Industry Expectations

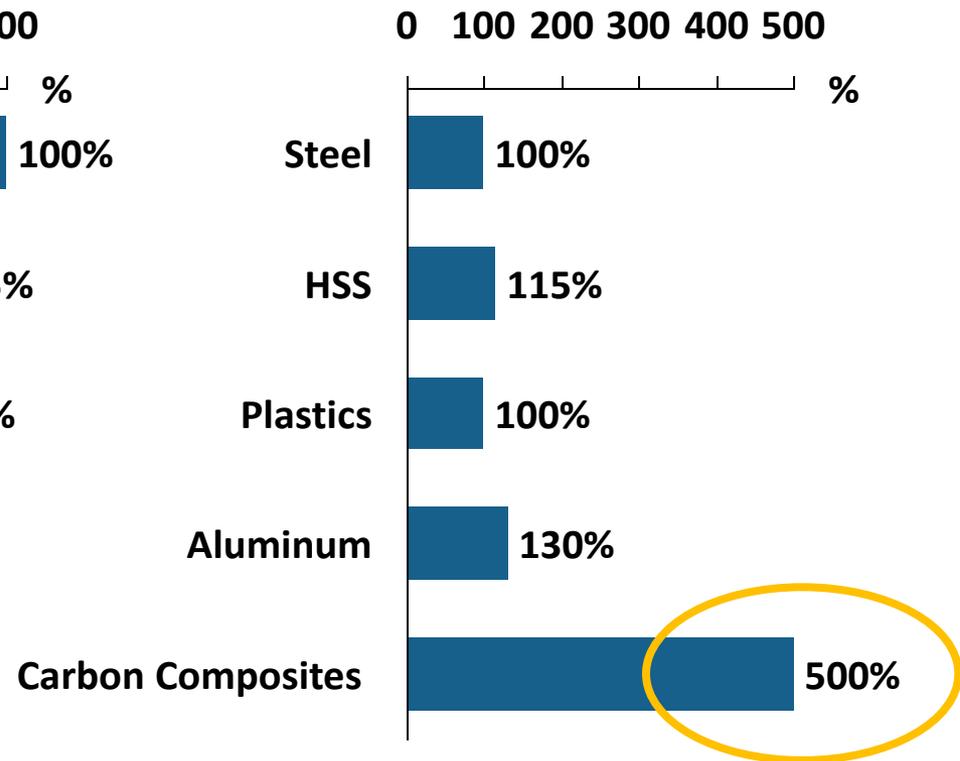
- Carbon fiber price reduction by 50%-60% (~\$5/lb)
- Glass fiber price reduction by 10%-30%
- Resin price reduction by 10%-40%
- More than 30,000 parts annually using continuous fiber composites
- Part manufacturing cycle time 1-2 minutes
- Materials layup rate upto 150 kg/hr
- Class A surface finish for exterior applications
- Improved machining and joining technologies for composites
- Improved technologies for composite part repairing and recycling

Limitations: Parts Made of Carbon Composites is Five times Costlier than Steel Parts

Relative Part Weight



Relative Part Cost



Example: FRP Pole is 3 to 4 times Costlier than Wood, Steel and Concrete Ones; However, Lifecycle Cost is Low

Materials	Initial Cost (\$)	Average Life (Years)	Installation Cost(\$)	Maintenance Cost (\$)	Lifecycle Cost/Year (\$)
Wood	\$250	30	\$8,000	\$210	\$282
Steel	\$260	35	\$9,000	\$245	\$272
Concrete	\$350	35	\$12,000	\$245	\$360
Composites	\$900	80	\$5,000		\$74

Note: Costs are based on a 40ft, class 4 pole

Maintenance costs apportioned at US \$35 per pole per 5 year maintenance cycle

Despite Limitations, Good Weight Saving Potentials Makes Composites a Good Materials of Choice

Space



Aerospace



Offshore Oil



Automotive



Wind Energy



Industrial



Intrinsic Weight Saving Value (\$/lb)

\$1,000's

\$100's

\$10's

\$5-\$10

\$1

<\$1

Structural Raw Material Cost



Composite Materials Performance over Existing Materials



Composites Current Penetration



Composites Growth Potential



Dominance Level



High



Medium



Low

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Push and Pull Strategy for Identifying Growth Opportunities

