



Composite Materials Outlook in the Automotive Industry

PRESENTED BY/DATE

Dr. Sanjay Mazumdar / November 11, 2014

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About Lucintel

Lucintel is a leading global management consulting & market research firm that helps companies in growth financing, M & A, market research and strategic consulting.

Vision:

- To provide accurate data, insights, strategy and innovation which empowers companies to make better informed decisions.

History

- Founded in 1998.
- Team of over 120 analysts / consultants

Industry Leadership

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

Published Market Reports:

- Over 500 published market reports

Consulting Services:

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

Executive Summary

- **Composite materials shipment in the global automotive industry was estimated at 3.8 billion lbs in 2013, and is likely to grow with a CAGR of 6% in next 6 years to reach 5.1 billion lbs in 2018**
- **CAFÉ standards of 54.5 mpg by 2025, EU mandate of CO₂ emission to the level of 95 g/km by 2020 and light weighting of vehicle parts are the major drivers of composite materials in the auto industry.**
- **Glass fiber composites is likely to remain dominant in exterior, interior, and under the hood applications.**
- **Increasing use of natural fiber composites in major applications such as door panel and seat backs are expected to drive the market in coming years**
- **Carbon composites have excellent weight saving potential than other materials but price is very high. Significant interest by auto makers in carbon fiber parts.**

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Major Raw Materials and Its Applications in the Automotive Industry

Steel (37.5%)



- Chassis
- Suspension arms
- Door frame
- Car hood hinge
- Exhaust system
- Bumper beams
- A, B, C pillars

Aluminum (8.5%)



- Wheels
- Powertrain mount
- Cylinder block / Engine
- Auto transmission case
- Suspension arms
- Bumper beams
- Intake manifolds

Iron (5.5%)



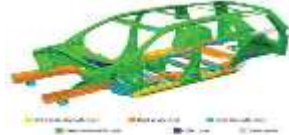
- Engine blocks
- Drum breaks
- Front & rear calipers

Plastics (8.3%)



- Dashboards
- Bumpers
- Seats
- Interior & exterior trim
- Electrical components
- Under the bonnet components

High Strength Steel (16.8%)



- Body in White
- Chassis
- B pillars
- Front end structures
- Bumper beams

Glass Composites (1%)



- Instrument panel
- Air intake manifold
- Fender
- Bumper
- Roof
- Door Module
- Headlamp

Carbon Composites (0.007%)



- Roof
- Chassis / monocoque
- Fender
- Tailgate
- Bumper

Others (22.4%)



- Windshields
- Mirrors
- Sunroofs
- Windows
- Dashboards

% represents weight distribution of total vehicle weight

Raw Materials Used in Major Segments of the Automotive Industry

Structural (30%)



- Chassis
- Body in White

- Steel
- HSS
- Carbon Composites

Power Train (22%)



- Engine
- Suspension
- Transmission

- Steel
- Aluminum
- Magnesium
- Carbon Composites
- Titanium

Interior (23%)



- Dash board
- Floor
- Door panel
- Steering
- Seat

- Plastics
- Steel
- Glass Composites
- Carbon Composites
- Magnesium

Exterior (11%)



- Door modules
- Hood
- Trunk lid
- Bumper

- Steel
- Aluminum
- Plastics
- Glass Composites
- Carbon Composites

Electrical/Electronic & Others (14%)

