

The Global Graphene Market Report 2023

https://marketpublishers.com/r/GCEB13425B43EN.html

Date: June 2023

Pages: 760

Price: US\$ 1,000.00 (Single User License)

ID: GCEB13425B43EN

Abstracts

The market for graphene has grown hugely in the past decade, with numerous products now on the market and more to come as graphene producers record steadily increasing revenues and OEMs witnessing significant returns in clothing, sportswear, footwear, tires, batteries etc. The market for graphene in batteries is seeing large-scale investments and several producers have increased capacities or have plans to.

Graphene is attracting increasing attention from investors, researchers and industrial players due to exceptional mechanical, electronic, and thermal properties. Graphene is available in multi-ton quantities from many producers and has been identified by many industry sectors as a key materials that will drive future product development in flexible electronics, smart textiles, biosensors, drug delivery, water filtration, supercapacitors and more.

The Global Graphene Market Report 2023 is the most comprehensive and up-to date report on graphene and 2D materials currently available, from the world's leading market authority on graphene and publisher of Graphene Magazine. Profiling over 350 companies, the report provides key information for investors and executives to enable them to understand and take advantage of the opportunities provided by graphene and 2D materials.

The Global Graphene Market Report 2023 contains:

Assessment of graphene by market including applications, key benefits, market megatrends, market drivers for graphene, technology drawbacks, competing materials, potential consumption of graphene to 2033 and main players.

Assessment of graphene materials (CVD graphene, graphene nano platelets, graphene oxide, etc), intermediate products (graphene masterbatches,



dispersions, etc) and final products with graphene embedded (e.g. headphones, tennis racquets, etc). Tabular data on current graphene products.

Graphical depictions of graphene applications by market.

In depth-assessment of graphene producer and distributor pricing in 2023.

Global market for graphene in tons, by sector, historical and forecast to 2033. Global graphene market size split by market in 2022 and for each application to 2033.

Full list of technology collaborations, strategic partnerships, and M&As in the global graphene market including collaboration dates.

Applications roadmap, by market.

In-depth profiles of more than 365 graphene and 2D materials producers and application/product developers including products, production capacities, manufacturing methods, collaborations, TRL, licensing, customers and target markets. Companies profiled include Anaphite, Black Swan Graphene, Carbon Rivers, Directa Plus, Evove, G6 Materials Corporation, General Graphene Corporation, Gerdau Graphene, Graphene Manufacturing Group, Graphenest, Haydale, HydroGraph Clean Power, Ionic Industries, LayerOne, Lyten, NanoXplore Inc., SoundCell, Sparc Technologies, Universal Matter GBR Ltd and Versarien.

List of ex-graphene producers.

Detailed forecasts for key growth areas, opportunities and demand.

Market overview of industry developments in 2020-23.

Unique market assessment tools to assess the viability of graphene, by market, and application.

Market assessment of other 2D materials.

Analysis of 2D materials market including Boron Nitride nanotubes (BNNTs), hexagonal boron-nitride (BNNS), transition metal dichalcogenides (TMDC),



Mxenes, Borophene, Phosphorene, Graphitic carbon nitride, Germanene, Graphyne, graphane, Rhenium disulfide (ReS2) and diselenide (ReSe2), silicene, Stanene/tinene, Tungsten diselenide, Antimonene, diamene and indium selenide.



Contents

1 EXECUTIVE SUMMARY

- 1.1 Graphene and other 2D materials
- 1.2 Commercialization
- 1.3 The graphene market in 2023
- 1.4 Graphene market developments 2020-June 2023
- 1.5 Graphene funding and investments 2020-2023
- 1.6 Publicly listed graphene companies
- 1.7 Graphene global production capacities, in tons and by type
- 1.8 Global demand for graphene
 - 1.8.1 Global graphene demand, to 2033, tons
 - 1.8.2 Global graphene demand, by end user market to 2033
 - 1.8.3 Graphene market, by region
 - 1.8.3.1 Asia-Pacific
 - 1.8.3.1.1 China
 - 1.8.3.1.2 Main graphene producers in Asia-Pacific
 - 1.8.3.2 North America
 - 1.8.3.2.1 Main graphene producers in North America
 - 1.8.3.3 Europe
 - 1.8.3.3.1 Main graphene producers in Europe
- 1.9 Graphene products
- 1.10 Industrial collaborations and licence agreements
- 1.11 Graphene market challenges

2 OVERVIEW OF GRAPHENE

- 2.1 History
- 2.2 Properties
- 2.3 Types of graphene
 - 2.3.1 Graphene materials
 - 2.3.1.1 CVD Graphene
 - 2.3.1.1.1 Applications
 - 2.3.1.2 Graphene nanoplatelets
 - 2.3.1.3 Graphene oxide and reduced Graphene Oxide
 - 2.3.1.4 Graphene quantum dots (GQDs)
 - 2.3.1.4.1 Composition
 - 2.3.1.4.2 Comparison to quantum dots



- 2.3.1.4.3 Properties
- 2.3.1.4.4 Synthesis
 - 2.3.1.4.4.1 Top-down method
 - 2.3.1.4.4.2 Bottom-up method
 - 2.3.1.4.4.3 Comparison of synthesis methods
- 2.3.1.4.5 Applications
- 2.3.1.4.6 Markets for graphene quantum dots
 - 2.3.1.4.6.1 Electronics and photonics
 - 2.3.1.4.6.2 Energy storage and conversion
 - 2.3.1.4.6.3 Sensors
 - 2.3.1.4.6.4 Biomedicine and life sciences
 - 2.3.1.4.6.5 Anti-counterfeiting
- 2.3.1.4.7 Challenges
- 2.3.1.4.8 Current and projected revenues
- 2.3.1.4.9 Pricing
- 2.3.1.4.10 Companies 102 (14 company profiles)
- 2.3.2 Intermediate products
 - 2.3.2.1 Graphene masterbatches
 - 2.3.2.2 Graphene dispersions
- 2.4 Graphene production
 - 2.4.1 Quality
 - 2.4.2 Assessment of graphene production methods
- 2.5 Regulations
 - 2.5.1 Environmental, health and safety regulation
 - 2.5.1.1 Europe
 - 2.5.1.2 United States
 - 2.5.1.3 Asia-Pacific
 - 2.5.2 Workplace exposure