Push Strategy

Civil Engineering

Oil & Gas

Industrial

Medical



- 1 Educate OEMs and government agencies such as DOTs and DOEs
- 2 Participate in seminars, conferences, and trade shows
- 3 Organize workshop and join efforts with concerned parties and customers
- 4 Lobbying and publishing articles in magazines

Pull Strategy

Aerospace

Automotive

Wind Energy



- 1 Several demand pull factors are creating opportunities for composites
- 2 Address many areas such as reduction in materials cost, manufacturing process with low cycle time and high layup rate, etc. to leverage demand pull

Factors Creating Demand Pull and Areas to Leverage Demand Pull

Factors Creating Pull Demand for Composites Industry

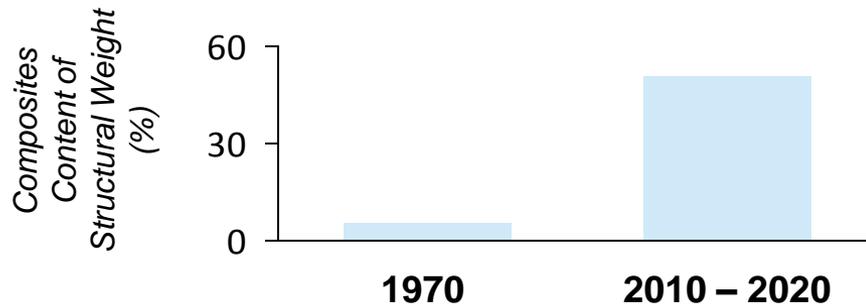
- Fuel Efficiency
- Lightweight
- Government Policies
- Corrosion and Chemical Resistance
- Intensifying Competition
- Green Energy

Areas that Need to Be Addressed to Leverage Pull Demand

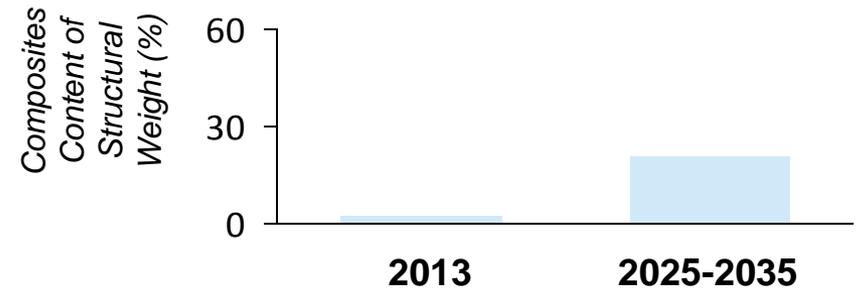
- Reduction in Cost of Materials
- Reduction in Processing Cost
- Improved Lifecycle Cost
- Better Value Proposition
- Sustainability
- Data Analytics

Advanced Composites Usage in Mass Automotive Today is Where Aerospace Industry was 40 Years Back. Automotive Will be the Next Growth Segment

Aerospace Trend



Automotive Trend



Composites Content (% Structural Weight)	5%	50%-55%	Composites Content (% Structural Weight)	Less than 2%	10%-30%
Fuel Efficiency (Miles Per Gallon)	0.2-0.3 (MPG)	0.3-0.4 (MPG)	Fuel Efficiency (Miles Per Gallon)	27 (MPG)	54-70 (MPG)
Aircrafts	B737, A320	B787, A350	Vehicles	BMW, Honda, Daimler	GM, Ford, BMW, Mercedes

Civil Engineering Strategy: Educate DOTs and Related Parties via Workshop, Trade Shows, and Lobbying

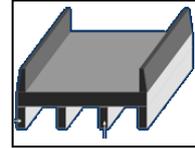
Applications



**Rebar/
Cable**



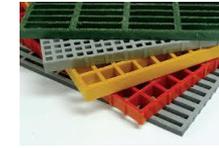
**CFRP
Plates**



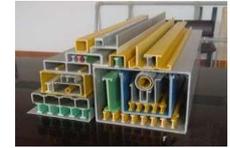
**CFRP
Girders**



**FRP
Pole**



Putrudded Profiles



Push Strategy: Educate Related Parties

Workshops: Conduct workshops for DOTs & stakeholders to educate them about the offerings and their benefits

Participate in Civil Engineering Tradeshow and Exhibitions: ASCE Annual Civil Engineering conference, AASHTO Annual Meeting, International Bridge Conference, etc.

