



Advanced materials: the emergence of new-age materials across key manufacturing sectors in India

March 2023

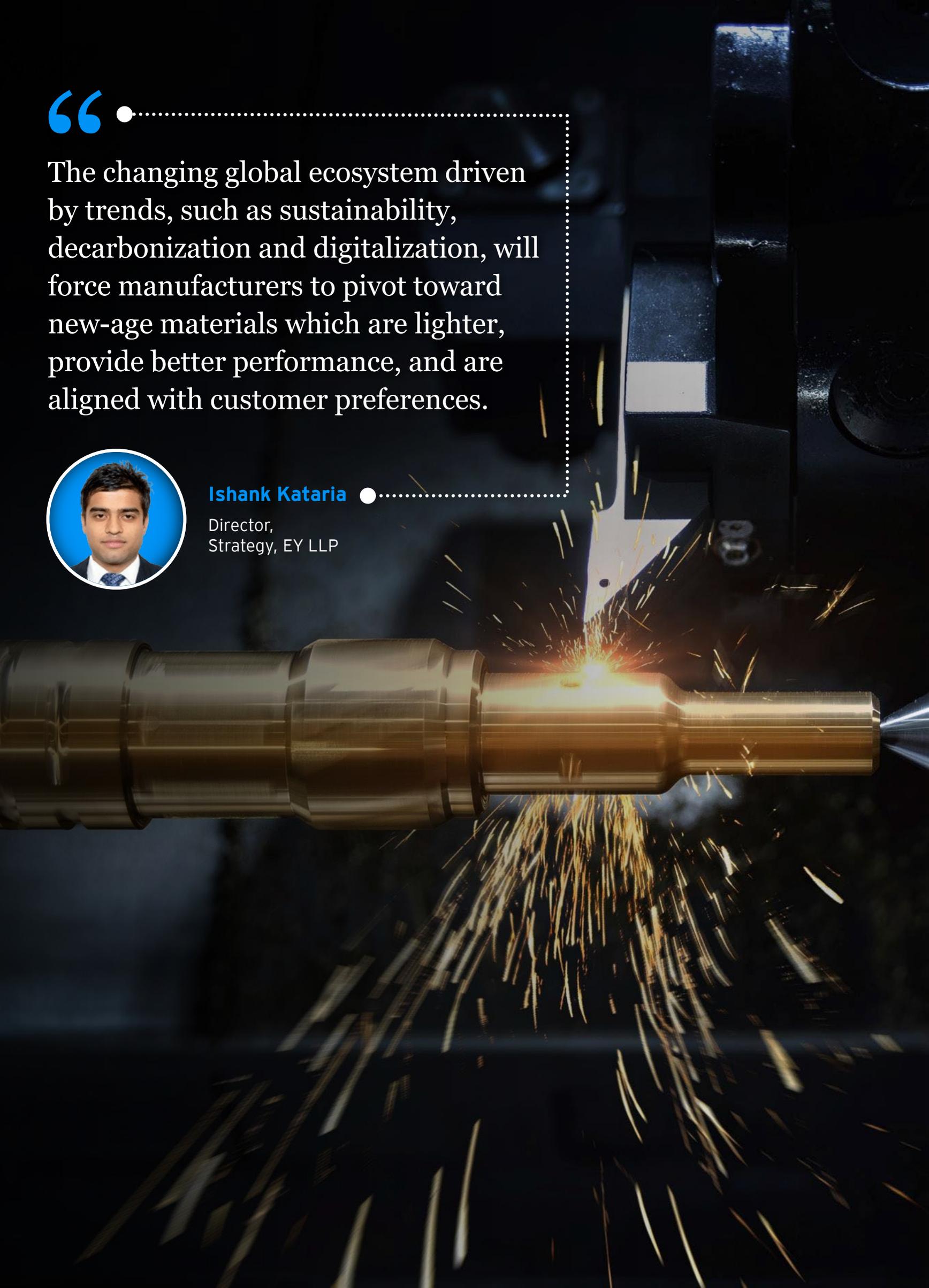
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The changing global ecosystem driven by trends, such as sustainability, decarbonization and digitalization, will force manufacturers to pivot toward new-age materials which are lighter, provide better performance, and are aligned with customer preferences.