3 GRAPHENE PATENTS AND PUBLICATIONS

4 GRAPHENE PRODUCTION AND PRICING

- 4.1 Commercial production capacities
- 4.2 Graphene oxide and reduced Graphene Oxide production capacities
 - 4.2.1 By producer
- 4.3 Graphene nanoplatelets production capacities
 - 4.3.1 By producer
- 4.4 CVD graphene film



- 4.4.1 By producer
- 4.5 Graphene production issues and challenges
 - 4.5.1 Oversupply
 - 4.5.2 Quality
 - 4.5.3 Large-volume markets
 - 4.5.4 Commoditisation
 - 4.5.5 Industrial end-user perspective
- 4.6 Graphene pricing 2023
 - 4.6.1 Pristine graphene flakes pricing/CVD graphene
 - 4.6.2 Few-Layer graphene pricing
 - 4.6.3 Graphene nanoplatelets pricing
 - 4.6.4 Graphene oxide (GO) and reduced Graphene Oxide (rGO) pricing
 - 4.6.5 Multilayer graphene (MLG) pricing
 - 4.6.6 Graphene ink
- 4.7 Graphene market players

5 MARKETS FOR GRAPHENE

- 5.1 ENERGY STORAGE: BATTERIES
 - 5.1.1 Technology overview
 - 5.1.2 Battery market megatrends
 - 5.1.2.1 Electrification of transport
 - 5.1.2.2 Reducing dependence on lithium and other materials (e.g. cobalt).
 - 5.1.2.3 New advanced battery materials
 - 5.1.2.4 Development of next-generation flexible electronics
 - 5.1.2.5 Reduced battery costs
 - 5.1.2.6 Increasing demand for green energy
 - 5.1.3 Market overview
 - 5.1.3.1 Market drivers and trends
 - 5.1.3.2 Applications
 - 5.1.3.2.1 Applications roadmap to 2033
 - 5.1.3.3 Global market in tons, historical and forecast to 2033
 - 5.1.4 Product developers
- 5.2 ENERGY STORAGE: SUPERCAPACITORS
 - 5.2.1 Technology overview
 - 5.2.2 Market overview
 - 5.2.2.1 Applications
 - 5.2.2.1.1 Applications roadmap to 2033
 - 5.2.2.2 Global market in tons, historical and forecast to 2031



5.2.3 Product developers

5.3 POLYMER COMPOSITES

- 5.3.1 Technology overview
- 5.3.2 Applications
 - 5.3.2.1 Applications roadmap to 2033
- 5.3.3 Fiber-based polymer composite parts
 - 5.3.3.1 Applications
- 5.3.4 Metal-matrix composites
 - 5.3.4.1 Applications
- 5.3.5 Global market in tons, historical and forecast to 2033
- 5.3.6 Product developers

5.4 SENSORS

- 5.4.1 Technology overview
- 5.4.2 Market overview
 - 5.4.2.1 Applications
 - 5.4.2.1.1 Applications roadmap to 2033
 - 5.4.2.2 Global market in tons, historical and forecast to 2031
- 5.4.3 Product developers

5.5 CONDUCTIVE INKS

- 5.5.1 Technology overview
- 5.5.2 Market overview
 - 5.5.2.1 Applications
 - 5.5.2.1.1 Applications roadmap to 2033
 - 5.5.2.2 Global market in tons, historical and forecast to 2033
- 5.5.3 Product developers

5.6 TRANSPARENT CONDUCTIVE FILMS AND DISPLAYS

- 5.6.1 Technology overview
- 5.6.2 Market outlook
 - 5.6.2.1 Applications
 - 5.6.2.1.1 Applications roadmap to 2033
 - 5.6.2.2 Global market, historical and forecast to 2033
- 5.6.3 Product developers

5.7 TRANSISTORS

- 5.7.1 Technology overview
- 5.7.2 Market overview
 - 5.7.2.1 Applications
 - 5.7.2.1.1 Applications roadmap to 2033
 - 5.7.2.2 Global market, historical and forecast to 2033
- 5.7.3 Product developers



5.8 FILTRATION MEMBRANES

- 5.8.1 Technology overview
- 5.8.2 Market overview
 - 5.8.2.1 Applications
 - 5.8.2.1.1 Applications roadmap to 2033
 - 5.8.2.2 Global market in tons, historical and forecast to 2033
- 5.8.3 Product developers

5.9 ADDITIVE MANUFACTURING

- 5.9.1 Technology overview
- 5.9.2 Market overview
- 5.9.2.1 Applications
 - 5.9.2.1.1 Applications roadmap to 2033
- 5.9.2.2 Global market in tons, historical and forecast to 2033
- 5.9.3 Product developers
- 5.10 ADHESIVES
 - 5.10.1 Technology overview
 - 5.10.2 Market overview
 - 5.10.2.1 Applications
 - 5.10.2.1.1 Applications roadmap to 2033
 - 5.10.2.2 Global market in tons, historical and forecast to 2033
 - 5.10.3 Product developers
- 5.11 AEROSPACE
 - 5.11.1 Technology overview
 - 5.11.2 Market overview
 - 5.11.2.1 Applications
 - 5.11.2.1.1 Applications roadmap to 2033
 - 5.11.2.2 Global market in tons, historical and forecast to 2033
 - 5.11.3 Product developers
- 5.12 AUTOMOTIVE
 - 5.12.1 Technology overview
 - 5.12.2 Market overview
 - 5.12.2.1 Applications
 - 5.12.2.1.1 Applications roadmap to 2033
 - 5.12.2.2 Global market in tons, historical and forecast to 2033
 - 5.12.3 Product developers
- 5.13 CONSTRUCTION AND BUILDINGS
 - 5.13.1 Technology overview
 - 5.13.2 Market overview
 - 5.13.2.1 Applications