Lobby: With the help of key lobbyists, influence DOTs and other concerned Govt. agencies

Publish & Advertise in Magazines such as “Civil Engineering”: The flagship monthly magazine of ASCE. A huge readership (primarily from civil engineering) base of ~79,000

Develop Cost Effective Composites solutions

Lucintel discussed with many DOTs during last five years and found increasing awareness about composites; however, there is still lack of awareness to leverage potentials

Oil & Gas Push Strategy: Educate Oil & Gas Companies via Workshop, Trade Shows, and Magazines

Applications



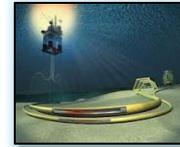
Risers



Tethers



Drill Pipes



Umbilical



GRE Pipes



Frac Balls



Frac Plugs

Push Strategy: Educate Related Parties

Workshops: Conduct workshops for Oil & Gas Equipment & Services Companies such as Transocean, Seadrill, Saipem, Technip, and Nation oil well varco and Integrated Oil & Gas Companies such as Royal Dutch Shell, Exxon Mobil, Chevron Corporation, and Conoco Philips

Participate or exhibit in various oil & gas tradeshow and exhibitions: Offshore Technology Conferences (OTC), GITA Oil & Gas Pipeline Conference & Exhibition, Abu Dhabi International Petroleum Exhibition & Conferences, etc.

Publish & Advertise in Magazines such as “Oil & Gas”: Monthly and weekly magazine of World’s most widely petroleum industry publication. A huge readership base of ~95,000

Develop Cost Effective Composites Solutions

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Three Growth and Profit Scenarios for the US until 2020

Scenario 1: Expand Core Business

Target core products and business segments and expand along with the value chain

Identify unmet needs in existing applications

Scenario 2: Growth Segments and Application Development

Target growing segments such as aerospace, automotive, high pressure tanks, construction, etc.

Develop carbon fiber applications for automotive segments

Develop cost effective solutions for Oil & Gas segments

Scenario 3: Emerging Countries

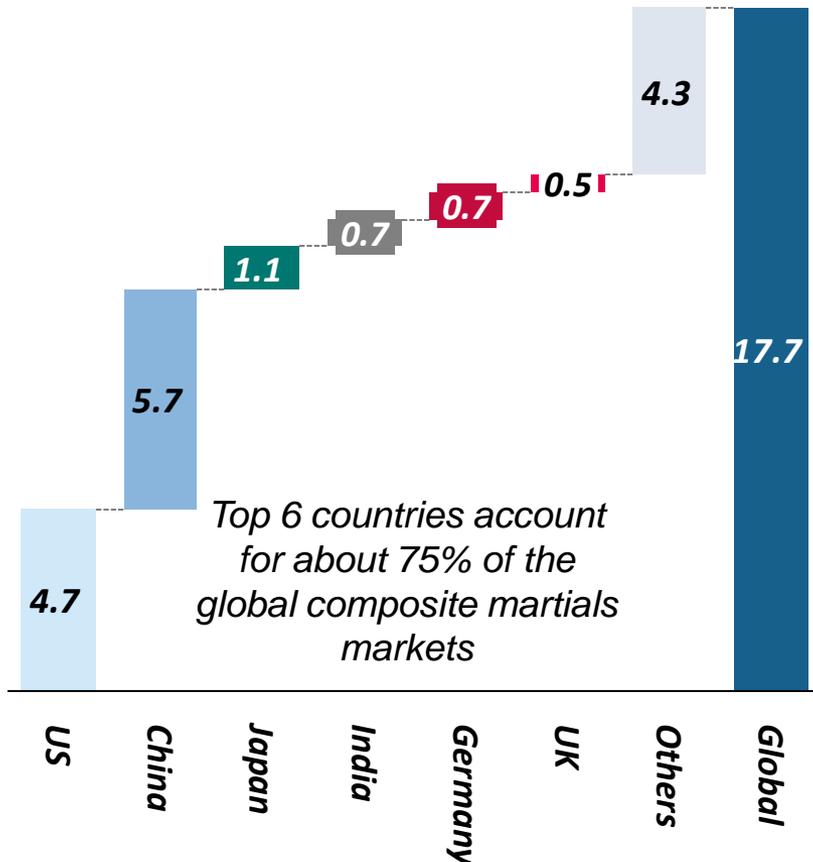
Strategic alliances across value chain nodes in emerging countries such as India, Brazil, China, etc.

