Global Nanomaterials Opportunity and Emerging Trends

Lucintel Brief

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- Nanomaterials Market Outlook
- Market Trends and Opportunities
- Growth Opportunities in 2019 and Beyond
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Executive Summary

- **Global nanomaterials market was estimated at $8.4 B in 2019, and is likely to grow at a CAGR of ~13% in the next six years to reach $17.5 B in 2025**
  - Carbon Nano Tubes (CNTs) and nanoclay materials holds major percentage share in the global nanomaterials market, followed by metal nanopowders and quantum dots
  - Graphene market is gaining wider acceptance, and is growing rapidly, driven by better price performance ratio compare to that of other competing materials
  - Major market drivers for healthy growth of the nanomaterials market in the different end use industries such as healthcare, E&E, Automotive and many more.
- **Major drivers and trends shaping the global nanomaterials market are:**
  - Government funding to encourage nanotechnology
  - Ongoing research & development to identify new and emerging applications and materials
  - Collaborations and joint product development between material suppliers, universities and Government bodies
  - Healthcare industry is increasing utilization of nanomaterials in different applications
- **Major suppliers having significant contribution in the development of the nanomaterials market are Clariant, Showa Denko, Arkema, Nanocore, Umicore, and many more**

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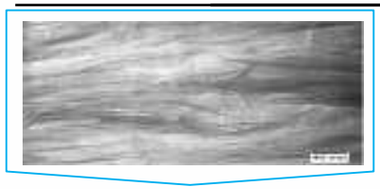
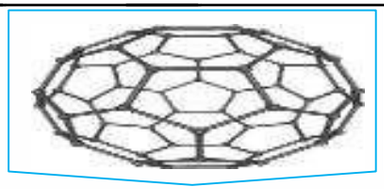
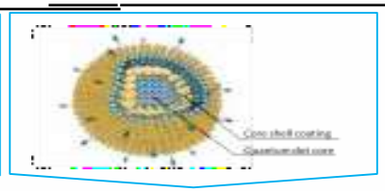
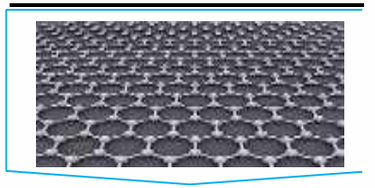
Nanomaterials Market Overview

Nanomaterial

	Carbon Nanotubes	Nanoclay	Fullerenes	Quantum Dots	Metal Nanopowders	Graphenes
						
Benefits	• Excellent mechanical properties • Reduce weight • Radio transparency • Crack/vibration resistant	• Excellent thixotropic agent • Improve gas & liquid barrier properties • Enhance flame retardant	• Reduces weight • Provide flexibility	• High extinction co-efficient	• Good mechanical properties • Improved chemical properties • Resist deformation	• Excellent optical & thermal, electrical and mechanical properties
Industry	• Energy • Sporting Goods • Aerospace • Polymer & Ceramics • Medical	• Automotive • Plastics • Pipe & Tank • Packaging • Paint & Coating • Consumer goods	• Energy • E&E • Automotive • Medical/Health Care • Sporting Goods	• Computing Devices • Medical • E&E • Solar Energy	• Industrial • Healthcare/ Medical • Energy • E&E • Consumer Goods	• Energy • Bio Medical • Devices • Energy Storage Devices • E&E

Nanomaterials Value Chain

• Nanoclays • CNTs • Fullerenes • Graphene • Metal Nanomaterial	• Nanocomposites • Paints/Coatings • Ceramics & MMC	• Auto Tier 1 Suppliers • Aero Tier 1 Suppliers • E&E	• Automotive • Aerospace & Defense • Sporting Goods • Medical • E&E • Construction
• Clariant • Nanocore • Nanocyl • Cnano Technologies • Alfa Aesar • Frontier Carbon • Ningbo Morsh • Umicore	• Basell Polyolefins • BASF • Akzo Nobel • PPG Industries • Nissin Kogyo • NKK	• ArvinMeritor • Borg-Warner • Spirit AeroSystem • Triumph Aerospace	• BMW • Daimler • Boeing • Airbus • Easton Sports • Yonex • GE Health Care Siemens • Samsung • Nokia

Current and Potential Applications of Nanomaterials

Transportation

- Engine, Powertrain & Fuel Systems
- Scratch Resistant Exterior Paint and Coatings
- Car Interior
- LED Lights
- Batteries

Construction

- Conductive Flooring
- Pipes
- Insulating Materials for Roofs & Thatches
- House & Building Siding
- Self Cleaning Windows

Packaging

- Meat & Food Packaging
- Computers & Electronics
- Medicines & Pharmaceuticals
- Beer Bottles

Aerospace & Defense

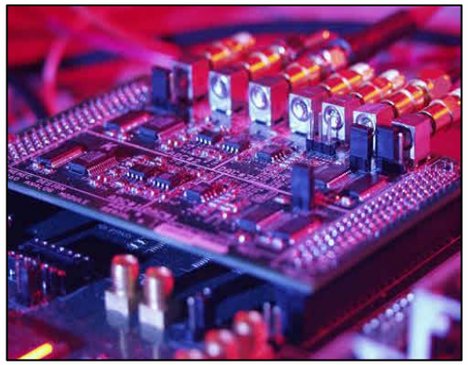
- Aircraft Structures
- Wear Resistant Paints & Coatings for Defense Vehicles