- 5.13.2.1.1 Cement
- 5.13.2.1.2 Asphalt bitumen
- 5.13.2.1.3 Aerogels
 - 5.13.2.1.3.1 3D printed aerogels
 - 5.13.2.1.3.2 Carbon-based aerogel composites
- 5.13.2.1.4 Applications roadmap to 2033
- 5.13.2.2 Global market in tons, historical and forecast to 2033
- 5.13.3 Product developers
- 5.14 MEMORY DEVICES
 - 5.14.1 Technology overview
 - 5.14.2 Market overview
 - 5.14.2.1 Applications
 - 5.14.2.1.1 Applications roadmap to 2033
 - 5.14.2.2 Global market in tons, historical and forecast to 2033
 - 5.14.3 Product developers
- 5.15 FUEL CELLS
 - 5.15.1 Technology overview
 - 5.15.2 Market overview
 - 5.15.2.1 Applications
 - 5.15.2.1.1 Applications roadmap to 2033
 - 5.15.2.2 Global market in tons, historical and forecast to 2033
 - 5.15.3 Product developers
- 5.16 BIOMEDICINE AND HEALTHCARE
 - 5.16.1 Technology overview
 - 5.16.2 Market overview
 - 5.16.2.1 Applications
 - 5.16.2.1.1 Applications roadmap to 2033
 - 5.16.2.2 Drug delivery
 - 5.16.2.3 Imaging and diagnostics
 - 5.16.2.4 Implants
 - 5.16.2.5 Medical biosensors
 - 5.16.2.6 Woundcare
 - 5.16.2.7 Medical wearables
 - 5.16.2.8 Gene delivery
 - 5.16.2.9 Global market in tons, historical and forecast to 2033
 - 5.16.3 Product developers
- 5.17 LIGHTING
 - 5.17.1 Technology overview
 - 5.17.2 Market overview



- 5.17.2.1 Applications
 - 5.17.2.1.1 Applications roadmap to 2033
- 5.17.2.2 Global market in tons, historical and forecast to 2033
- 5.17.3 Product developers
- 5.18 LUBRICANTS
 - 5.18.1 Technology overview
 - 5.18.2 Market overview
 - 5.18.2.1 Applications
 - 5.18.2.2 Global market in tons, historical and forecast to 2033
 - 5.18.3 Product developers
- 5.19 OIL AND GAS
 - 5.19.1 Technology overview
 - 5.19.2 Market overview
 - 5.19.2.1 Applications
 - 5.19.2.1.1 Applications roadmap to 2033
 - 5.19.2.2 Global market in tons, historical and forecast to 2033
 - 5.19.3 Product developers
- 5.20 PAINTS AND COATINGS
 - 5.20.1 Technology overview
 - 5.20.2 Market overview
 - 5.20.2.1 Applications
 - 5.20.2.1.1 Applications roadmap to 2033
 - 5.20.2.2 Global market in tons, historical and forecast to 2031
 - 5.20.3 Product developers
- 5.21 PHOTONICS
 - 5.21.1 Technology overview
 - 5.21.2 Market overview
 - 5.21.2.1 Applications
 - 5.21.2.1.1 Applications roadmap to 2033
 - 5.21.2.2 Global market in tons, historical and forecast to 2031
 - 5.21.3 Product developers
- 5.22 PHOTOVOLTAICS
 - 5.22.1 Technology overview
 - 5.22.2 Market overview
 - 5.22.2.1 Applications
 - 5.22.2.1.1 Applications roadmap to 2033
 - 5.22.2.2 Global market in tons, historical and forecast to 2033
 - 5.22.3 Product developers
- 5.23 RUBBER AND TYRES



- 5.23.1 Technology overview
- 5.23.2 Market overview
 - 5.23.2.1 Applications
 - 5.23.2.1.1 Applications roadmap to 2033
 - 5.23.2.2 Global market in tons, historical and forecast to 2033
- 5.23.3 Product developers
- 5.24 TEXTILES AND APPAREL
 - 5.24.1 Technology overview
 - 5.24.2 Market outlook
 - 5.24.2.1 Applications
 - 5.24.2.1.1 Applications roadmap to 2033
 - 5.24.2.2 Global market in tons, historical and forecast to 2031
 - 5.24.3 Product developers
- 5.25 OTHER MARKETS
 - 5.25.1 Audio equipment
 - 5.25.2 Sporting goods and apparel

6 GRAPHENE COMPANY PROFILES 397 (350 COMPANY PROFILES)

7 GRAPHENE EX-PRODUCERS AND PRODUCT DEVELOPERS

8 OTHER 2-D MATERIALS

- 8.1 Comparative analysis of graphene and other 2D materials
- 8.2 2D MATERIALS PRODUCTION METHODS
 - 8.2.1 Top-down exfoliation
 - 8.2.1.1 Mechanical exfoliation method
 - 8.2.1.2 Liquid exfoliation method
 - 8.2.2 Bottom-up synthesis
 - 8.2.2.1 Chemical synthesis in solution
 - 8.2.2.2 Chemical vapor deposition
- 8.3 TYPES OF 2D MATERIALS
 - 8.3.1 Hexagonal boron-nitride (h-BN)/Boron nitride nanosheets (BNNSs)
 - 8.3.1.1 Properties
 - 8.3.1.2 Applications and markets
 - 8.3.1.2.1 Electronics
 - 8.3.1.2.2 Fuel cells
 - 8.3.1.2.3 Adsorbents
 - 8.3.1.2.4 Photodetectors



- 8.3.1.2.5 Textiles
- 8.3.1.2.6 Biomedical
- 8.3.2 MXenes
 - 8.3.2.1 Properties
 - 8.3.2.2 Applications
 - 8.3.2.2.1 Catalysts
 - 8.3.2.2.2 Hydrogels
 - 8.3.2.2.3 Energy storage devices
 - 8.3.2.2.3.1 Supercapacitors
 - 8.3.2.2.3.2 Batteries
 - 8.3.2.2.3.3 Gas Separation
 - 8.3.2.2.4 Liquid Separation
 - 8.3.2.2.5 Antibacterials
- 8.3.3 Transition metal dichalcogenides (TMD)
 - 8.3.3.1 Properties
 - 8.3.3.1.1 Molybdenum disulphide (MoS2)
 - 8.3.3.1.2 Tungsten ditelluride (WTe2)
 - 8.3.3.2 Applications
 - 8.3.3.2.1 Electronics
 - 8.3.3.2.2 Optoelectronics
 - 8.3.3.2.3 Biomedical
 - 8.3.3.2.4 Piezoelectrics
 - 8.3.3.2.5 Sensors
 - 8.3.3.2.6 Filtration
 - 8.3.3.2.7 Batteries and supercapacitors
 - 8.3.3.2.8 Fiber lasers
- 8.3.4 Borophene
 - 8.3.4.1 Properties
 - 8.3.4.2 Applications
 - 8.3.4.2.1 Energy storage
 - 8.3.4.2.2 Hydrogen storage
 - 8.3.4.2.3 Sensors
 - 8.3.4.2.4 Electronics
- 8.3.5 Phosphorene/ Black phosphorus
 - 8.3.5.1 Properties
 - 8.3.5.2 Applications
 - 8.3.5.2.1 Electronics
 - 8.3.5.2.2 Field effect transistors
 - 8.3.5.2.3 Thermoelectrics