Profit



Viable Opportunities Exist for Composite Players to Grow in Other Countries Organically or Inorganically

**Global Composite Materials Market by Countries
(In Billion lbs in 2013)**



Industry Insights

- Significant opportunities exist outside US
- Most of the large material suppliers already expanded globally by setting up plants in China, India, Brazil, etc.
- Significant opportunities exist for part fabricators within and outside US
- Kaman Aerospace and Kinenco entered into JV to fabricate parts for aerospace industry
- Luxfer group acquires Vexxel Composites LLC (Manufacturer of high-pressure composite cylinders)
- Lucintel has been assisting companies in creating JV and acquisition targets outside of their region for long-term profitable growth

Composites Opportunities Across Globe

- Growing wind energy installations
- High demand of composite rich content aircrafts (C Series)



- Automotive: CAFÉ standards (54.5 MPG by 2025)
- Recovery of housing market
- High demand of composite rich content aircrafts (B787)
- High automotive production



- Growing wind energy installations
- Increasing automotive production

- Automotive: CO2 emission standards (130 g/km by 2015)
- High order backlog of A350XWB
- Sustainable growth in Wind energy
- High orders of high speed trains



- High demand of commercial aircrafts and helicopters
- High investment in infrastructure
- High wind turbine installations
- Continuous shift of E&E and sporting goods



- Offset Requirement (30%)
- High investment in infrastructure
- Increasing automotive production
- High orders of metro and monorail
- No indigenous advanced material production capability

Top Five Areas for Composites Innovations to Address Market Needs

1. Application Development

- Aerospace: Fuselage, Wing, Fan Blades, etc.
- Automotive: Suspension Control Arm, Wheels, roof panels, etc.
- Wind Energy: Tower, Drive Shafts

2. Low Materials Cost

- ORNL and Weyerhaeuser working to lower carbon fiber cost to the level of \$5 - \$7/lbs

3. Low Cycle Time and High Layup Rate

- High Pressure RTM (3-10 minutes)
- CFRTM technology by Toho Tenax (<1 minute)
- Pressure Press by Plasan Composites (17 minutes)
- Combination of AFP and ATL Machines (150 kg/hr)

4. Property Enhancement

- Increase in mechanical performance (strength, stiffness, etc.) of Glass and Carbon Fibers
- Develop better resin system (low cure, low gel, higher strength)

5. Composites Recycling

- Closed-loop CFRP Recycling Technology by BMW for its i3
- Collaboration between BMW and Boeing for composite recycling

Growth Strategies for Composites Industry Companies

1. Identify Growth Applications based on Synergy



- Identify new opportunities with good synergy and profitability
- Identify growing regions

2. Cost Reduction and Improved Processes



- Reduce cost of composite products to make it cost effective alternative to steel and aluminum
- Improve process characteristics such as high cycle time and low energy consumption

3. Strategic Alliances (M & A)



- Develop strategic alliances to gain competitive advantages
- Enter into new markets and regions

4. Data Analytics



- Use data and insights rather than gut feel to identify opportunities

Lucintel has Strong Capability in Developing Growth Strategies for Companies

Automotive, Civil Engineering, Oil & Gas, and Medical will be Future Growth Engines