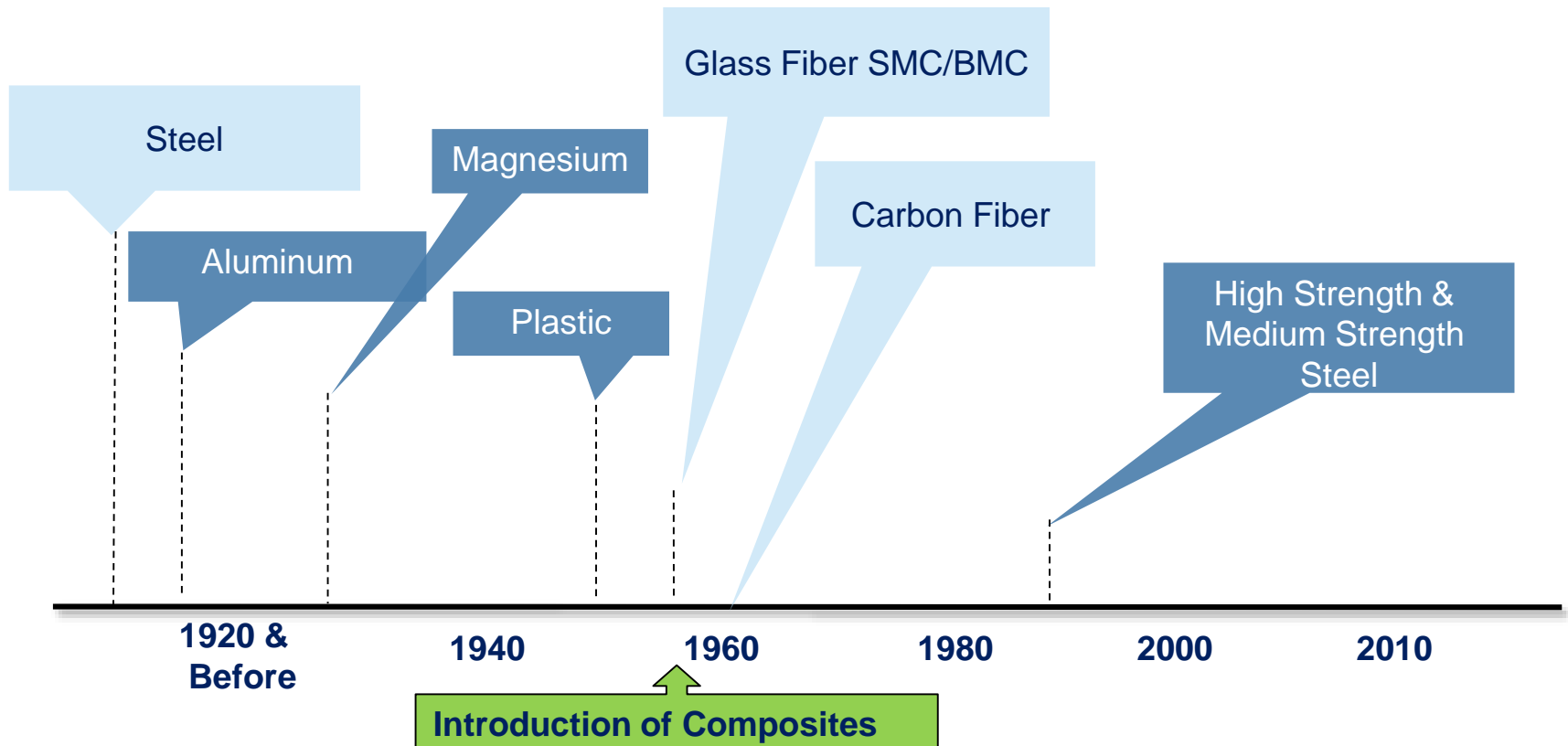


- Switches & Modules
- Wiring and lamps

- Plastics
- Rubber
- Glass Composites
- Magnesium

% represents weight distribution of total vehicle weight

Evolution of Raw Materials in the Automotive Industry

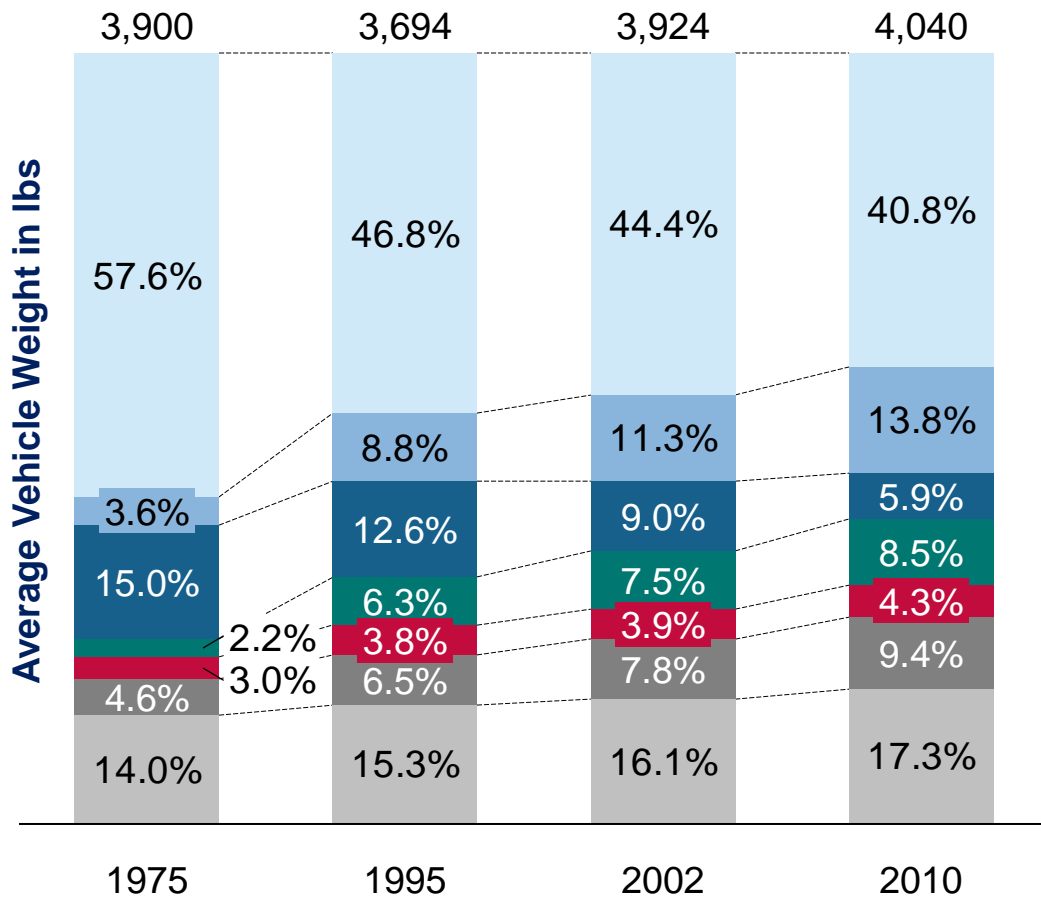


Key Insights

- High emphasis on greenhouse gas reduction, improvement in fuel efficiency, and safety concerns led to the evolution of advanced lightweight materials in the automotive industry.
- To achieve lightweight construction without compensating properties, auto OEMs came up with solution of replacing conventional materials with HSS, AHSS, aluminum, magnesium, composites etc.