- 8.3.5.2.4 Batteries
 - 8.3.5.2.4.1 Lithium-ion batteries (LIB)
 - 8.3.5.2.4.2 Sodium-ion batteries
 - 8.3.5.2.4.3 Lithium-sulfur batteries
- 8.3.5.2.5 Supercapacitors
- 8.3.5.2.6 Photodetectors
- 8.3.5.2.7 Sensors
- 8.3.6 Graphitic carbon nitride (g-C3N4)
 - 8.3.6.1 Properties
 - 8.3.6.2 C2N
 - 8.3.6.3 Applications
 - 8.3.6.3.1 Electronics
 - 8.3.6.3.2 Filtration membranes
 - 8.3.6.3.3 Photocatalysts
 - 8.3.6.3.4 Batteries
 - 8.3.6.3.5 Sensors
- 8.3.7 Germanene
 - 8.3.7.1 Properties
 - 8.3.7.2 Applications
 - 8.3.7.2.1 Electronics
 - 8.3.7.2.2 Batteries
- 8.3.8 Graphdiyne
 - 8.3.8.1 Properties
 - 8.3.8.2 Applications
 - 8.3.8.2.1 Electronics
 - 8.3.8.2.2 Batteries
 - 8.3.8.2.2.1 Lithium-ion batteries (LIB)
 - 8.3.8.2.2.2 Sodium ion batteries
 - 8.3.8.2.3 Separation membranes
 - 8.3.8.2.4 Water filtration
 - 8.3.8.2.5 Photocatalysts
 - 8.3.8.2.6 Photovoltaics
 - 8.3.8.2.7 Gas separation
- 8.3.9 Graphane
 - 8.3.9.1 Properties
 - 8.3.9.2 Applications
 - 8.3.9.2.1 Electronics
 - 8.3.9.2.2 Hydrogen storage
- 8.3.10 Rhenium disulfide (ReS2) and diselenide (ReSe2)



- 8.3.10.1 Properties
- 8.3.10.2 Applications
- 8.3.11 Silicene
 - 8.3.11.1 Properties
 - 8.3.11.2 Applications
 - 8.3.11.2.1 Electronics
 - 8.3.11.2.2 Thermoelectrics
 - 8.3.11.2.3 Batteries
 - 8.3.11.2.4 Sensors
 - 8.3.11.2.5 Biomedical
- 8.3.12 Stanene/tinene
 - 8.3.12.1 Properties
 - 8.3.12.2 Applications
 - 8.3.12.2.1 Electronics
- 8.3.13 Antimonene
 - 8.3.13.1 Properties
 - 8.3.13.2 Applications
- 8.3.14 Indium selenide
 - 8.3.14.1 Properties
 - 8.3.14.2 Applications
 - 8.3.14.2.1 Electronics
- 8.3.15 Layered double hydroxides (LDH)
 - 8.3.15.1 Properties
 - 8.3.15.2 Applications
 - 8.3.15.2.1 Adsorbents
 - 8.3.15.2.2 Catalyst
 - 8.3.15.2.3 Sensors
 - 8.3.15.2.4 Electrodes
 - 8.3.15.2.5 Flame Retardants
 - 8.3.15.2.6 Biosensors
 - 8.3.15.2.7 Tissue engineering
 - 8.3.15.2.8 Anti-Microbials
 - 8.3.15.2.9 Drug Delivery
- 8.4 2D MATERIALS PRODUCER AND SUPPLIER PROFILES 721 (19 company profiles)

9 RESEARCH METHODOLOGY

9.1 Technology Readiness Level (TRL)



10 REFERENCES



List Of Tables

LIST OF TABLES

- Table 1. Graphene market developments 2020-June 2023.
- Table 2. Graphene funding and investments 2020-2023.
- Table 3. Publicly listed graphene companies.
- Table 4. Main graphene producers by country, annual production capacities, types and main markets they sell to.
- Table 5. Demand for graphene (tons), 2018-2033.
- Table 6. Main graphene producers in North America.
- Table 7. Main graphene producers in Europe.
- Table 8. Commercial products incorporating graphene.
- Table 9. Graphene industrial collaborations, licence agreements and target markets.
- Table 10. Graphene market challenges.
- Table 11. Properties of graphene, properties of competing materials, applications thereof.
- Table 12. Applications of GO and rGO.
- Table 13. Comparison of graphene QDs and semiconductor QDs.
- Table 14. Advantages and disadvantages of methods for preparing GQDs.
- Table 15. Applications of graphene quantum dots.
- Table 16. Markets and applications for graphene quantum dots in electronics and photonics.
- Table 17. Markets and applications for graphene quantum dots in energy storage and conversion.
- Table 18. Markets and applications for graphene quantum dots in sensors.
- Table 19. Markets and applications for graphene quantum dots in biomedicine and life sciences.
- Table 20. Markets and applications for graphene quantum dots in electronics.
- Table 21. Market and technology challenges for graphene quantum dots.
- Table 22. Prices for graphene quantum dots.
- Table 23. Assessment of graphene production methods.
- Table 24. Regulations and rulings related to graphene in Europe.
- Table 25. Regulations and rulings related to graphene in North America.
- Table 26. Regulations and rulings related to graphene in Asia-Pacific.
- Table 27. Accumulated number of patent publications for graphene, 2004-2019.
- Table 28. Graphene oxide production capacity by producer, 2014-2022.
- Table 29. Graphene nanoplatelets capacity in tons by producer, 2010-2022.
- Table 30. CVD graphene film capacity by producer, 2014-2022 in 000s m2.