Consumer Goods

- Home appliances
- Sporting goods & toys
- Furniture & others

Current and Potential Applications of Nanomaterials

Electrical & Electronics



- Sensors
- Semiconductors
- Hard disk storage in computers

Energy

- Battery electrodes
- Fuel cell membranes
- Supercapacitors

Health Care

- Body implants
- Medical devices
- Dental filling materials

Others

- Anti-foul coatings for marine ships
- Industrial equipment
- Fire resistant clothes

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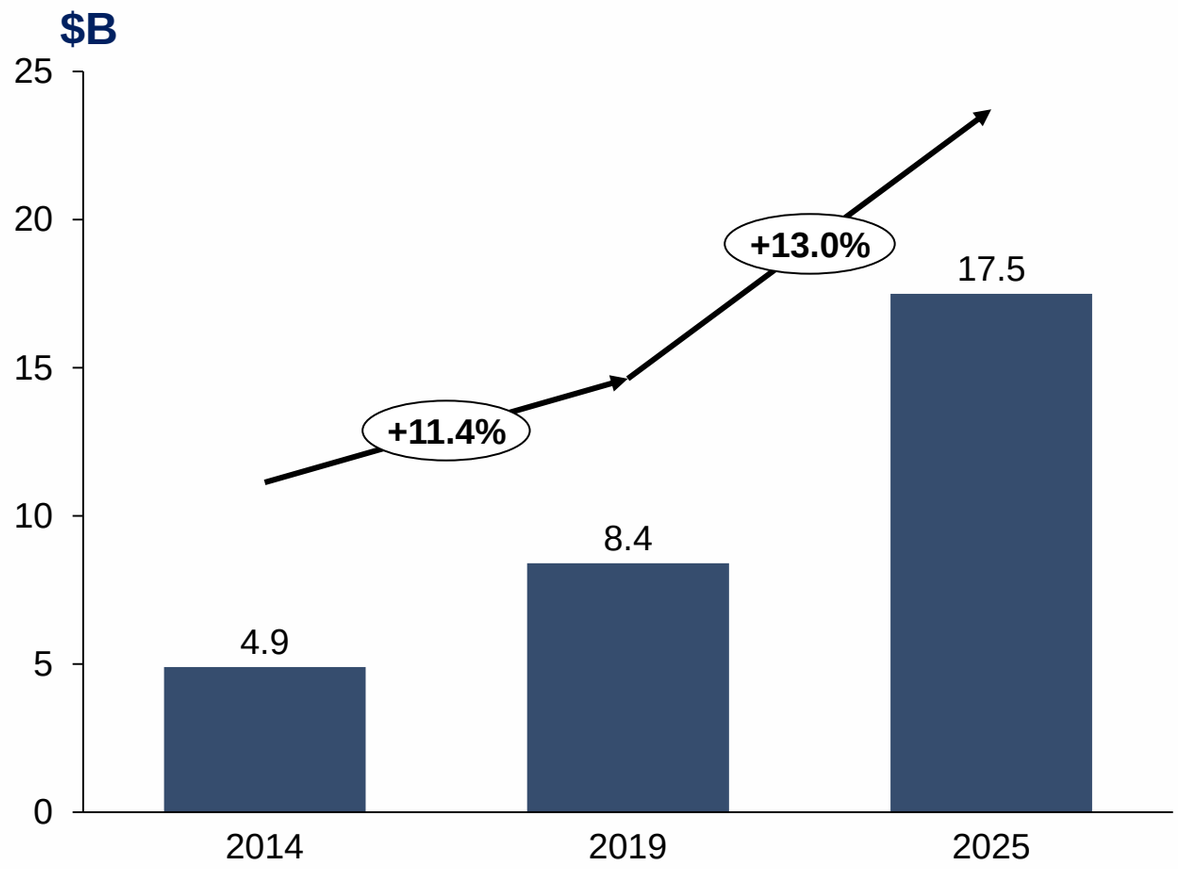
Global Nanomaterials Market Trend and Forecast (2014-2025)

Global Nanomaterials Market Trend and Forecast ($B) 2014-2025



Key Insights

- Global nanomaterials market was estimated at $8.4 B in 2019 and is likely to grow at a CAGR of 13% in next six years to reach $17.5 B in 2020
- Carbon Nano Tubes (CNTs) holds major percentage share in Global nanomaterials market and is expected to grow at double digit growth in the next six years
- Increasing penetration and awareness in the end use industries, growing Government support and funding, expanding ongoing research and development to identify newer applications and new materials are the major drivers shaping nanomaterials market

Light Weight, High Strength are the Major Drivers for Nanomaterials To be Used in Different Industries

