

Global Graphene Market Outlook to 2027

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Abstracts

Graphene is a two-dimensional atomic-scale material made of a single layer of carbon atoms. Graphene has incredible mechanical, electronic, chemical, magnetic, and optical properties, which makes graphene material a severe alternative to replace conventional materials such as silicon and copper for different applications. Graphene has extensive applications in microelectronics such as LED lighting and mobile devices, energy storage such as batteries and supercapacitors, anti-corrosion coatings and paints, solar panels, and drug delivery, among others. According to BlueQuark Research & Consulting, the global Graphene market is expected to witness a rapid growth rate during the forecast period. The major factors responsible for the growth of the global graphene market are, increasing demand for lightweight, flexible and strong material with a long life span, increase in graphene applications, and increasing research and development. Currently, there are around 200 players in the global market who produce graphene at commercial levels. Apart from these, there are several start-ups or small-scale producers aiming to reach the commercial level of graphene production in the coming years.

Graphene is a promising material that can revolutionize everything, from computing to car tires and solar cells to smoke detectors. Graphene is an incredibly diverse material and can be combined with other elements, both gases, and metals to produce different materials with various superior properties. Graphene and sensors form a natural combination due to the large surface-to-volume ratio of graphene. Sensors are used in a vast range of applications in day-to-day life and are usually made up of silicon. Given recent ongoing research, graphene is emerging as an ideal material for sensors due to its excellent sensing ability. Every atom in graphene, when exposed to the environment, can sense changes in its surroundings, and this ability has led to the incorporation of graphene in different types of sensors such as gas sensors, biosensors, temperature sensors, and many more. Graphene's ultra-thin flexible biosensors can be integrated into packages as data carriers for producers, retailers, and consumers. Due to an

increase in globalization, the movement and shelf life of food products has been increased manifolds. To assure food safety and quality, the food supply chain requires new approaches and systems for smart packaging. Graphene smart food packaging has the ability to detect atmospheric changes caused by decaying food, and it can dramatically cut down on unnecessary food wastage and simultaneously help prevent illnesses. Graphene sensors can also be smaller, lighter, and less expensive than traditional sensors. In October 2019, Tetra Pak, a research and development company in the packaging sector, joined the European Commission Graphene Flagship project as the exclusive representative from the packaging industry to explore possible future applications of graphene in food and beverage manufacturing.

Graphene shows vast possibilities in medicine, such as in medical devices, drug delivery, and DNA sequencing, among the top few. Most of the graphene technological patents in biomedical research are in the field of cancer due to the worldwide increase of cancer prevalence and mortality. According to the World Health Organization (WHO), cancer is the second leading cause of death globally and was responsible for an estimated 9.6 million deaths in 2018. Most of the present cancer treatment kills healthy cells together with affected cells which can be avoided with targeted drug delivery with graphene. Graphene offers promising potential to be used as a drug delivery agent in cancer treatment due to its 2D structure and high specific surface area. The Centre for Organelle Research (CORE), Germany, is carrying out a research project to investigate the use of graphene as a drug carrier for the treatment of cancer, using cell models from leukemia and colorectal cancer. Intensive research has also shown that medical devices built with a layered graphene casing show antibacterial properties. This, in turn, is boosting the investigation of graphene as an antibacterial protective surface after surgical implants.

In June 2020, researchers at the Massachusetts Institute of Technology developed a new roll-to-roll production process for large sheets of high-quality graphene. This process could lead to flexible solar cells, ultra-lightweight, and to new classes of light-emitting devices and other thin-film electronics. In June 2020, researchers from the University of Houston and Texas A&M University reported a structural supercapacitor electrode made of reduced graphene oxide and aramid nanofiber that is reportedly stronger and more versatile than regular carbon-based electrodes. In 2020, the world's first-ever graphene-applied lead-acid battery is set to come into mass production in Sri Lanka with the commissioning of Ceylon Graphene Technologies' (CGT) latest plant to convert locally mined vein graphite into graphene. CGT is a joint venture between Sri Lanka Institute of Nanotechnology (SLINTEC) and LOLC Group. CGT is expecting to commission the plant in April. Grapheal SAS, France, has developed a new generation

of dressings by integrating an embedded electronic biosensor. The Grapheal device consists of monolayer graphene on a polymer layer that is 0.3 nanometers thick. This noninvasive embedded device collects data from the wound and the wireless e-health wound monitoring system, or smart patch, remotely reports the status of chronic wounds to the care team.

The global graphene market is segmented based on type, and application. The type segment is further segmented as Graphene Oxide, Graphene Nanosheets, and others. The application segment is further segmented as Composites, Paints & Coatings, Electronics, Energy Storage, Lubricants, and others. In electronics, Graphene has very swiftly moved from research laboratories to the marketplace. It is due to the remarkable electronic properties of Graphene, with an extraordinarily high charge carrier mobility and conductivity. Graphene has a wide variety of applications in the electronics industry that are expected to replace silicon and copper, the most widely used elements in electronics, in the near future.