Ishank Kataria

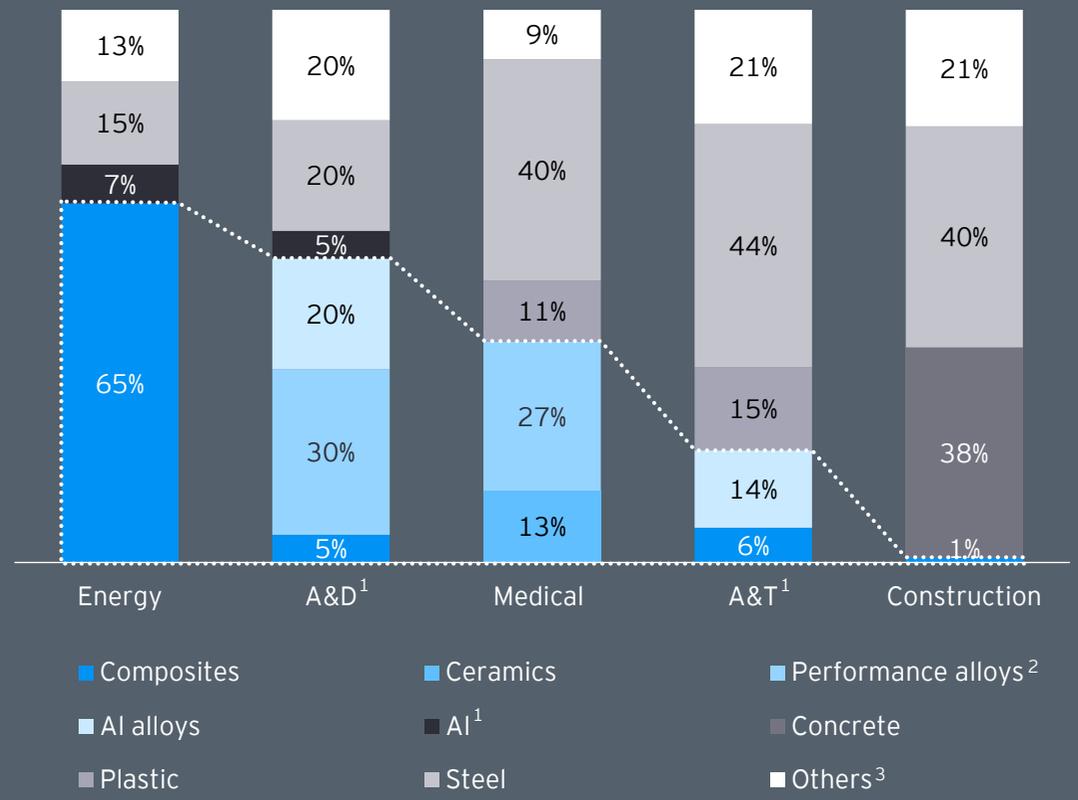
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Although steel and aluminum remain the most used materials across key industries due to superior price performance ratio, new materials are emerging

Steel and aluminum are being replaced globally by new-age and lightweight materials, such as composites, ceramics, advanced aluminum alloys, and performance alloys. Better performance efficiency and changing customer requirements are driving the use of these materials.

Advanced material penetration in India by key applications in 2021



Source: Copyright JEC Group: JEC Observer- February 2022 and EY- Research and Analysis

Advanced material market in India in 2021, US\$b



India is not far behind, with applications such as wind energy, aerospace and defense, and medical implants nearly on par with global penetration. Significant investment in end-use industries, such as energy, automotive, and aerospace and defense is driving innovation and, as a result, demand for new age materials in India.