	Automotive	E&E	Health/ Personal Care	Energy	Others (Sporting Goods, etc.)
Nanomaterials Market					
Major Drivers	• Light weight • High strength	• Electrical conductivity	• Diagnostics • Efficient drug delivery	• Increase efficiency • Efficient Storage	• Strength to weight ratio • Crack & vibration resistance
Major Applications	 Engine & Powertrain  Tires  Paint & Coating	 FEDs  Nano electronic Devices	 Medicines  Medical Equipment & Devices	 Wind Energy  Solar Energy	 Racquets  Archery  Golf  Kayaks

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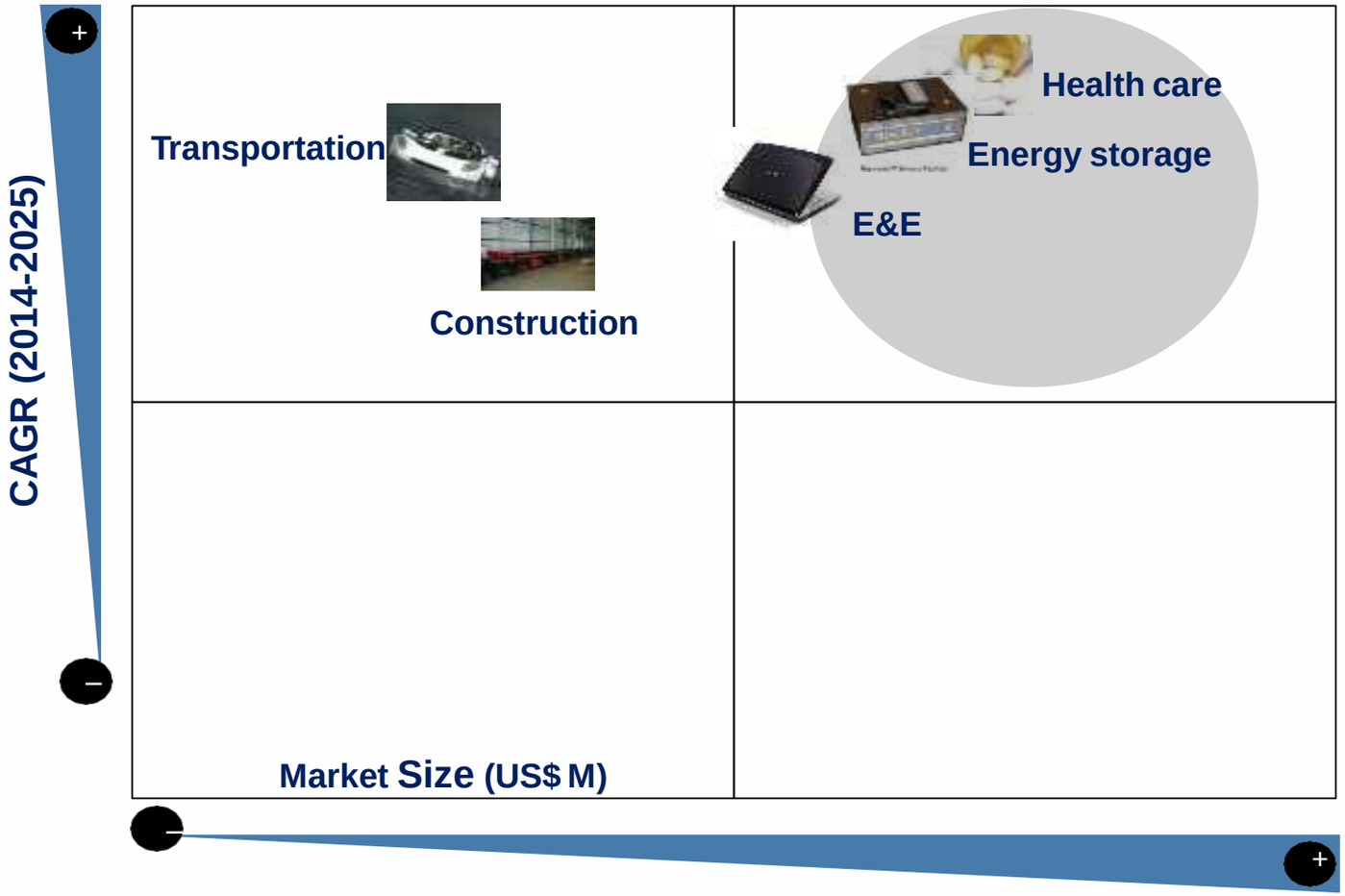
Health Care Industry is Expected to Gain Market Share and Overtake E&E Segment in Size Over Next Five Years