- Table 31. Types of graphene and typical prices.
- Table 32. Pristine graphene flakes pricing by producer.
- Table 33. Few-layer graphene pricing by producer.
- Table 34. Graphene nanoplatelets pricing by producer.
- Table 35. Graphene oxide and reduced graphene oxide pricing, by producer.
- Table 36. Multi-layer graphene pricing by producer.
- Table 37. Graphene ink pricing by producer.
- Table 38. Graphene producers and types produced.
- Table 39. Graphene producers target market matrix.
- Table 40. Graphene product developers target market matrix.
- Table 41. Applications of nanomaterials in batteries.
- Table 42. Market overview for graphene in batteries.
- Table 43. Market outlook for graphene in batteries.
- Table 44. Market drivers for use of graphene in batteries.
- Table 45. Applications of nanomaterials in flexible and stretchable batteries, by materials type and benefits thereof.
- Table 46. Market and applications for graphene in batteries.
- Table 47. Estimated demand for graphene in batteries (tons), 2018-2033.
- Table 48. Product developers in graphene batteries.
- Table 49. Market overview for graphene in supercapacitors.
- Table 50. Market overviewfor graphene in supercapacitors.
- Table 51: Comparative properties of graphene supercapacitors and lithium-ion batteries.
- Table 52. Market and applications for graphene in supercapacitors.
- Table 53. Demand for graphene in supercapacitors (tons), 2018-2033.
- Table 54. Product developers in graphene supercapacitors.
- Table 55. Market overview for graphene in composites.
- Table 56. Market outlook for graphene in fiber-based polymer composite parts.
- Table 57. Market and applications for graphene in fiber-based composite parts.
- Table 58. Market and applications for graphene in metal matrix composites.
- Table 59. Global market for graphene in composites 2018-2033, tons.
- Table 60. Product developers in graphene composites.
- Table 61. Market overview for graphene in sensors.
- Table 62. Market overview for graphene in sensors.
- Table 63. Market and applications for graphene in sensors.
- Table 64. Demand for graphene in sensors (tons), 2018-2033.
- Table 65. Product developers in graphene sensors.
- Table 66. Market overview for graphene in conductive inks.
- Table 67. Market outlook for graphene in conductive inks.
- Table 68. Market and applications for graphene in conductive inks.



- Table 69. Comparative properties of conductive inks.
- Table 70. Demand for graphene in conductive ink (tons), 2018-2033.
- Table 71. Product developers in graphene conductive inks.
- Table 72. Market overview for graphene in wearable electronics and displays.
- Table 73. Market outlook for graphene in transparent conductive films.
- Table 74. Market and applications for graphene in transparent conductive films.
- Table 75. Comparison of ITO replacements.
- Table 76. Demand for graphene in transparent conductive films, 2018-2033.
- Table 77. Product developers in graphene transparent conductive films.
- Table 78. Market overview for graphene in transistors.
- Table 79. Comparative properties of silicon and graphene transistors.
- Table 80. Market outlook for graphene in transistors.
- Table 81. Market and applications for graphene transistors.
- Table 82. Demand for graphene in transistors and integrated circuits, 2018-2033.
- Table 83. Product developers in graphene transistors and integrated circuits.
- Table 84. Market overview for graphene in filtration membranes.
- Table 85. Market outlook for graphene in filtration membranes.
- Table 86. Market and applications for graphene in filtration membranes.
- Table 87. Demand for graphene in filtration membranes (tons), 2018-2033.
- Table 88. Graphene companies in filtration.
- Table 89. Market overview for graphene in additive manufacturing.
- Table 90. Market outlook for graphene in additive manufacturing.
- Table 91. Market and applications for graphene in additive manufacturing.
- Table 92. Demand for graphene in additive manufacturing (tons), 2018-2033.
- Table 93. Product developers in additive manufacturing.
- Table 94. Market overview for graphene in adhesives.
- Table 95. Market outlook for graphene in adhesives.
- Table 96. Market and applications for graphene in adhesives.
- Table 97. Demand for graphene in adhesives (tons), 2018-2033.
- Table 98. Product developers in graphene adhesives.
- Table 99. Market overview for graphene in aerospace.
- Table 100. Market assessment for graphene in aerospace.
- Table 101. Market and applications for graphene in aerospace.
- Table 102: Demand for graphene in aerospace (tons), 2018-2030.
- Table 103: Product developers in graphene for aerospace.
- Table 104. Market overview for graphene in the automotive market.
- Table 105. Market outlook for graphene in automotive.
- Table 106. Market and applications for graphene in automotive.
- Table 107. Market and applications for graphene in automotive.



- Table 108. Demand for graphene in automotive (tons), 2018-2033.
- Table 109. Product developers in the graphene automotive market.
- Table 110. Market overview for graphene in construction and buildings.
- Table 111. Market outlook for graphene in construction.
- Table 112. Graphene for concrete and cement.
- Table 113. Graphene for asphalt bitumen.
- Table 114. Demand for graphene in construction (tons), 2018-2033.
- Table 115: Graphene product developers in construction.
- Table 116. Market overview for graphene in memory devices.
- Table 117. Market outlook for graphene in memory devices.
- Table 118. Market and applications for graphene in memory devices.
- Table 119. Demand for graphene in memory devices, 2018-2033.
- Table 120. Product developers in graphene memory devices.
- Table 121. Market overview for graphene in fuel cells.
- Table 122. Market overview for graphene in fuel cells.
- Table 123. Market and applications for graphene in fuel cells.
- Table 124. Demand for graphene in fuel cells (tons), 2018-2033.
- Table 125. Product developers in graphene fuel cells.
- Table 126. Market overview for graphene in life sciences and medicine.
- Table 127. Market and applications for graphene in biomedicine and healthcare.
- Table 128. Market overview for graphene in drug delivery.
- Table 129. Market overview for graphene in imaging and diagnostics.
- Table 130. Market overview for graphene in medical implants.
- Table 131. Market overview for graphene in medical biosensors.
- Table 132. Market overview for graphene in woundcare.
- Table 133. Demand for graphene in biomedicine and healthcare (tons), 2018-2033.
- Table 134. Product developers in biomedicine and healthcare.
- Table 135. Market overview for graphene in lighting.
- Table 136. Market overview for graphene in lighting.
- Table 137. Market and applications for graphene in lighting.
- Table 138. Demand for graphene in lighting, 2018-2033.
- Table 139. Product developers in graphene lighting.
- Table 140. Market overview for graphene in lubricants.
- Table 141. Nanomaterial lubricant products.
- Table 142. Market overview for graphene in lubricants.
- Table 143. Market and applications for graphene in lubricants.
- Table 144. Demand for graphene in lubricants (tons), 2018-2033.
- Table 145. Product developers in graphene lubricants.
- Table 146. Market overview for graphene in oil and gas.