Source: Copyright JEC Group: JEC Observer- February 2022 and EY- Research and Analysis

¹ A&T - Automotive and Transportation; A&D - Aerospace and defense; Al - Aluminium

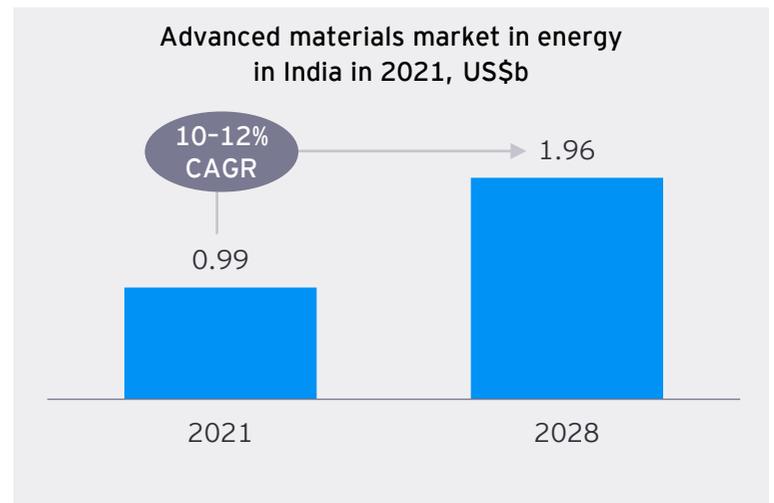
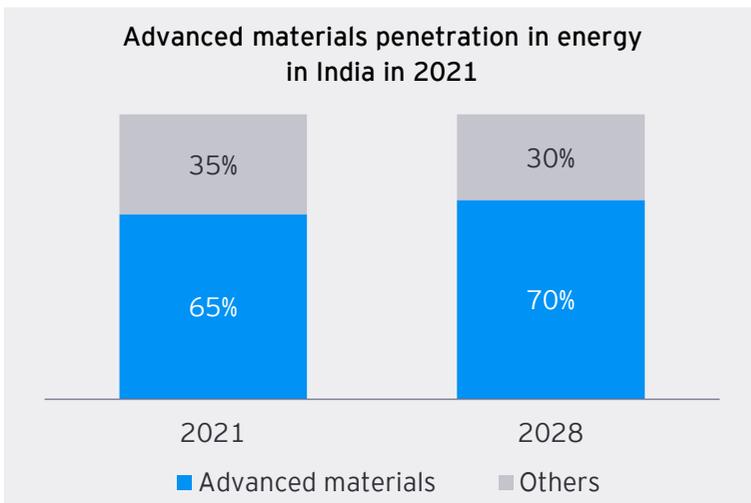
² Performance alloys include nickel alloys, titanium alloys etc.

³ Other materials includes lithium, silicon, engineering plastics, glass, wood, etc. Materials with less than 5% share in the overall segment has been clubbed into other materials



Energy sector has taken a lead in this material shift, with growth in renewable energy driving usage of composites and silicon

Rising demand for clean energy is driving capacity expansions in India for wind and solar. Longer wind blade sizes are driving up demand for glass and carbon composites. With solar establishing itself as a low-cost energy source, the demand for silicon panels may rise.



*Penetration in energy sector based on wind energy turbine blades
 Source: Copyright JEC Group: JEC Observer- February 2022, NREL, EY- Research and Analysis