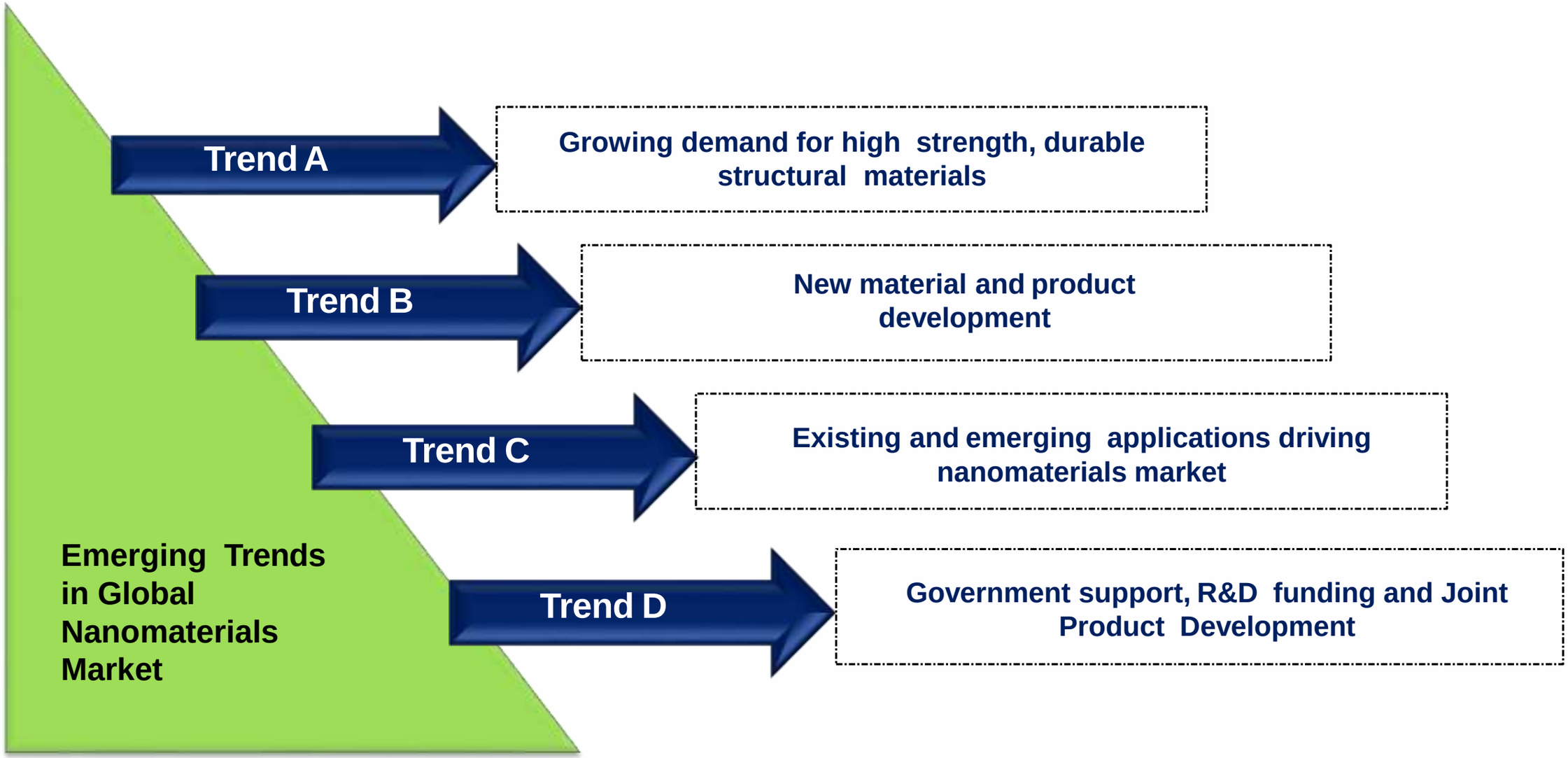
Growth Opportunities for Nanomaterials in Various Industries