- Table 147. Market overview for graphene in oil and gas.
- Table 148. Market and applications for graphene in oil and gas.
- Table 149. Demand for graphene in oil and gas (tons), 2018-2033.
- Table 150. Product developers in graphene oil and gas.
- Table 151. Market overview for graphene in paints and coatings.
- Table 152. Market overview for graphene in paints and coatings.
- Table 153. Market and applications for graphene in paints and coatings.
- Table 154. Demand for graphene in paints and coatings (tons), 2018-2033.
- Table 155. Product developers in graphene paints and coatings.
- Table 156. Market overview for graphene in paints and coatings.
- Table 157. Market overview for graphene in photonics.
- Table 158. Market and applications for graphene in photonics.
- Table 159. Demand for graphene in photonics, 2018-2033.
- Table 160. Product developers in graphene photonics.
- Table 161. Market overview for graphene in photovoltaics.
- Table 162. Market overview for graphene in photovoltaics.
- Table 163. Market and applications for graphene in photovoltaics.
- Table 164. Demand for graphene in photovoltaics (tons), 2018-2033.
- Table 165. Product developers in graphene solar.
- Table 166. Market overview for graphene in rubber and tyres.
- Table 167. Market outlook for graphene in rubber and tyres.
- Table 168. Market and applications for graphene in rubber and tyres.
- Table 169. Demand for graphene in rubber and tyres (tons), 2018-2033.
- Table 170. Product developers in rubber and tyres.
- Table 171. Market overview for graphene in smart textiles and apparel.
- Table 172. Market outlook for graphene in smart textiles and apparel.
- Table 173. Market and applications for graphene in smart textiles and apparel.
- Table 174. Demand for graphene in textiles (tons), 2018-2033.
- Table 175. Graphene product developers in smart textiles and apparel.
- Table 76. Graphene audio equipment producers and products.
- Table 177. Graphene sporting goods producers and products.
- Table 178. Performance criteria of energy storage devices.
- Table 179. 2D materials types.
- Table 180. Comparative analysis of graphene and other 2-D nanomaterials.
- Table 181. Comparison of top-down exfoliation methods to produce 2D materials.
- Table 182. Comparison of the bottom-up synthesis methods to produce 2D materials.
- Table 183. Properties of hexagonal boron nitride (h-BN).
- Table 184. Electronic and mechanical properties of monolayer phosphorene, graphene and MoS2.



- Table 185. Properties and applications of functionalized germanene.
- Table 186. GDY-based anode materials in LIBs and SIBs
- Table 187. Physical and electronic properties of Stanene.
- Table 188. Technology Readiness Level (TRL) Examples.



List Of Figures

LIST OF FIGURES

- Figure 1. Demand for graphene, by market, 2022.
- Figure 2. Asus ROG Swift OLED PG49WCD gaming monitor.
- Figure 3. Demand for graphene, 2018-2033, tons.
- Figure 4. Global graphene demand by market, 2018-2033 (tons), conservative estimate.
- Figure 5. Global graphene demand by market, 2018-2033 (tons). Medium estimate.
- Figure 6. Global graphene demand by market, 2018-2033 (tons). High estimate.
- Figure 7. Demand for graphene in China, by market, 2022.
- Figure 8. Demand for graphene in Asia-Pacific, by market, 2022.
- Figure 9. Main graphene producers in Asia-Pacific.
- Figure 10. Demand for graphene in North America, by market, 2022.
- Figure 11. Demand for graphene in Europe, by market, 2022.
- Figure 12. Graphene layer structure schematic.
- Figure 13. Illustrative procedure of the Scotch-tape based micromechanical cleavage of HOPG.
- Figure 14. Graphite and graphene.
- Figure 15. Graphene and its descendants: top right: graphene; top left: graphite = stacked graphene; bottom right: nanotube=rolled graphene; bottom left:
- fullerene=wrapped graphene.
- Figure 16. Types of CVD methods.
- Figure 17. Schematic of the manufacture of GnPs starting from natural graphite.
- Figure 18. Green-fluorescing graphene quantum dots.
- Figure 19. Schematic of (a) CQDs and (c) GQDs. HRTEM images of (b) C-dots and (d)
- GQDs showing combination of zigzag and armchair edges (positions marked as 1–4).
- Figure 20. Graphene quantum dots.
- Figure 21. Top-down and bottom-up graphene QD synthesis methods.
- Figure 22. Revenues for graphene quantum dots 2019-2033, millions USD
- Figure 23. Dotz Nano GQD products.
- Figure 24. InP/ZnS, perovskite quantum dots and silicon resin composite under UV illumination.
- Figure 25. Quantag GQDs and sensor.
- Figure 26. Fabrication methods of graphene.
- Figure 27. TEM micrographs of: A) HR-CNFs; B) GANF® HR-CNF, it can be observed its high graphitic structure; C) Unraveled ribbon from the HR-CNF; D) Detail of the ribbon; E) Scheme of the structure of the HR-CNFs; F) Large single graphene oxide sheets derived from GANF.



- Figure 28. (a) Graphene powder production line The Sixth Element Materials
- Technology Co. Ltd. (b) Graphene film production line of Wuxi Graphene Films Co. Ltd.
- Figure 29. Schematic illustration of the main graphene production methods.
- Figure 30. Published patent publications for graphene, 2004-2021.
- Figure 31. CVD Graphene on Cu Foil.
- Figure 32. Annual cobalt demand for electric vehicle batteries to 2031.
- Figure 33. Annual lithium demand for electric vehicle batteries to 2031.
- Figure 34. Costs of batteries to 2031.
- Figure 35. Applications of graphene in batteries.
- Figure 36. Applications roadmap to 2033 for graphene in batteries.
- Figure 37. Demand for graphene in batteries (tons), 2018-2033.
- Figure 38. Apollo Traveler graphene-enhanced USB-C / A fast charging power bank.
- Figure 39. Exide Graphene Lead Acid Battery.
- Figure 40. 6000mAh Portable graphene batteries.
- Figure 41. Real Graphene Powerbank.
- Figure 42. Graphene Functional Films UniTran EH/FH.
- Figure 43. Applications of graphene in supercapacitors.
- Figure 44. Applications roadmap to 2033 for graphene in supercapacitors.
- Figure 45. Demand for graphene in supercapacitors (tons), 2018-2033.
- Figure 46. KEPCO's graphene supercapacitors.
- Figure 47. Skeleton Technologies supercapacitor.
- Figure 48. Zapgo supercapacitor phone charger.
- Figure 49. Applications roadmap to 2033 for graphene in polymer composites.
- Figure 50. Applications of graphene in composites.
- Figure 51. Demand for graphene in composites (tons), 2018-2033.
- Figure 52. Graphene bike.
- Figure 53. Graphene lacrosse equipment.
- Figure 54. Graphene-based suitcase made from recycled plastic.
- Figure 55. Aros Create.
- Figure 56. Grays graphene hockey sticks.
- Figure 57. Graphene-based sensors for health monitoring.
- Figure 58. Applications of graphene in sensors.
- Figure 59. Applications roadmap to 2033 for graphene in sensors.
- Figure 60. Demand for graphene in sensors (tons), 2018-2033.
- Figure 61. AGILE R100 system.
- Figure 62. Graphene fully packaged linear array detector.
- Figure 63. GFET sensors.
- Figure 64. Graphene is used to increase sensitivity to middle-infrared light.
- Figure 65. Applications roadmap to 2033 for graphene in conductive inks.