Source: Green energy holding, EY- Research and Analysis

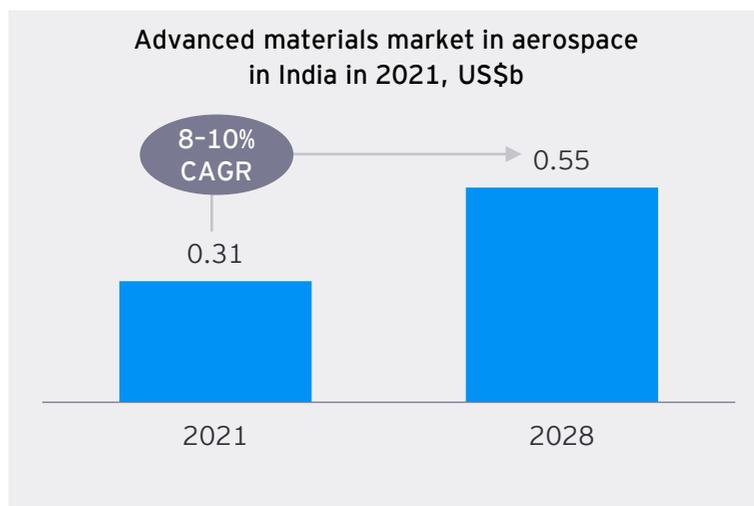
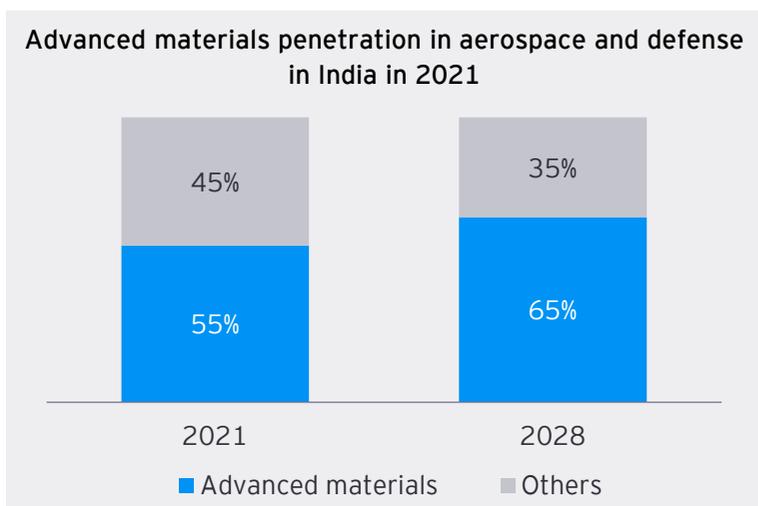
Industry trend	Impact of industry trend	Material shift	Applications
Decarbonization	<ul style="list-style-type: none"> ▶ Shift to clean energy sources such as renewables 	<ul style="list-style-type: none"> ▶ Glass composites ▶ Carbon composites 	<ul style="list-style-type: none"> ▶ Wind turbines ▶ Wind bladed ▶ Nacelles
Decentralization	<ul style="list-style-type: none"> ▶ Power generated locally through distributed resources such as rooftop solar panels 	<ul style="list-style-type: none"> ▶ Silicon 	<ul style="list-style-type: none"> ▶ Photovoltaic cells ▶ Batteries ▶ Smart grids
Energy storage	<ul style="list-style-type: none"> ▶ Growing demand for energy storage solutions, such as batteries to help balance supply and demand 	<ul style="list-style-type: none"> ▶ Lithium ▶ Nickel 	<ul style="list-style-type: none"> ▶ Electrode ▶ Electrolyte

Source: Startus insights, BHP, Carbon trust, EY- Research and Analysis



In the aerospace and defense sector, drones and hypersonic aircraft are driving use of high-performance alloys and piezoelectric materials

This industry has long used advanced materials, such as performance alloys and composites, but adoption is increasing due to increased demands for hypersonic capabilities and light weighting. With drones becoming an integral part of global defense strategies, the demand for smart materials is increasing.