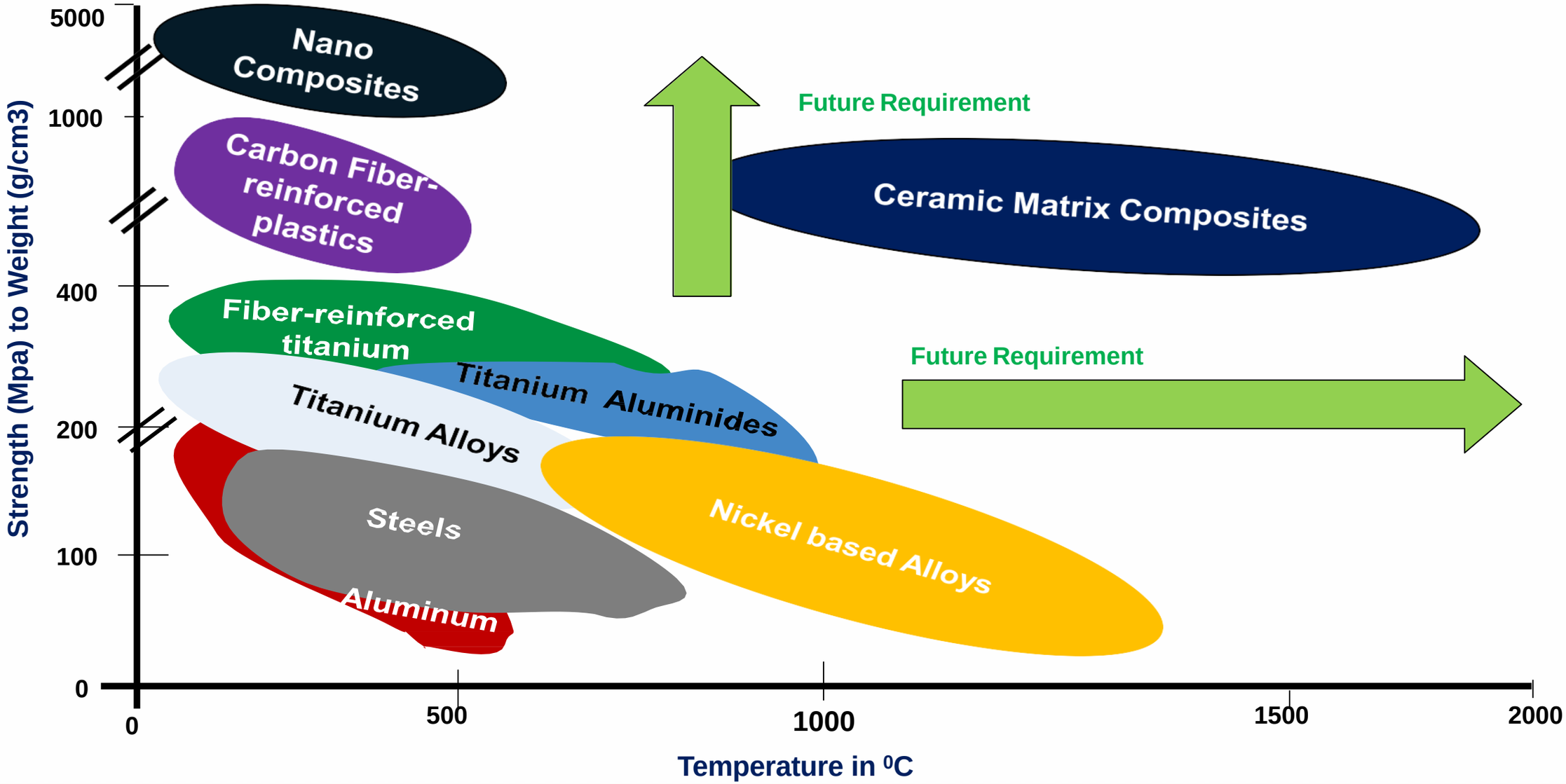
Key Insights

- Nanomaterials have great potential in electrical and electronics applications because of their extraordinary electrical conductivity
- Significant developments in healthcare technology, growth in the medical diagnostics industry, and medicinal imaging applications creating space and gaining market of nanomaterials
- Packaging is another important segment, flourishing mainly in North America and Western Europe
- Energy segment is also expected to grow at a double digit growth

Lucintel Predicts Five Key Emerging Trends Shaping the Global Nanomaterials Market



Trend A: Continuous Focus on Property Improvement and Part Performance Will Drive the Usage of Nanomaterials in Future



Continuous Focus on Property Improvement and Part Performance will Drive the Usage of Nanomaterials in Future