- Figure 66. Applications of graphene in conductive inks.
- Figure 67. Demand for graphene in conductive ink (tons), 2018-2033.
- Figure 68. BGT Materials graphene ink product.
- Figure 69. Printed graphene conductive ink.
- Figure 70. Textiles covered in conductive graphene ink.
- Figure 71. Applications roadmap to 2033 for graphene in transparent conductive films and displays.
- Figure 72. Demand for graphene in transparent conductive films, 2018-2033.
- Figure 73. Moxi flexible film developed for smartphone application.
- Figure 74. Applications of graphene transistors.
- Figure 75. Applications roadmap to 2033 for graphene transistors.
- Figure 76. Demand for graphene in transistors and integrated circuits, 2018-2033.
- Figure 77. Graphene IC in wafer tester.
- Figure 78. Schematic cross-section of a graphene based transistor (GBT, left) and a graphene field-effect transistor (GFET, right).
- Figure 79. Applications of graphene in filtration membranes.
- Figure 80. Applications roadmap to 2033 for graphene filtration membranes.
- Figure 81. Demand for graphene in filtration (tons), 2018-2033.
- Figure 82. Graphene anti-smog mask.
- Figure 83. Graphene filtration membrane.
- Figure 84. Graphene water filer cartridge.
- Figure 85. Applications of graphene in additive manufacturing
- Figure 86. Applications roadmap to 2033 for graphene in additive manufacturing.
- Figure 87. Demand for graphene in additive manufacturing (tons), 2018-2033.
- Figure 88. CNCTArch lightweight mounting for digital signalling.
- Figure 89. Applications of graphene in adhesives.
- Figure 90. Applications roadmap to 2033 for graphene in adhesives.
- Figure 91. Demand for graphene in adhesives (tons), 2018-2033.
- Figure 92. Graphene Adhesives.
- Figure 93. Applications of graphene in aerospace.
- Figure 94. Applications roadmap to 2033 for graphene in aerospace.
- Figure 95. Demand for graphene in aerospace (tons), 2018-2033.
- Figure 96. Orbex Prime rocket.
- Figure 97: Graphene enhanced aircraft cargo container.
- Figure 98: Graphene aircraft.
- Figure 99. Summary of graphene in automobiles.
- Figure 100. Applications of graphene in automotive.
- Figure 101. Demand for graphene in automotive (tons), 2018-2033.
- Figure 102. Supercar incorporating graphene.



- Figure 103. Graphene anti-corrosion primer.
- Figure 104. Graphene-R Brake pads.
- Figure 105. Antistatic graphene tire.
- Figure 106. Graphene engine oil additives.
- Figure 107. Comparison of nanofillers with supplementary cementitious materials and aggregates in concrete.
- Figure 108. Applications roadmap to 2033 for graphene in construction.
- Figure 109. Demand for graphene in construction (tons), 2018-2033.
- Figure 110. Graphene asphalt additives.
- Figure 111. OG (Original Graphene) Concrete Admix Plus.
- Figure 112. Applications roadmap to 2033 for graphene in memory devices.
- Figure 113. Demand for graphene in memory devices, 2018-2033.
- Figure 114. Layered structure of tantalum oxide, multilayer graphene and platinum used for resistive random-access memory (RRAM).
- Figure 115. Applications of graphene in fuel cells.
- Figure 116. Applications roadmap to 2033 for graphene in fuel cells.
- Figure 117. Demand for graphene in fuel cells (tons), 2018-2033.
- Figure 118. Graphene-based E-skin patch.
- Figure 119. Applications of graphene in biomedicine and healthcare.
- Figure 120. Applications roadmap to 2033 for graphene in biomedicine and healthcare.
- Figure 121. Flexible and transparent bracelet that uses graphene to measure heart rate, respiration rate etc.
- Figure 122. Demand for graphene in biomedicine and healthcare (tons), 2018-2033.
- Figure 123. Graphene medical biosensors for wound healing.
- Figure 124. Hememics' handheld reader with a disposable test chip containing a 32-plex graphene-based biosensor.
- Figure 125. GraphWear wearable sweat sensor.
- Figure 126. BioStamp nPoint.
- Figure 127. Applications of graphene in lighting.
- Figure 128. Applications roadmap to 2033 for graphene in lighting.
- Figure 129. Demand for graphene in lighting, 2018-2033.
- Figure 130. Graphene LED bulbs.
- Figure 131. Applications of graphene in lubricants.
- Figure 132. Demand for graphene in lubricants (tons), 2018-2033.
- Figure 133. Tricolit spray coating.
- Figure 134. Graphenoil products.
- Figure 135. Applications of graphene in oil and gas.
- Figure 136. Applications roadmap to 2033 for graphene in oil and gas.
- Figure 137. Demand for graphene in oil and gas (tons), 2018-2033.