*A&D penetration based on aerospace and defense vehicles
 Source: Copyright JEC Group: JEC Observer - February 2022, CSIR-NAL, EY- Research and Analysis

Source: CMR DRHP, Midhani RHP, MOCI- Export Import Data Bank, EY- Research and Analysis

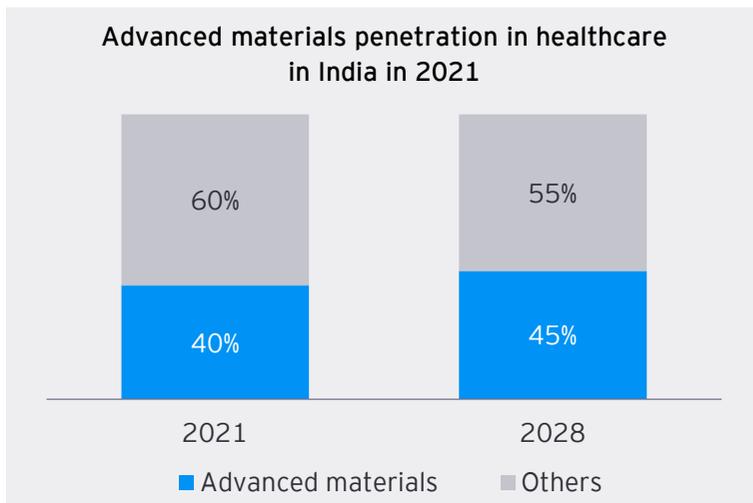
Industry trend	Impact of industry trend	Material shift	Applications
Light weighting and net zero aircrafts	<ul style="list-style-type: none"> ▶ Changed designs for weight reduction and better fuel efficiency 	<ul style="list-style-type: none"> ▶ Carbon composites 	<ul style="list-style-type: none"> ▶ Panels ▶ Tail parts
Hypersonic weapons and aircrafts	<ul style="list-style-type: none"> ▶ Use of materials that can withstand extreme temperature and high speed 	<ul style="list-style-type: none"> ▶ Super alloys ▶ Titanium alloys 	<ul style="list-style-type: none"> ▶ Engine components ▶ Structural components
Autonomous aircrafts and drones	<ul style="list-style-type: none"> ▶ Rising demand of electronic components and smart materials 	<ul style="list-style-type: none"> ▶ Shape memory alloys ▶ Piezoelectric materials (PVDF) 	<ul style="list-style-type: none"> ▶ Active control components ▶ Electronic sensors

Source: Ansys, Prescouter, ICAO, BBVA, EY- Research and Analysis

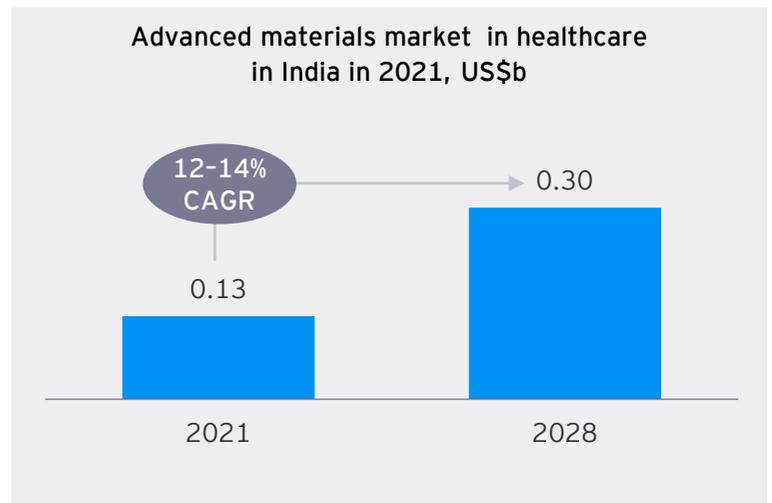


Healthcare, which is witnessing a breakthrough in implants and prosthetics, is increasing their use of ceramics and nanomaterials

Biocompatibility requirements are expected to drive the demand for titanium and biomaterials. There has also been a rise in consumer preference for ceramic implants such as aluminum dioxide, zirconia, and calcium phosphate, which account for a sizable share of this market.