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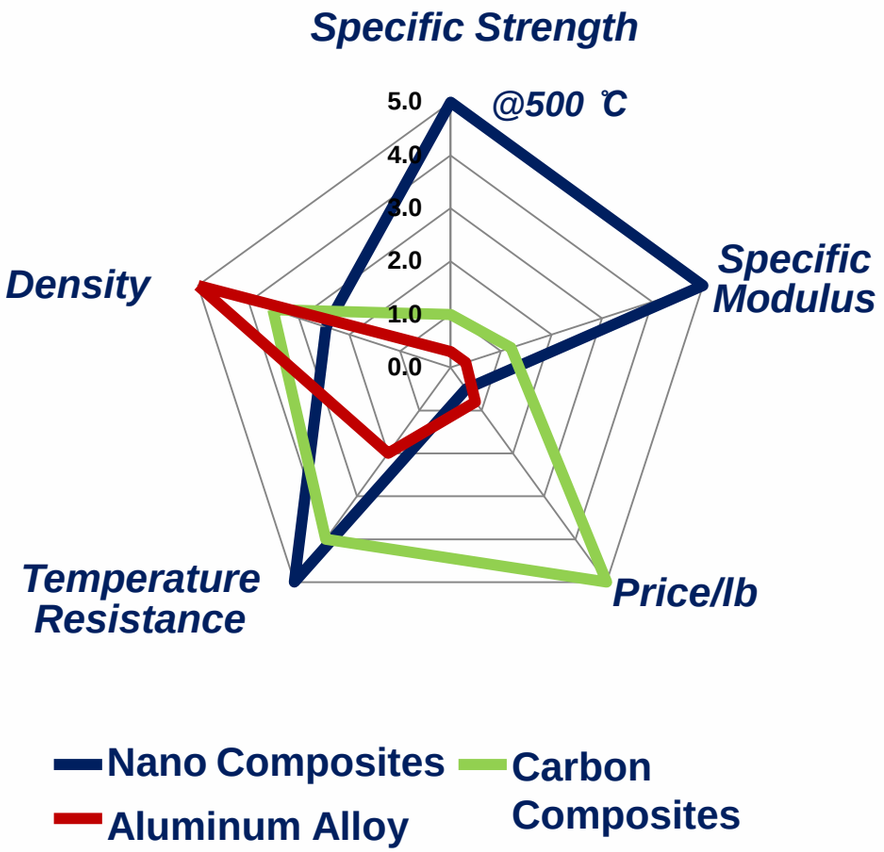
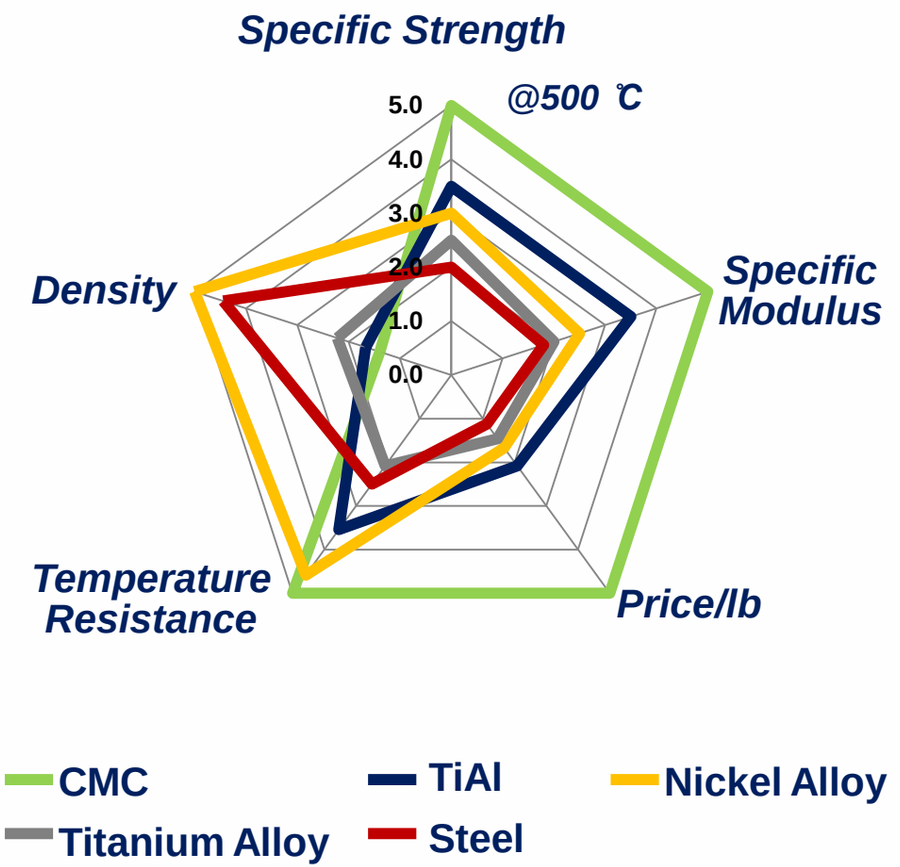
Airframe



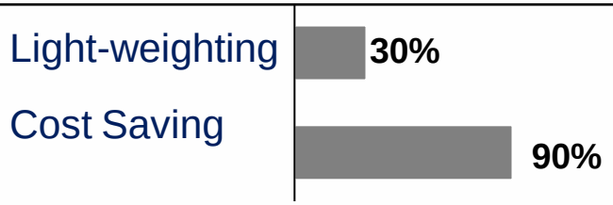
Engine



Lockheed Martin Incorporated CNRP into F35 Lightning II Wingtip Fairings Resulting in Significant Cost & Weight Reduction

Advanced Polymers Engineered for the Extreme (APEX) Technology: A Light-weighting Initiative

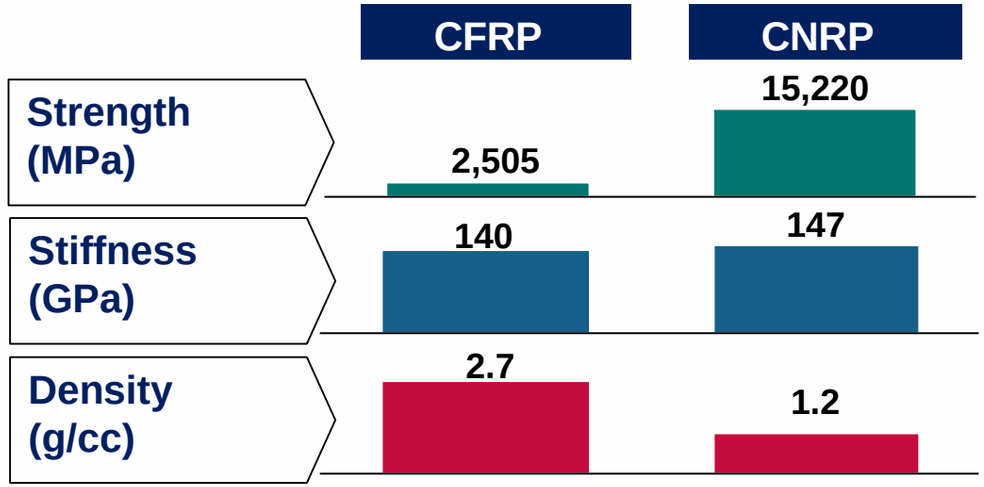
Carbon Nanotube Reinforced Polymer (CNRP) Wing Tip Fairings Benefits over CFRP