- Figure 138. Directa Plus Grafysorber.
- Figure 139. Applications of graphene in paints and coatings.
- Figure 140. Applications roadmap to 2033 for graphene in paints and coatings.
- Figure 141. Demand for graphene in paints and coatings (tons), 2018-2033.
- Figure 142. Cryorig CPU cooling system with graphene coating.
- Figure 143. Four layers of graphene oxide coatings on polycarbonate.
- Figure 144. 23303 ZINCTON GNC graphene paint.
- Figure 145. Graphene-enhanced anti-corrosion aerosols under their Hycote brand.
- Figure 146. Scania Truck head lamp brackets ACT chamber 6 weeks, equivalent to 3y
- field use. Piece treated with GO to the left together with different non-GO coatings.
- Figure 147. Schematic of graphene heat film.
- Figure 148. Applications roadmap to 2033 for graphene in photonics.
- Figure 149. Applications of graphene in photonics.
- Figure 150. Demand for graphene in photonics, 2018-2033.
- Figure 151. All-graphene optical communication link demonstrator operating at a data rate of 25 Gb/s per channel.
- Figure 152. Applications of graphene in photovoltaics.
- Figure 153. Applications roadmap to 2033 for graphene in in photovoltaics.
- Figure 154. Demand for graphene in photovoltaics (tons), 2018-2033.
- Figure 155. Graphene coated glass.
- Figure 156. Applications of graphene in rubber and tyres.
- Figure 157. Applications roadmap to 2033 for graphene in rubber and tyres.
- Figure 158. Demand for graphene in rubber and tyres (tons), 2018-2033.
- Figure 159. Eagle F1 graphene tyre.
- Figure 160. Graphene floor mats.
- Figure 161. Vittoria Corsa G+ tire.
- Figure 162. Applications of graphene in smart textiles and apparel.
- Figure 163. Applications roadmap to 2033 for graphene in textiles and apparel.
- Figure 164. Demand for graphene in textiles (tons), 2018-2033.
- Figure 165. 878 Project One jacket display.
- Figure 166. Colmar graphene ski jacket.
- Figure 167. Graphene dress. The dress changes colour in sync with the wearer's breathing.
- Figure 168. G+ Graphene Aero Jersey.
- Figure 169. Inov-8 graphene shoes.
- Figure 170. Graphene Functional Membranes UniTran GM.
- Figure 171. Graphene jacket.
- Figure 172. Callaway Chrome Soft golf and Chrome Soft X golf balls.
- Figure 173. Graphene heating films.



- Figure 174. Graphene flake products.
- Figure 175. AIKA Black-T.
- Figure 176. Printed graphene biosensors.
- Figure 177. Prototype of printed memory device.
- Figure 178. Brain Scientific electrode schematic.
- Figure 179. Graphene battery schematic.
- Figure 180. Dotz Nano GQD products.
- Figure 181. Graphene-based membrane dehumidification test cell.
- Figure 182. Proprietary atmospheric CVD production.
- Figure 183. Wearable sweat sensor.
- Figure 184. InP/ZnS, perovskite quantum dots and silicon resin composite under UV illumination.
- Figure 185. Sensor surface.
- Figure 186. BioStamp nPoint.
- Figure 187. Nanotech Energy battery.
- Figure 188. Hybrid battery powered electrical motorbike concept.
- Figure 189. NAWAStitch integrated into carbon fiber composite.
- Figure 190. Schematic illustration of three-chamber system for SWCNH production.
- Figure 191. TEM images of carbon nanobrush.
- Figure 192. Test performance after 6 weeks ACT II according to Scania STD4445.
- Figure 193. Quantag GQDs and sensor.
- Figure 194. The Sixth Element graphene products.
- Figure 195. Thermal conductive graphene film.
- Figure 196. Talcoat graphene mixed with paint.
- Figure 197. T-FORCE CARDEA ZERO.
- Figure 198. Structures of nanomaterials based on dimensions.
- Figure 199. Schematic of 2-D materials.
- Figure 200. Diagram of the mechanical exfoliation method.
- Figure 201. Diagram of liquid exfoliation method
- Figure 202. Structure of hexagonal boron nitride.
- Figure 203. BN nanosheet textiles application.
- Figure 204. Structure diagram of Ti3C2Tx.
- Figure 205. Types and applications of 2D TMDCs.
- Figure 206. Left: Molybdenum disulphide (MoS2). Right: Tungsten ditelluride (WTe2)
- Figure 207. SEM image of MoS2.
- Figure 208. Atomic force microscopy image of a representative MoS2 thin-film transistor.
- Figure 209. Schematic of the molybdenum disulfide (MoS2) thin-film sensor with the deposited molecules that create additional charge.



- Figure 210. Borophene schematic.
- Figure 211. Black phosphorus structure.
- Figure 212. Black Phosphorus crystal.
- Figure 213. Bottom gated flexible few-layer phosphorene transistors with the
- hydrophobic dielectric encapsulation.
- Figure 214: Graphitic carbon nitride.
- Figure 215. Structural difference between graphene and C2N-h2D crystal: (a) graphene;
- (b) C2N-h2D crystal. Credit: Ulsan National Institute of Science and Technology.
- Figure 216. Schematic of germanene.
- Figure 217. Graphdiyne structure.
- Figure 218. Schematic of Graphane crystal.
- Figure 219. Schematic of a monolayer of rhenium disulfide.
- Figure 220. Silicene structure.
- Figure 221. Monolayer silicene on a silver (111) substrate.
- Figure 222. Silicene transistor.
- Figure 223. Crystal structure for stanene.
- Figure 224. Atomic structure model for the 2D stanene on Bi2Te3(111).
- Figure 225. Schematic of Indium Selenide (InSe).
- Figure 226. Application of Li-Al LDH as CO2 sensor.
- Figure 227. Graphene-based membrane dehumidification test cell.



I would like to order

Product name: The Global Graphene Market Report 2023

Product link: https://marketpublishers.com/r/GCEB13425B43EN.html

Price: US\$ 1,000.00 (Single User License / Electronic Delivery)

If you want to order Corporate License or Hard Copy, please, contact our Customer

Service:

info@marketpublishers.com

Payment

First name: Last name:

To pay by Credit Card (Visa, MasterCard, American Express, PayPal), please, click button on product page https://marketpublishers.com/r/GCEB13425B43EN.html

To pay by Wire Transfer, please, fill in your contact details in the form below:

Email:	
Company:	
Address:	
City:	
Zip code:	
Country:	
Tel:	
Fax:	
Your message:	
	**All fields are required
	Custumer signature

Please, note that by ordering from marketpublishers.com you are agreeing to our Terms & Conditions at https://marketpublishers.com/docs/terms.html

To place an order via fax simply print this form, fill in the information below and fax the completed form to +44 20 7900 3970