Material Trends in the Automotive Industry

**Automotive Material Mix from 1975 to 2010
(Average Vehicle Weight in lbs)**



**Change in Materials Usage Per Vehicle
from 1975 to 2010 (in lbs)**



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Current Major Problems Encountered By the Automotive Industry

- **Demand of Fuel Efficient Vehicles:**
 - The Obama Administration's CAFE (Corporate Average Fuel Efficiency) standards of 54.5 mpg by 2025. Currently, per vehicle fuel efficiency in the US is about 28.9 mpg
 - CO₂ Emission Reduction: The European Union mandate of CO₂ emission to the level of 95g/km by 2020. Currently, per vehicle CO₂ emission in Europe is about 132.2 g/km
- **Increasing Passenger Safety Regulations:**
 - FMVSS (Federal Motor Vehicle Safety Standards and Regulations) 216 3.0 X GVW
- **Technology Innovation challenge:** Develop new material products to reduce cost, improve efficiency and speed to market
- **Manufacturing Implementation Challenge:** High cycle time of new materials
- **Product Complexity Challenge:** Demand of more sophisticated cars with high functionality
- **Demand of Cars with Better Aesthetic Property**
- **Supply Chain Challenge:** Parts count consolidation, securing carbon fiber supply, etc.

To Address the Current Problems, Powertrain is Likely to Experience Greatest Change in Materials, followed by Chassis and Exterior

Segments	Expected Materials Change			Currently Dominant Materials	Future Dominant Materials
	Low	Moderate	High		
Powertrain	[High Change Bar]			Steel, Iron and Aluminum	Aluminum, HSS/AHSS
Chassis	[Moderate Change Bar]			Steel, HSS/AHSS	HSS/AHSS, Composites
Exterior	[Moderate Change Bar]			Steel, Aluminum, Plastics, Composites,	Steel, HSS, Aluminum, Plastics, Composites,
Interior	[Low Change Bar]			Steel, Plastics, Composites	Plastics, Composites

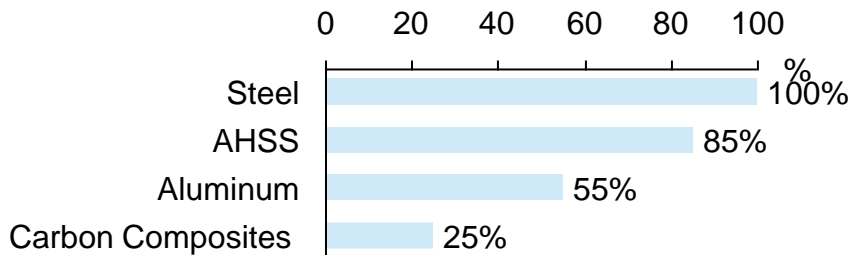
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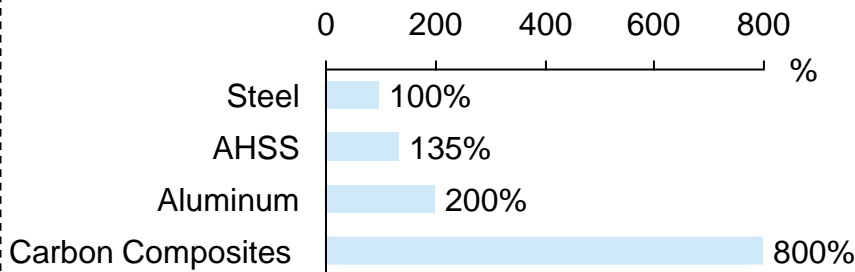
Role of Composite Materials: Composites Offer Advantage of Light Weight for Fuel Efficiency but it Comes at a Cost Penalty

Structural (Chassis)