Graphene is expected to be an integral part of the phone and tablet industry in the coming years in the form of highly advanced touch screens and batteries. The last decade has seen a great evolution in smartphones' functionality and applications and has made them an integral part of daily life. The number of smartphone users is increasing at a rapid pace globally, and according to a recent global study, the estimated number of total smartphone users is expected to reach nearly 3 billion in 2020. While chips and operating systems in smartphones are becoming more efficient each year to save power, the batteries have not advanced in a very long time. To make use of all the features present in smartphones, there is a requirement for longer battery life and fast charging. Research has shown that graphene batteries in the phone can improve energy storage and speed up charging significantly. Samsung, one of the primary key players in the smartphone market, is a leading graphene technology developer. The company is planning to launch a graphene battery smartphone in the year 2021, a Graphene-based touch screen foldable phone by the end of 2025. The graphene battery will be able to charge in less than half an hour fully, and the phone will be able to reduce to a quarter of its original size after folding. Graphene-based headphones are already in the market with better frequency response compared to other pairs of commercial headphones available.

On the basis of geography, the global graphene market is segmented into North America, Europe, Asia-Pacific, South America, and Middle East & Africa. Asia-Pacific and North American regions are expected to continue to dominate the market in the forecast period. The United States and China are expected to maintain their dominance

in terms of both production and consumption of graphene during the forecast period.

Europe is expected to be the most dominant region due to significant investments by the government in the research and development of graphene and related technology. The United Kingdom is a highly developed nation in the European region and invests a large sum of money for research and development. The UK government has put research and innovation at the heart of its industrial strategy by setting an ambition to become the most innovative country in the world and increase its total R&D expenditure to 2.4% of total GDP by 2027. In 2018, Research England's UK Research Partnership Investment Fund (UKRPIF) funded the GBP 60 million Graphene Engineering Innovation Centre (GEIC) at the University of Manchester. The center will see industry-led development in graphene applications in partnership with academics. The UK has always been a global leader in research on graphene since it was isolated at the University of Manchester in 2004 and is funding several research institutes and organizations for graphene research and innovation.

UK's world-leading position in graphene and related 2-D materials research is maintained by continuous innovations in the field. For instance, researchers from the University of Manchester at the National Graphene Institute demonstrated the first all inkjet-printed graphene e-textiles in 2017. Similarly, researchers at Exeter University are developing a pioneering technique that enables graphene fibers to be woven into clothing to create smart textiles. Smart textiles have the potential to be used in a wide variety of healthcare monitoring applications. The presence of strong research and development capabilities is expected to develop new growth opportunities in the country over the years to come. Graphene finds a significant role in advanced electronics such as smartphones, which makes the UK an ideal place for new product launches. The country comes in the top 10 smartphone users in the world, with around 94% of the total population of the country having a smartphone. Samsung is the second-largest brand in the country and the first in the world for graphene research and development. Graphene-based innovations launched by smartphone companies in the future will hold a substantial marketplace in the country.

Furthermore, in recent years the UK is shifting towards a renewable source of energy such as wind farms, which is the most potent source of renewable energy for the country and supplies 20% of the total electricity. Graphene has shown anticorrosive properties that can prevent oxidation and rusting of metal blades. Adding graphene to the epoxy composite materials increases the strength of the wind blades to a large magnitude as the two-dimensional structure of graphene sheets is superior in deflecting cracks. Ahead of a 2025 ban on coal plants, the country will become more dependent

on renewable energy sources, which in turn will lead to the growth of graphene coating commercially. Together with ongoing research in the field, there is a launch of the graphene product in the market as well. In 2017, Graphene paint came to the UK market that improves the thermal regulation of buildings, saving energy by requiring less heating and air conditioning. Moreover, the government is also trying new applications of graphene in the country. In November 2019, an Oxfordshire village hosted the first UK trial of a graphene-based wonder material designed to prevent cracks from forming. The surfacing product combines graphene with recycled asphalt and is less likely to soften in the heat or harden and crack up in colder temperatures.

Some of the key players in the market are Global Graphene Group, XG Science, Inc., Applied Graphene Materials Plc, The Sixth Element (Changzhou) Materials Technology Co., Ltd., and Perpetuus Advanced Materials Plc, among others. The companies in the market are focusing on increasing the overall production capacity to meet the growing demand for graphene.

In Jun 2020, Applied Graphene has signed an exclusive distribution agreement with Dichem Polymers that will give it access to the polymers and coatings markets in Greece.

In Apr 2020, Graphene Flagship partners CIC nanoGUNE and Graphenea, together with start-up accelerator BerriUP, launched a new funding programme to foster the creation of graphene-related businesses.

In January 2020, the US Real Graphene company announced that they are preparing to enter the market with graphene-enhanced batteries. The batteries produced by Real Graphene company are expected to be the evolution of the lithium batteries used in smartphones currently.

In January 2020, Graphene 3D Lab Inc. announced that on January 23, 2020, the Company will be changing its name to G6 Materials Corp. The Company has already developed graphene additives for laminated carbon fiber and fiberglass composites.

Our Global Graphene Market research report provides deep insight into the current and future state of the Graphene Market across various regions. The study comprehensively analyzes the Graphene Market by segments based on Type (Graphene Oxide, Graphene Nanosheets, and Others), Application (Composites, Paints & Coatings, Electronics, Energy Storage, Lubricants, and Others), and by Geography (Asia Pacific, North America, Europe, South America, and Middle-East and Africa). The report

examines the market drivers and restraints, along with the impact of Covid-19 are influencing the market growth in detail. The study covers & includes emerging market trends, market developments, market opportunities, market analysis, market dynamics, global graphene market size, and challenges in the industry. This report also covers extensively researched competitive landscape sections with profiles of major companies including their market share and projects.

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Graphene - Market Share of Key Companies in 2020

Smartphone usage trend

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