Upto 30% of light weight as compared to CFRP component

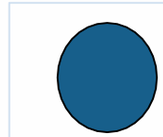
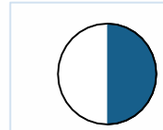
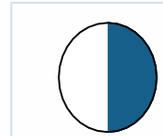
The new wingtip fairing is being made for one-tenth of the cost of the equivalent CFRP component

Typical CNRP Property Comparison with CFRP



Lockheed Martin has identified more than 100 additional parts for potential APEX insertion into the F-35 to achieve additional cost savings

Trend B(i): Increasing Adoption of Nanomaterials to Improve Mechanical & Chemical Properties of End Parts at Reduced Weight and Prices

Application	Nanomaterial Used	Unmet Needs	Industry Served	Benefits Derived	Relative Importance
 LED Lights	• Nano Ceramic Aluminum	• Low cost LED devices • Temperature performance	• Automotive & Mass Transportation • Construction & Infrastructure	• 25% cost reduction of LED devices • 43% Component count reduction • 24% assembly cost reduction	
Application Developer: Cambridge Nanotherm					
 Batteries	• Carbon Nanotubes • Carbon Nanowires	• Environmental friendly • Smaller in size • Low cost	• Transportation • Energy • Healthcare • Defense • Electronics	• Reduction in toxicity of electrolyte solution • Significant reduction in size of the batteries • Prevents loss of active materials during storage	
Application Developer: mPhase Technologies					
 Blade Paint	**Not Available**	• Anti-Icing solution with improved resistance to corrosion	• Wind Energy	• Prevents ice formation • Improves efficiency • Sustain & improves corrosion resistance property of a blade	
Application Developer: Gamesa					

Importance to Industry  **High**  **Low**

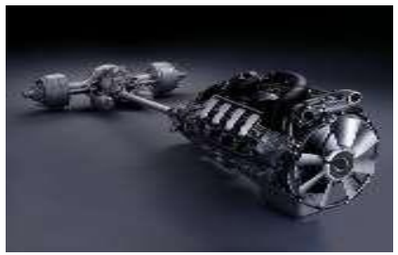
Trend B(ii): Product Launches in Nanomaterial

Contd..

Innovation Description	Material Name	Company Launched	Market Served	Innovation Attractiveness		
				Ease of Integration	Application Enhancement	Market Acceptance
Attractive product launches in intermediates						
Hybrid glass/carbon fiber nanofabric	Not Available	Carbon Composite Technologies	Wind-Energy, Aerospace, Armor, Marine and Automotive			
Nano Adaptive Hybrid Fabric	Fuzzy Fiber	URDI, Goodrich, Owens Corning, Renegade Materials	Wind-Energy			**NA**
Nanocomposite Prepreg	Arovex HT	Zyvex	Sporting Goods			

Degree of Attractiveness **High** **Low**

Trend C: Applications driving Opportunities in the Automotive, Healthcare and Energy Industries



Engine and Powertrain

Wind Energy

Solar Energy

Suspension & Braking System

LED Lights

Medicines

Lubricant

Medical Equipment & Devices

Engine Cover

Key Insights

- Nanocomposites exhibits excellent mechanical properties, dimensional stability, impact and scratch resistance, better thermal properties, etc.
- One of the fastest growing applications of nanomaterials is healthcare. Nanomaterials help in delivering drugs, heat, light, and other substances to specific types of cells for treatment purposes.
- Energy industry can also be benefitted with the nanotechnology ensuring better efficiency in energy production and storage
- Major driver in increasing usage of nanocomposites in automotive applications are reduction in vehicle weight and improved engine efficiency (ensuring better mileage and emission reduction)

Trend D: Collaborations and Joint Product Development between Materials Suppliers, Universities and Government Bodies

• Park Systems are the manufacturer of Atomic Force Microscopes announced $1 million Nano Research to support researchers who are starting new nanoscience labs in North America. Systems	• The Massachusetts Institute of Technology researchers have produced carbon fibers coated with carbon nanotubes that sustains the mechanical properties of the base fibers	• The U.S. Department of Energy (DOE) Grant to Georgia Institute of Technology to develop an additive manufacturing technique for fabricating three-dimensional (3D) nanoscale structures from a variety of materials	• University of Sussex developed a new way of producing nanomaterial inks and assembling them into coatings. Dalton expanded his lab to find nanomaterial technological solutions collaborating with different end use industries