*Healthcare penetration based on medical implants market
Source: Emerginova, NS Medical devices, EY- Research and Analysis



Source: Ministry of Textiles -India, RIS, Midhani- RHP, EY- Research and Analysis

Industry trend	Impact of industry trend	Material shift	Applications
3D printing and bionic limbs	<ul style="list-style-type: none"> Increased customization for patients need with higher speed efficiency 	<ul style="list-style-type: none"> ABS Ultem Biomaterials Titanium 	<ul style="list-style-type: none"> Prosthetic limb Replacement tissue
Smart prosthetics	<ul style="list-style-type: none"> Higher case of connected technology with biocompatible materials 	<ul style="list-style-type: none"> Titanium Ceramics Silicon 	<ul style="list-style-type: none"> Implantable sensors Spinal screws
Nanotechnology	<ul style="list-style-type: none"> Impetus on R&D in the material space to create devices which are more biocompatible and functional 	<ul style="list-style-type: none"> Carbon nanotubes Silica nanoparticles NHA¹ 	<ul style="list-style-type: none"> Prosthetic limbs Implants and scaffolds Biosensors

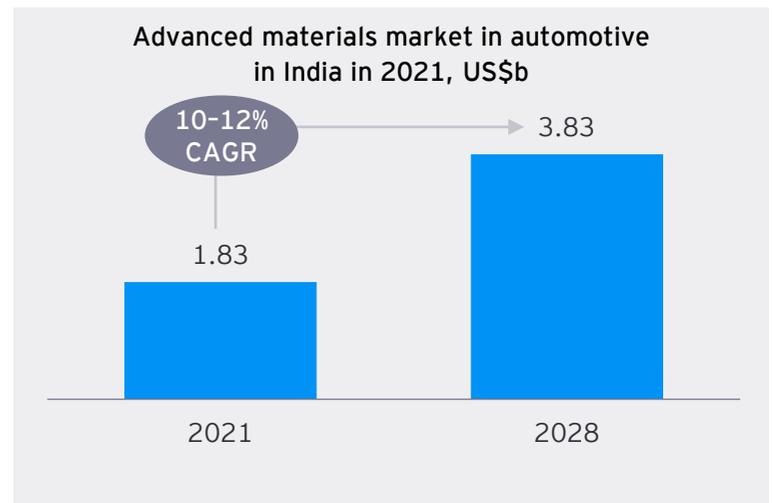
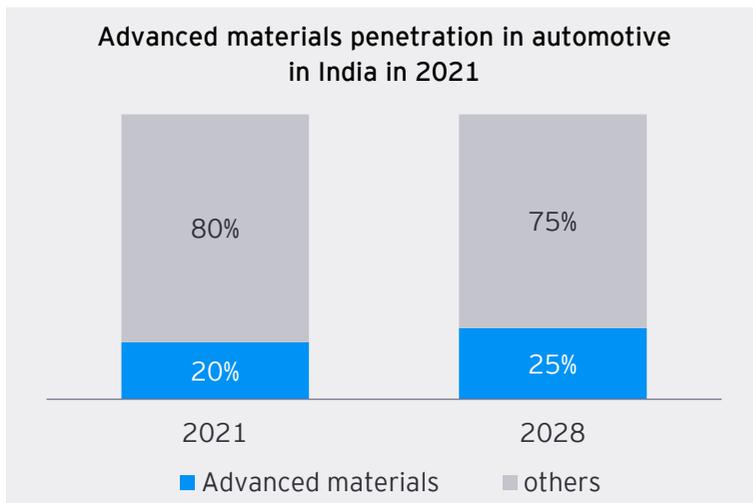
Source: Ansys, Prescouter, ICAO, BBVA, EY- Research and Analysis

¹ NHA: Nano-hydroxyapatite



Automotive segment driven by light-weighting and electric vehicles is increasing its use of thermosets and thermoplastics

The automotive industry is also seeing a surge in demand for advanced materials due to the need for light weighting to meet higher fuel efficiency norms and extending battery range. Glass and carbon composites along with aluminum alloys are witnessing increasing demand for automotive component and body manufacturing.