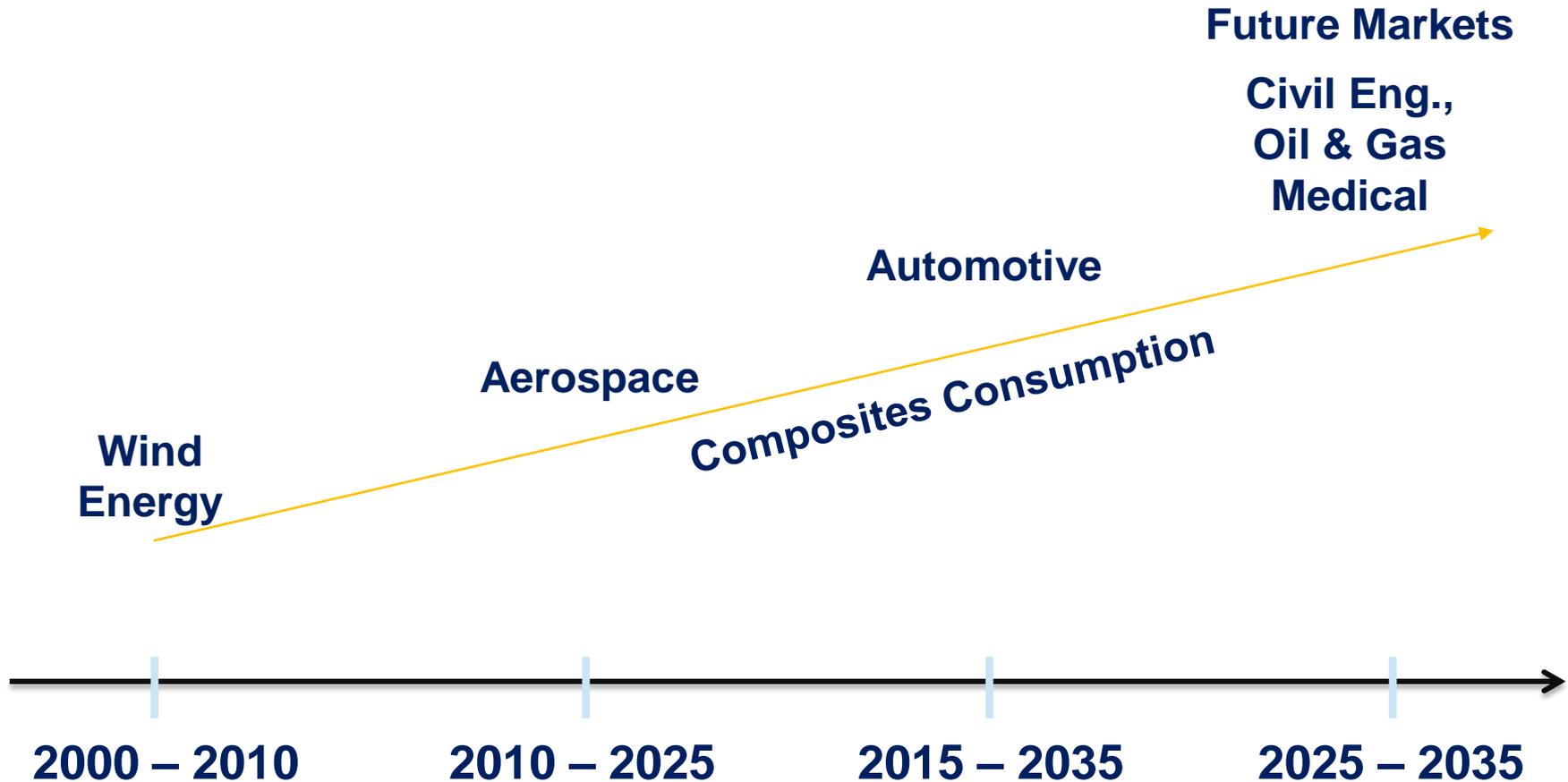


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About Lucintel

Vision:

- Passion for data, insights, strategy and innovation. Empower companies to take better decisions

History

- Founded in 1998
- Over 120 analysts / consultants. Global presence

Industry Leadership

- Over 1000 clients from 70 countries – Fortune 500 companies
- Fifteen years of proven management consulting and market research experience
- Panelists and key note speakers at leading conferences

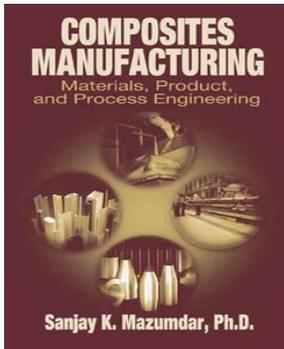
Services:

- Market entry strategy, M & A services, strategic consulting, due diligence, growth finance, competitive assessment, and opportunity screening

About Speaker

Sanjay Mazumdar, PhD. (CEO, Author, Thought Leader & Strategist)

- With a global consulting experience spanning over 14 years, Dr. Sanjay Mazumdar has been leading Lucintel since 1998 on projects as diverse as growth consulting, due diligence, value chain assessments and opportunity analysis providing actionable and cost-effective market intelligence, consulting and insights, to over 700 global customers. Some highlights:
 - Provided advisory services (M & A, market entry) to hundreds of clients.
 - Subject matter expert in chemical & advanced materials & authored a book titled "Composites Manufacturing: Materials, Product & Process Engineering".
 - Panelist at conferences with industry leaders such as Airbus, B/E Aerospace, Boeing, Core Molding, Ershigs, Owens Corning, and more.
 - Speaker at various conferences & published more than 25 papers.
 - Worked for General Motors in ultra-lightweight product development project and received 2 Record of Inventions.
 - Two Society of Plastics Engineers Awards and one DuPont Plunkett Award.
 - Ph.D. in Mechanical Engineering from Concordia University, Montreal and has additional training in Strategic Management from MIT, Boston.
 - Thought leadership on nature inspired innovations and launched video describing 5 innovation mega trends. [Click](#) to benefit from innovation ideas.



Lucintel Ensures Strategic Insights for the Right Market Entry

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

- Andy Schmidt, MacQuarie Partners, Managing Partner

- Lucintel has performed hundreds of consulting projects in the area of M & A, market entry strategy, opportunity screening, competitive benchmarking, value chain analysis, unmet needs analysis and others in a variety of markets for last 14 years.
- Lucintel with its profound business success knowledge, has driven strategic success across the value chain from material suppliers to component makers to OEM's to Investors seeking sustainable winning strategies.
- Access to vital, hard to find insights through detailed primary and secondary research and analysis. Incomparable data accuracy and integrity
- Lucintel has over 30,000 contacts in its database for conducting primary research
- Lucintel has +500 market reports on various market segments:
 - No Learning Curve - Deep industry knowledge and insight. Quality, Accuracy & Depth

Over thousand clients around 70 countries value our service



... 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.
- Over 120 full time analysts / consultants

Lucintel has published +500 multi-client market reports & conducted hundreds of consulting projects across multiple markets

Market Reports



Aerospace



Transportation



Marine



Construction



Renewable Energy



Recreational



Composite Materials

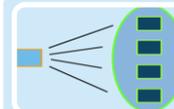
Consulting



Strategic Growth Consulting



Benchmarking



Opportunity Screening



Partner Search and Evaluation



Due Diligence and M&A



Market Entry Strategy

Lucintel's Experiences in Market & Strategic Analysis

- Lucintel has over thousand customers in 70 countries. It has worked with a variety of global companies, including (but not limited to) 3M, Audi, Carlyle, Credit Swiss, Cytec, DSM, Eastman, GE, Gurit, Sverica International, Sumitomo, etc. and has good experience in dealing with due diligence, M & A, market entry strategy, target screening and strategic growth consulting.
- Lucintel has done many research and published market research report and briefings in the areas of Composites and its markets and has deep material, technology, and market expertise. No learning curve for Lucintel in this market.
- Lucintel provides accurate data since we triangulate data using various means. During this project, Lucintel will talk to suppliers, buyers and users to drive insights about this project. We have more than 30,000 contacts from more than 70 countries across the different industry.
- Lucintel has performed a significant number of projects in market assessment, M & A, due diligence, investment thesis and winning strategy formulation. Below are comments from our satisfied clients in the area of M & A, market assessment, and Due Diligence, demonstrating our capabilities in management consulting and timely delivery.
 - “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, MacQuarie Partners

Dr. Sanjay Mazumdar

CEO, Lucintel

CONTACT INFORMATION

Address: Dallas, Texas, USA

Email: sanjay.mazumdar@lucintel.com

Phone: [972-804-8283](tel:972-804-8283) (cell)

Website: www.lucintel.com