Relative Part Weight

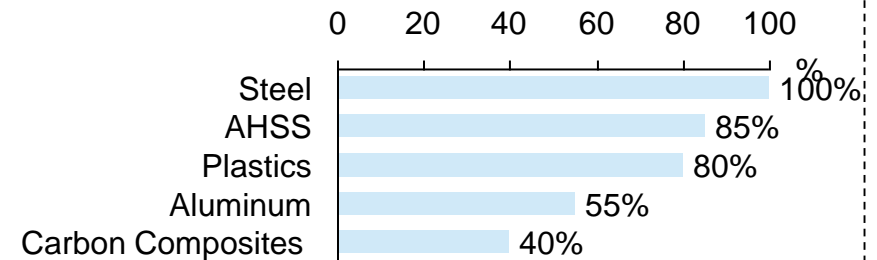


Relative Part Cost

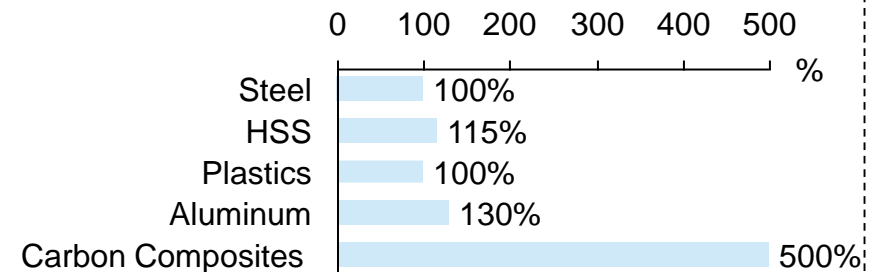


Non-Structural (Fender)

Relative Part Weight



Relative Part Cost



Drivers