*A&T penetration based on automotive segment

Source: Copyright JEC Group: JEC Observer- February 2022, EY- Research and Analysis

Source: CMR DRHP, ICERP India, EY- Research and Analysis

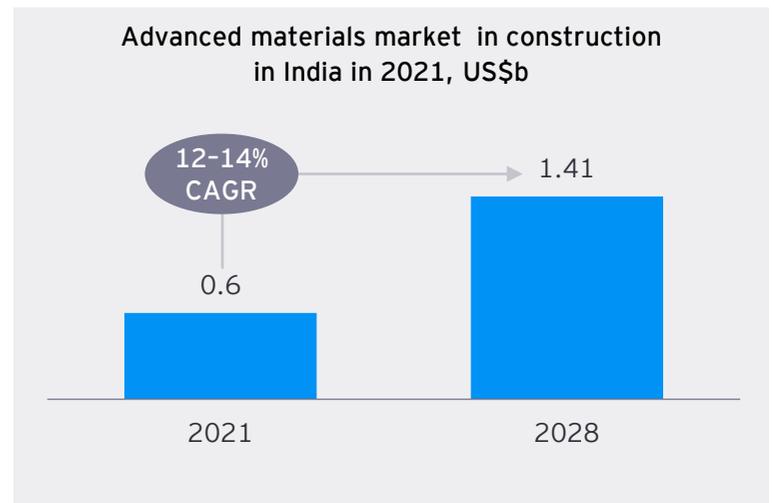
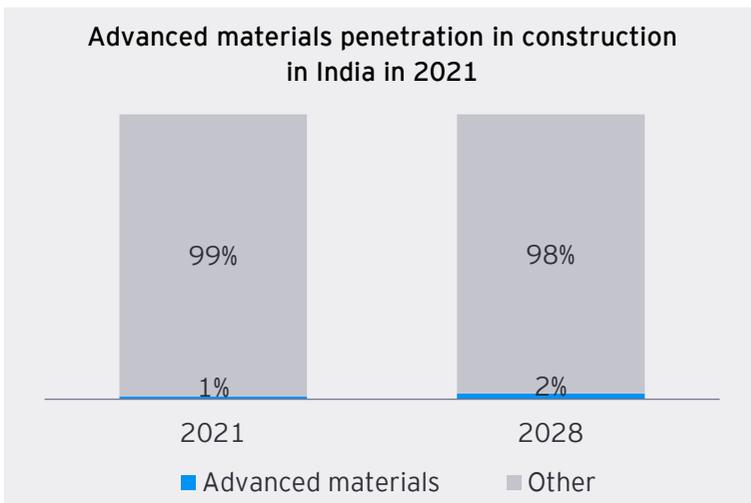
Industry trend	Impact of industry trend	Material shift	Applications
Light weighting and fuel efficiency increase	<ul style="list-style-type: none"> ▶ Lighter materials being preferred over traditional materials like steel 	<ul style="list-style-type: none"> ▶ Engineering plastics (ABS,PBT) ▶ Thermosets (Glass and carbon composites) 	<ul style="list-style-type: none"> ▶ Body panels ▶ CNG cylinders
Decarbonization and electrification	<ul style="list-style-type: none"> ▶ Rising demand for batteries for BEV and cylinders for FCEV 	<ul style="list-style-type: none"> ▶ Thermosets (Glass and carbon composite) ▶ Lithium 	<ul style="list-style-type: none"> ▶ EV Batteries ▶ Battery casing ▶ Body panels ▶ Hydrogen cylinders
Autonomous vehicles and connected mobility	<ul style="list-style-type: none"> ▶ Increasing use of electronic components such as sensors 	<ul style="list-style-type: none"> ▶ Silicon ▶ Nickel 	<ul style="list-style-type: none"> ▶ Temperature and pressure sensors ▶ Magnetic and speed sensors

Source: Startups insights, Financial express, Autotrends. EY- Research and Analysis



Lastly, within the building and construction sector, composites are emerging as strong alternatives driven by sustainability and smart cities

Because of its large end use market and low penetration, the building and construction sector has one of the highest potentials for advanced materials. With the rise of modular construction, a greater emphasis on sustainability, and a government emphasis on quality standards, green and lightweight substitute materials will triumph in the long run.