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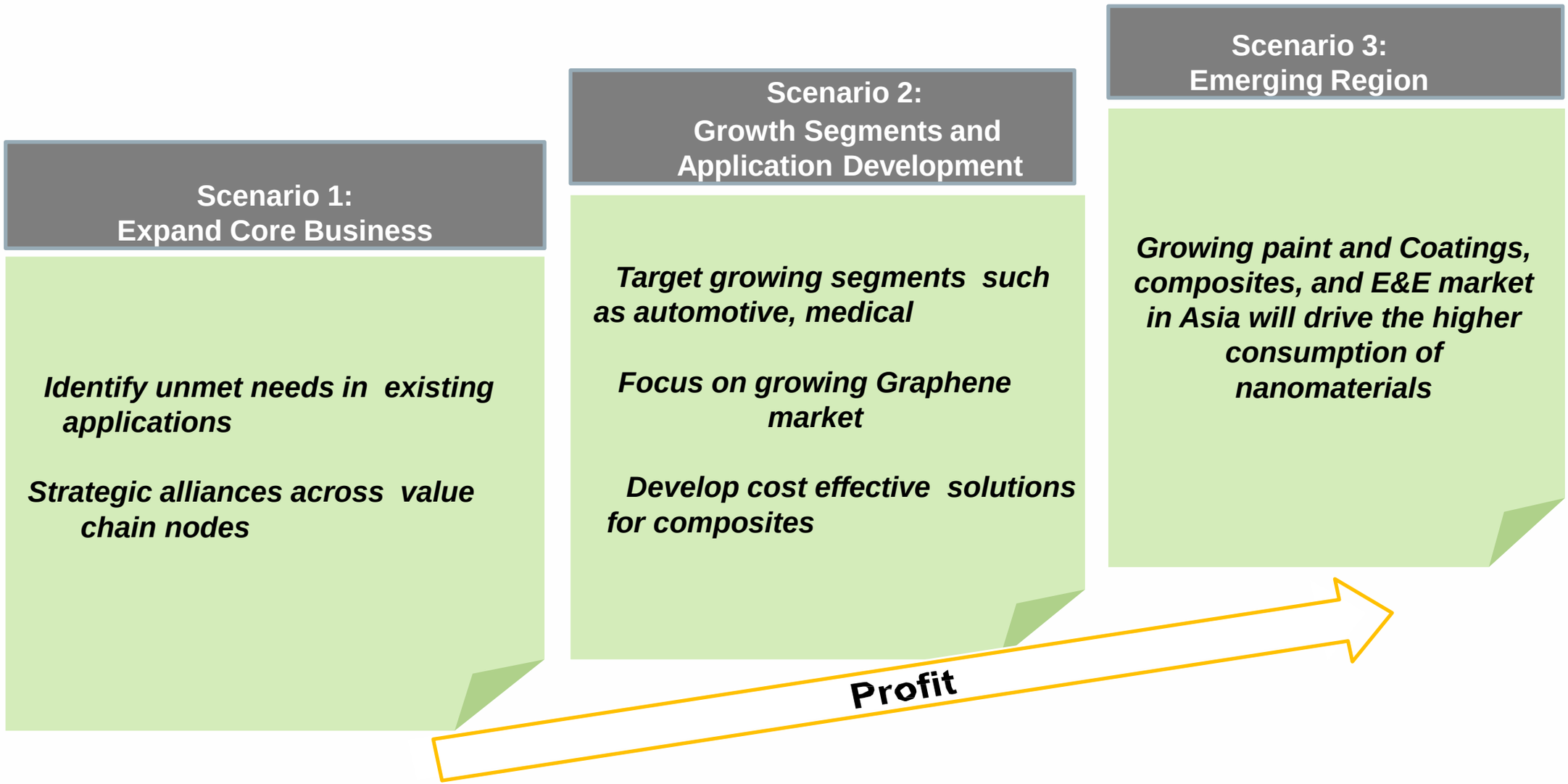
Three Growth and Profit Scenarios in Nanomaterials Market



Three Growth and Profit Scenarios in Nanomaterials Market

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 Nanomaterials to make it cost effective alternative against conventional materials by improving manufacturing process
- Improve process characteristics, such as stability in processing

3. ***Strategic Alliances (M & A)***

- Develop strategic alliances to gain competitive advantages with material suppliers, nano intermediaries, universities and Government bodies, etc.
- Enter into emerging markets and regions

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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

Why Lucintel

Trusted insights: Reliable insights. Widely cited in Wall Street Journal, Financial Times, Forbes, etc.

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

Contact Us

Sanjay Mazumdar, Ph.D.

CEO, Author, & Strategist

Email: sanjay.mazumdar@Lucintel.com

Tel.: 972-636-5056

Eric Dahl

Senior Executive Advisor

Email: eric.dahl@lucintel.com

Tel.: +1-323-388-6971

Brandon Fitzgerald

Director of Client Engagement

Email: brandon.fitzgerald@lucintel.com

Tel.: +1-303-775-0751

Nigel O'Dea

Business Development Manager

Email: nigel.odea@lucintel.com

Tel.: +44 (0) 7413571716