CAFÉ Requirement

CO₂ Emission

Safety

Carbon Fiber Has Excellent Property than Other Materials but Price is Very High

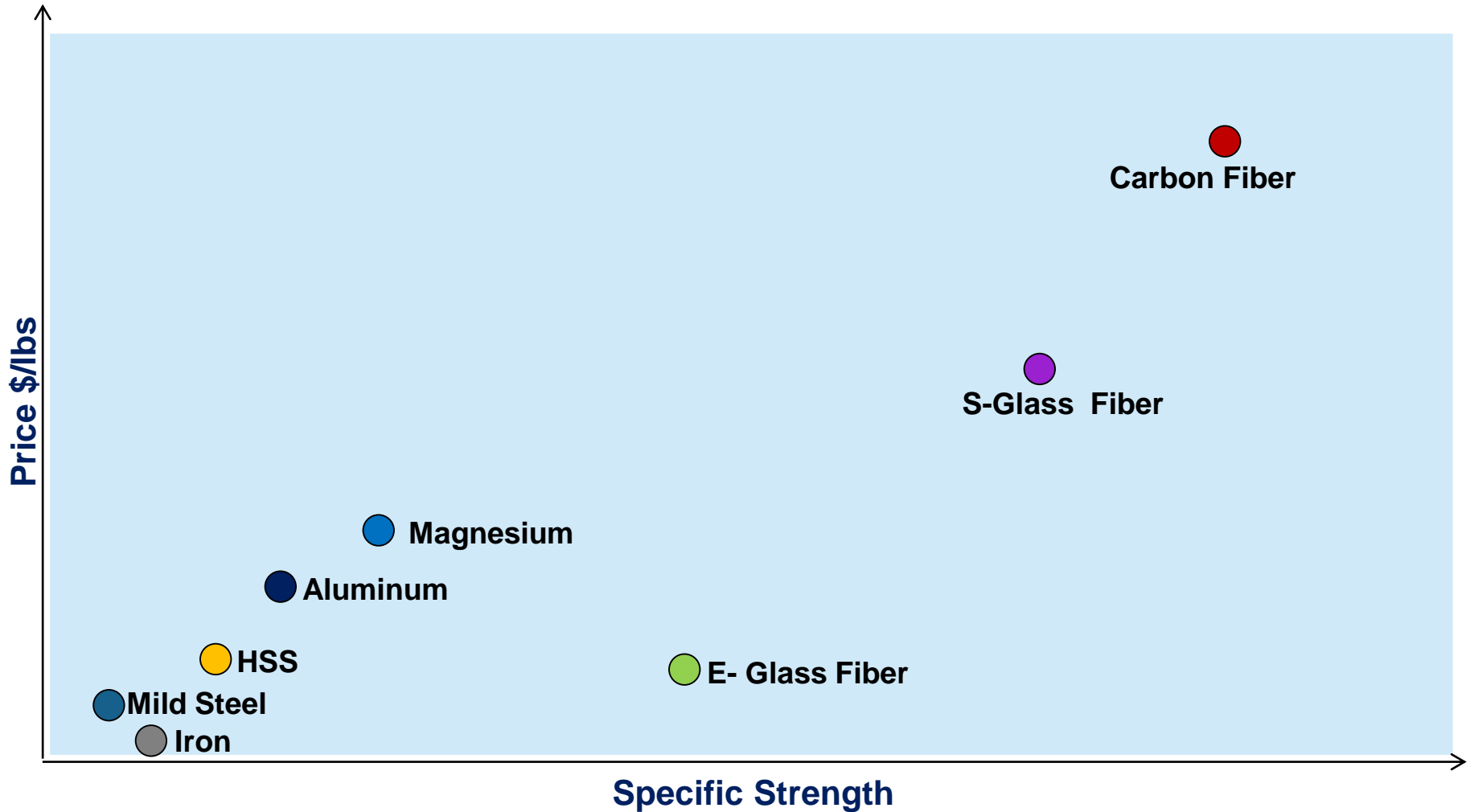
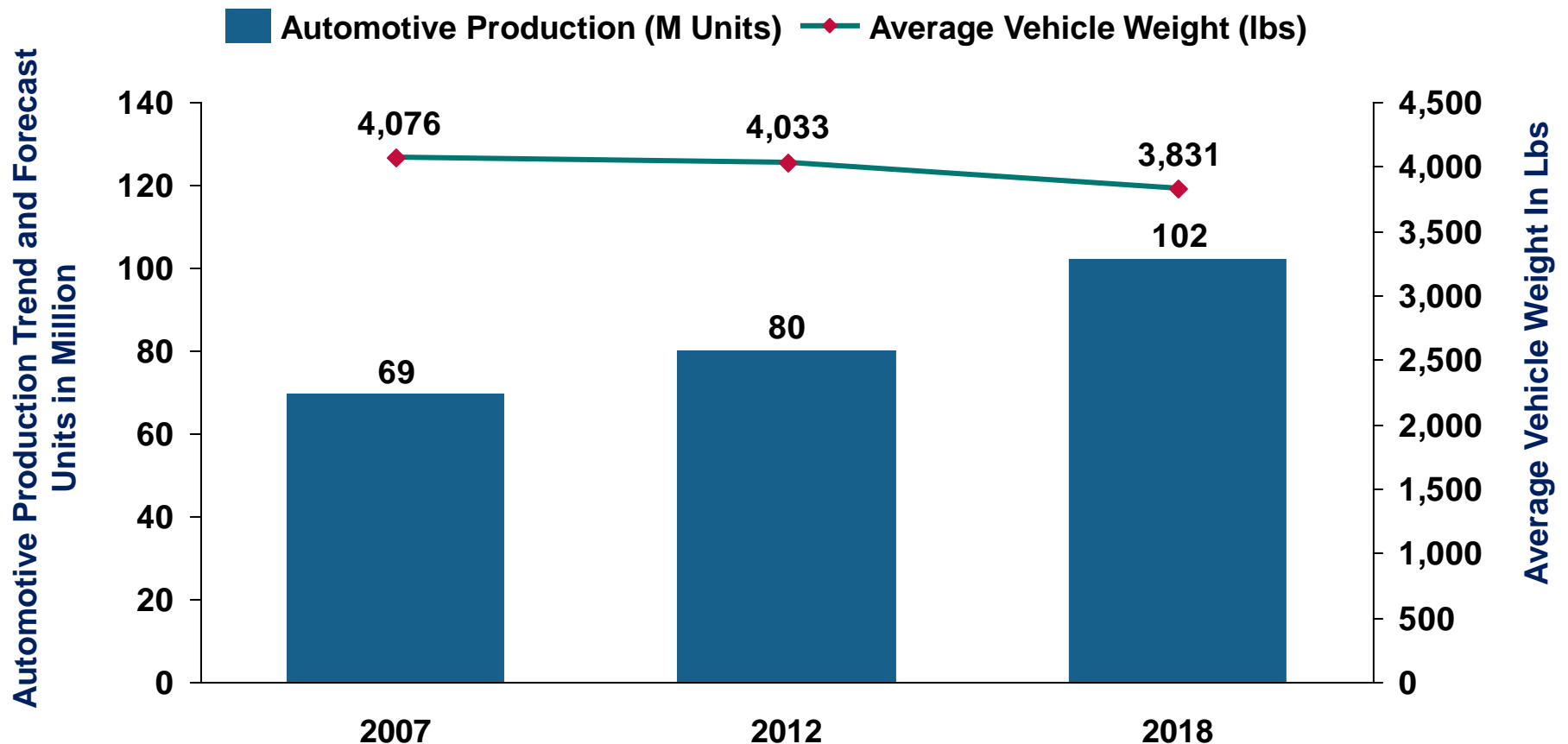