*Construction penetration based on replacement of steel and concrete
 Source: Copyright JEC Group: JEC Observer- February 2022 , EY- Research and Analysis

Source: ICERP India, EY- Research and Analysis

Industry trend	Impact of industry trend	Material shift	Applications
Prefabrication and modular construction	<ul style="list-style-type: none"> Rising demand for lightweight materials 	<ul style="list-style-type: none"> Wood composites Glass composites 	<ul style="list-style-type: none"> Walls Structural components Facades
Sustainability and green building	<ul style="list-style-type: none"> Use of materials which have lower carbon emissions 	<ul style="list-style-type: none"> Green concrete Glass composites 	<ul style="list-style-type: none"> Rebars Structural components Window panels
Smart building and smart cities	<ul style="list-style-type: none"> Construction designs that promote compactness, connectivity benefits, varied environments 	<ul style="list-style-type: none"> Glass composites Carbon composites 	<ul style="list-style-type: none"> Metro tunnels Swimming pools Structural strengthening

Source: Construct connect, Startus insights, Revolutionized, EY- Research and Analysis

Manufacturers in India have closely monitored material trends to ensure they do not miss out on new opportunities, have sustainable revenue growth and protect margins

Materials used in product manufacturing have a direct impact on manufacturers' revenue and margins across industries. Aligning to customer preferences, such as improved performance and lighter weight, will assist manufacturers in creating product differentiation, which will not only drive market share but also give them pricing power.

Examples of companies / government authorities adopting advanced materials across some key sectors

Industry	Company/ government authorities	Material	Use case
 Energy	Suzlon Wind	Glass and carbon fiber composites	▶ Introducing advanced materials such as carbon fiber in the next-generation turbines to make blades stronger and lighter
	TPI Composites	Glass and carbon fiber composites	▶ Manufacturing wind blades with glass, carbon and other advanced composites for optimized performance to meet customer preferences
 Aerospace	Hindustan Aeronautics Limited	Carbon fiber composites	▶ Aerospace composite division manufactures composite parts and composite structural assemblies
	Tata Advance System	Carbon fiber composites and super alloys	▶ Advanced composite floor beams, tail cone, wing spars, ailerons, control surfaces and panels ▶ Complex parts on aero-engines; Components such as high pressure turbines, compressor casings and compressor extension case
 Medical	Pivot implants	Titanium implants	▶ Using titanium alloys for dental usage in Prosthetic Solutions, Dental implants, etc.
	Ceramet (Tata Steel)	Advanced ceramics	▶ Producing Hydroxyapatite – a calcium phosphate-based ceramic, which can be used as a bone replacement
 Automotive	Mahindra and Mahindra	Glass fiber composites	▶ Uses thermoplastic composites for components such as tailgates and boot lids for passenger vehicles
	Tata Motors	Reinforced plastics and composites	▶ Uses thermoset composites for tempo, LCV, tractor components such as front panel, bumpers, fender among others
 Construction	DMRC	Glass composites	▶ Glass FRP Rebar (for Soft Eye and Structural Reinforcements) under Delhi Metro Rail Projects
	NHAI	Glass composites	▶ Usage of Glass FRP rebars for flatworks of roads in national highway projects ¹

Sustainability issues with traditional materials present manufacturers with an opportunity to innovate and disrupt markets. This will also assist them protect margins in a post-COVID-19 world of disrupted supply chains and re-aligned government priorities.

¹ Ministry of Road Transport & Highways issued circular on 'Value Engineering Practices for the Design, construction & Maintenance of National Highways Projects' for 'Use of Glass/ Carbon/ Aramid Fiber Reinforced Polymer Rebar for non-load bearing structures (like Crash barrier, Drain and minor CD structures like Hume pipe culvert and box culvert)'

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EYIN2303-006

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