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Global Annual Automotive Production is Likely to Reach 102 million Units in 2018. Average Vehicle Weight is Expected to Decline by 5%

Trend and Forecast of Global Automotive Production and Average Vehicle Weight (2007-2018)



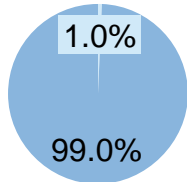
Note: Automotive includes Passenger Cars & Light Trucks

Composite Materials are Estimated to Account for 1.3% of Global Automotive Materials Market in 2018 with a total Demand of 5.1 billion lbs

Share of Composite Materials in Global Automotive Materials Market

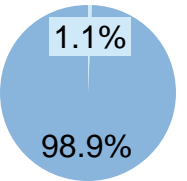
2007

Global Automotive Materials Market: 283 billion lbs



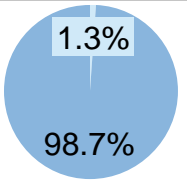
2012

Global Automotive Materials Market: 323 billion lbs



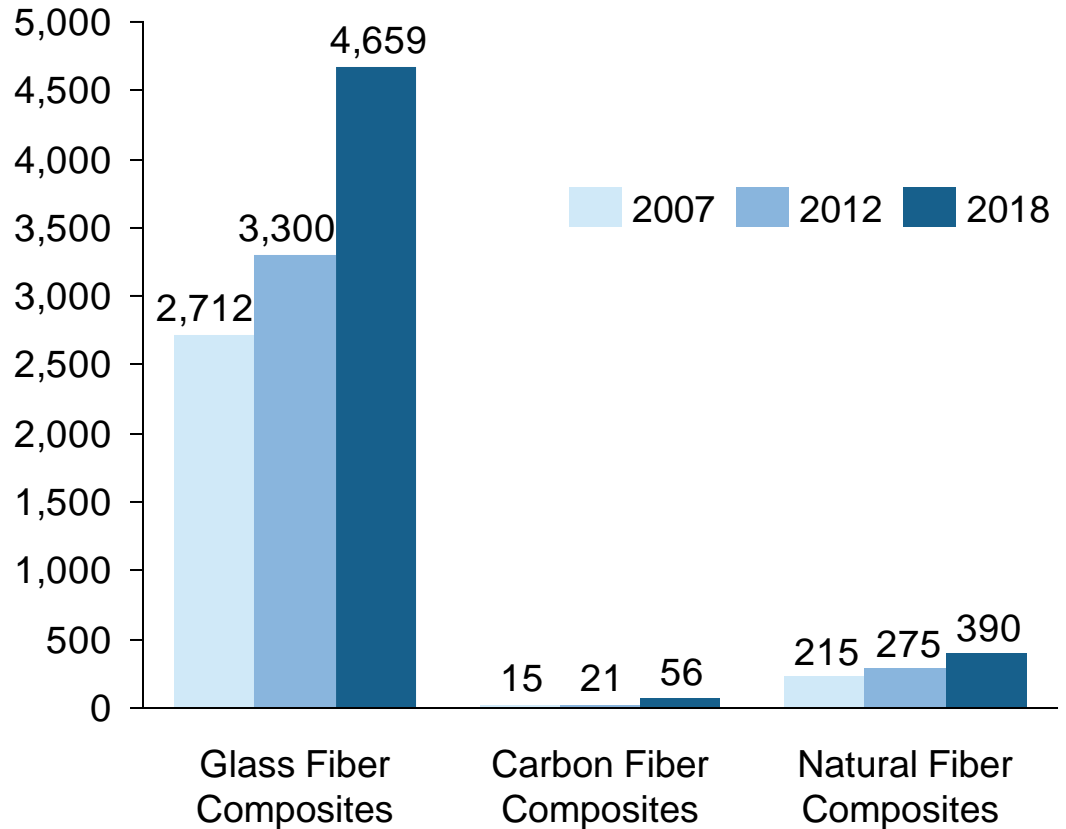
2018

Global Automotive Materials Market: 391 billion lbs



Composite Materials (light blue) Other Materials (dark blue)

Trend and Forecast of Composite Materials Market In Automotive Industry in Million lbs



Major Applications of Various Types of Composite Materials

1. Glass Fiber Composites



Interior Headliner



Underbody System



Air Intake Manifold



Instrument Panel



Bumper Beam



Air Cleaner Housing



Load Floor



Deck Lid



Air Duct



Airbag Housing



Front End Module



Engine Cover

2. Carbon Fiber Composites



Chassis/Monocoque



Roof



Tailgate



Hood



Floor Panel



Side Panels



Trunk Lid



Fender



Rear Spoiler



Bumper

3. Natural Fiber Composites



Door Panels



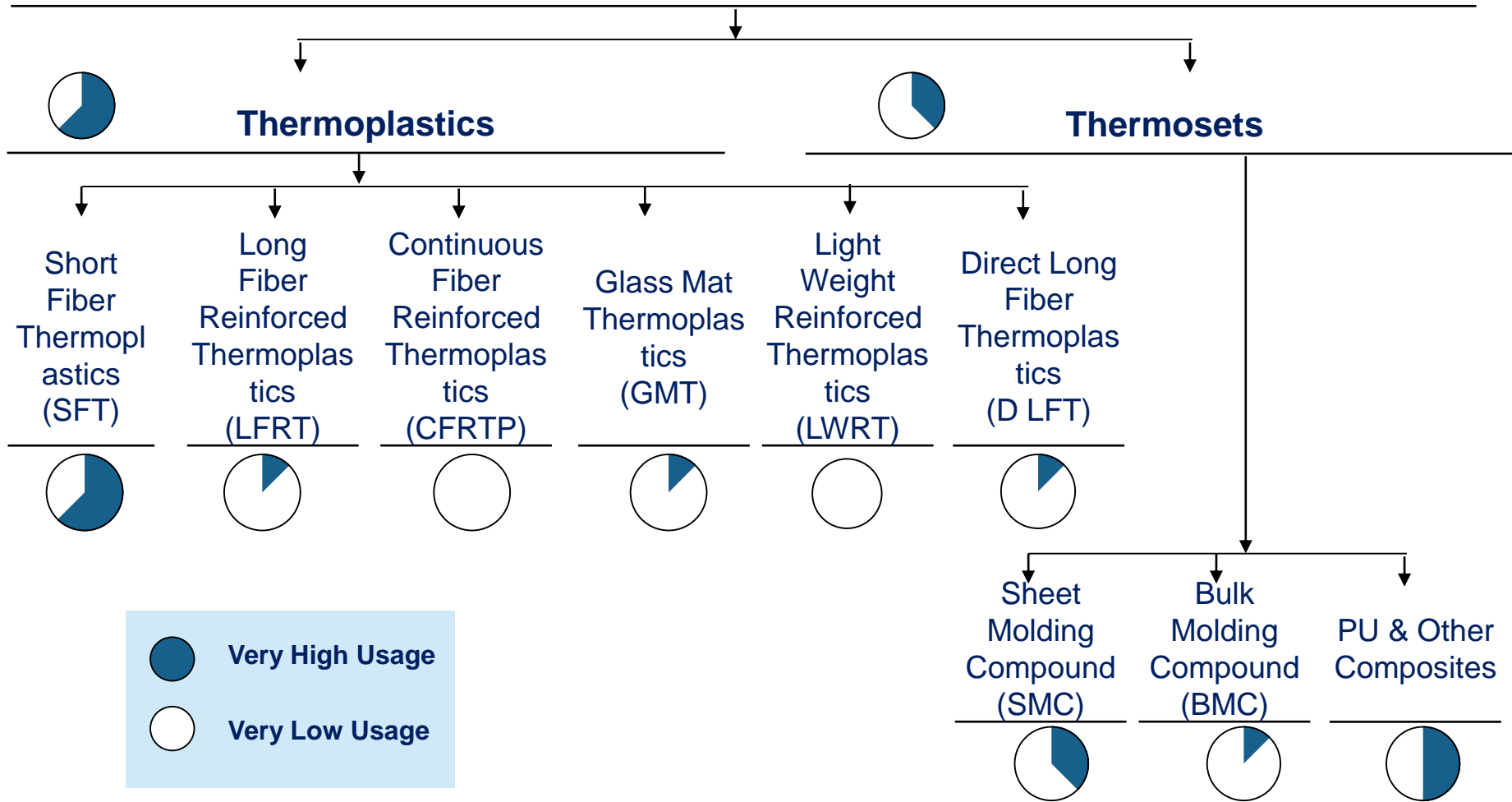
Seat backs



Load Floor

1. Types of Glass Fiber Composites Used in Automotive Industry

Glass Fiber Composites



Carbon Fiber Potential: Significant Opportunity from High-End Cars to High-Volume Cars with the Production of Low-Cost Carbon Fiber

Global Automotive Production Forecast by Car Type in 2018

Expected Demand of CF @ Current Price in 2018

Expected Demand of CF @ \$5/lb in 2018

		Expected Demand of CF @ Current Price in 2018			Expected Demand of CF @ \$5/lb in 2018		
		CF Usage in % of cars	Demand in MIbs	\$M	CF Usage in % of cars	Demand in MIbs	\$M
Super Cars	6,500	100%	0.17	1.6	100%	0.17	0.8
Super Luxury Cars	650,000	10%	1.65	16.5	25%	4.0	20
Luxury Cars	5 Million	10%	12.5	125.0	25%	32.5	157.5
Other/Regular Cars	96 Million	5%	120.0	1,200.0	10%	240.0	1200.0
Global Automotive Production in 2018	102 Million		134.3	1343.1		276.6	1,378.3

Assumption: Per vehicle CF consumption is 25 lbs

Source: Lucintel

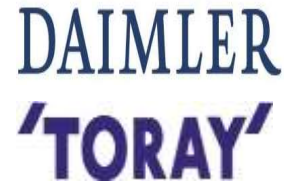
Strategic Alliances between OEMs and Carbon Fiber Suppliers in the Automotive Industry



Production of carbon fibers and carbon fiber fabrics for the upcoming BMW i-series electric vehicles for its passenger cell



To develop advanced carbon fiber thermoplastic composite technologies for high volume applications in GM cars, trucks, and crossovers



To develop, manufacturing and marketing of carbon fiber automotive components by utilizing High Cycle Resin Transfer Molding (RTM) developed by Toray



To develop cost-effective ways of using carbon fiber in high volume cars and trucks. By 2020, Ford aims to cut between 250 pounds and 750 pounds from its new cars and trucks



To develop use carbon fiber-based structural composite materials for high-volume serial automotive vehicles

Cycle Time Challenge: Auto OEMs are Looking for Part Manufacturing Process with Cycle Time in the Range of One to Two Minutes

Current Usage	Limited to	→	• Super Cars	• High Segment Cars	• Electric Cars
	Manufacturing Process	→	Prepreg Layup	Resin Transfer Molding	Pressure Press
	Cycle Time	→	2-4 Hours	0.05-1 Hour	17 Minutes

Current part fabrication process is good enough for low volume cars but for use in mass produced vehicle, there is need for process improvisation

Target Part Cycle Time

Carbon Fiber Part Cycle Time: One-Two Minute

Target Car Segment

- Sports cars
- Luxury cars
- Electric cars
- Regular cars

Area of Focus

- Technology improvement (HP RTM and CFRTP)
- Spreading carbon fiber tow
- Low viscose epoxy resin

Industry is on the Way of Achieving the Targeted Cycle Time

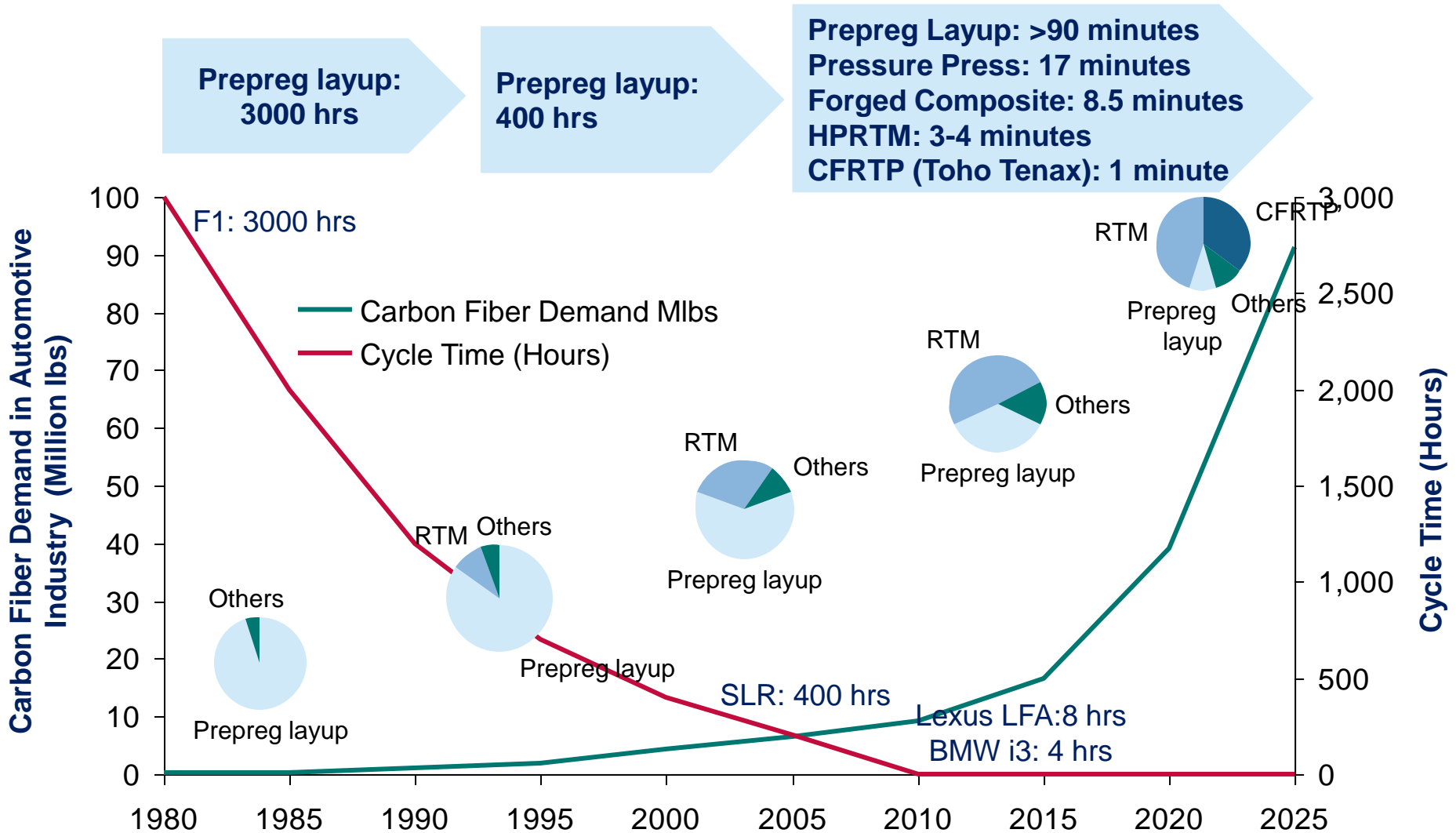


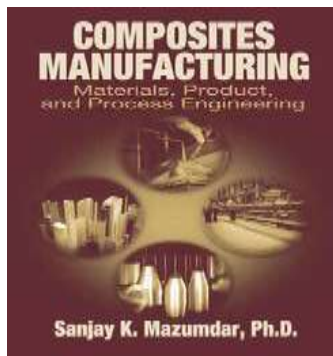
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About Speaker

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.



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Published Market Reports:

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Consulting Services:

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

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

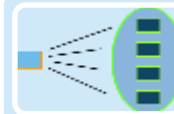
Consulting



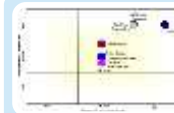
Strategic Growth Consulting



Benchmarking



Opportunity Screening



Partner Search and Evaluation



Due Diligence and M&A



Market Entry Strategy

Lucintel's Experience 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 provides accurate data since we triangulate data using various means. During the project, Lucintel talks to suppliers, buyers and users to drive insights about the project. We have more than 30,000 contacts from more than 70 countries across different industries.
- 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

Thank You!