

# The Global Market for Graphene and 2D Materials 2024-2034

https://marketpublishers.com/r/G0EF24D1E8D2EN.html

Date: October 2023

Pages: 855

Price: US\$ 1,250.00 (Single User License)

ID: G0EF24D1E8D2EN

## **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 witnessing large-scale investments.

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.

This in-depth graphene market report provides a comprehensive analysis of the global graphene industry. It examines the market size for graphene in both revenues and tons, with breakdowns by type of graphene material, world region, and end-user application.

The Global Market for Graphene and 2D Materials 2024-2034 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 380 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. Detailed application roadmaps are provided, showing graphene adoption timelines in key sectors like batteries, sensors, automotive, aerospace, energy, electronics, biomedicine and more. Regional demand forecasts are given for Asia Pacific, North America, Europe and others. The



competitive landscape is analyzed with SWOT assessments and revenue projections for graphene in each application sector.

The report also covers graphene patents and research trends, pricing, production methods, regulations, commercial products, strategic collaborations, funding, and more. It provides historical data from 2018, estimates up to 2022, and market projections to 2034. Emerging graphene applications like quantum dots, fuel cells, filtration, coatings, polymer composites and lubricants are analyzed in depth.

The Global Market for Graphene and 2D Materials 2024-2034 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 2034 and main players.

Assessment of graphene materials (CVD graphene, graphene nanoplatelets, 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 2034. Global graphene market size split by market in 2022 and for each application to 2034.

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 380 graphene and 2D materials producers and application/product developers including products, production capacities, manufacturing methods, collaborations, licensing, customers and target markets. Companies profiled include Anaphite Limited, CamGraPhic, Directa Plus, First Graphene, G6 Materials, Gerdau Graphene, Global Graphene Group, Graft Polymer, Graphjet Technology Sdn. Bhd., Grapheal, Graphex Group Ltd,



Graphmatech, Haydale Graphene, Huvis, Lyten, NanoXplore, Paragraf, SafeLi LLC, Saint Jean Carbon, Skeleton Technologies, Versarien and Talga Resources.

List of ex-graphene producers.

Detailed forecasts for key growth areas, opportunities and demand.

Market news and funding 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 Advanced carbon materials
- 1.1.1 Types
- 1.1.2 Comparative analysis
- 1.2 Graphene and other 2D materials
- 1.3 Commercialization
- 1.4 The graphene market in 2023
- 1.5 Graphene market developments 2020-June 2023
- 1.6 Graphene funding and investments 2020-2023
- 1.7 Publicly listed graphene companies
- 1.8 Graphene global production capacities, in tons and by type
- 1.9 Global market in tons and revenues
  - 1.9.1 By type of graphene material
  - 1.9.2 Global graphene revenues, by market, 2018-2034
  - 1.9.3 Global graphene production, tons, 2018-2034
  - 1.9.4 Global graphene demand, by end user market to 2034
  - 1.9.5 Graphene market, by region
    - 1.9.5.1 Asia-Pacific
      - 1.9.5.1.1 China
      - 1.9.5.1.2 Main graphene producers in Asia-Pacific
    - 1.9.5.2 North America
    - 1.9.5.2.1 Main graphene producers in North America
    - 1.9.5.3 Europe
      - 1.9.5.3.1 Main graphene producers in Europe
- 1.10 Graphene products
- 1.11 Industrial collaborations and licence agreements
- 1.12 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
- 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 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 PATENTS AND PUBLICATIONS**

#### **4 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
- 4.6 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 BATTERIES

- 5.1.1 Market overview
  - 5.1.1.1 Market drivers and trends
  - 5.1.1.2 Applications
  - 5.1.1.2.1 Applications roadmap to 2034
  - 5.1.1.3 SWOT analysis
  - 5.1.1.4 Global market
    - 5.1.1.4.1 Revenues
    - 5.1.1.4.2 Tons, 2018-2034
- 5.1.2 Market players
- **5.2 SUPERCAPACITORS** 
  - 5.2.1 Market overview
    - 5.2.1.1 Applications
      - 5.2.1.1.1 Applications roadmap to 2034
    - 5.2.1.2 SWOT analysis
    - 5.2.1.3 Global market
      - 5.2.1.3.1 Revenues
      - 5.2.1.3.2 Tons
  - 5.2.2 Market players
- 5.3 POLYMER ADDITIVES



#### 5.3.1 Market overview

## 5.3.1.1 Applications

5.3.1.1.1 Applications roadmap to 2034

5.3.1.1.2 Applications

5.3.1.2 SWOT analysis

5.3.1.3 Global market

5.3.1.3.1 Revenues

5.3.1.3.2 Tons

5.3.2 Market players

#### 5.4 SENSORS

5.4.1 Market overview

5.4.1.1 Applications

5.4.1.1.1 Applications roadmap to 2034

5.4.1.2 SWOT analysis

5.4.1.3 Global market

5.4.1.3.1 Revenues

5.4.1.3.2 Tons

5.4.2 Market players

#### 5.5 CONDUCTIVE INKS

5.5.1 Market overview

5.5.1.1 Applications

5.5.1.1.1 Applications roadmap to 2034

5.5.1.2 SWOT analysis

5.5.1.3 Global market

5.5.1.3.1 Revenues

5.5.1.3.2 Tons

5.5.2 Market players

## 5.6 TRANSPARENT CONDUCTIVE FILMS AND DISPLAYS

5.6.1 Market outlook

5.6.1.1 Applications

5.6.1.1.1 Applications roadmap to 2034

5.6.1.2 SWOT analysis

5.6.1.3 Global market

5.6.1.3.1 Revenues

5.6.1.3.2 Tons

5.6.2 Market players

## 5.7 TRANSISTORS

5.7.1 Market overview

5.7.1.1 Applications



- 5.7.1.1.1 Applications roadmap to 2034
- 5.7.1.2 SWOT analysis
- 5.7.1.3 Global market
  - 5.7.1.3.1 Revenues
  - 5.7.1.3.2 Tons
- 5.7.2 Market players

#### 5.8 FILTRATION MEMBRANES

- 5.8.1 Market overview
  - 5.8.1.1 Applications
    - 5.8.1.1.1 Applications roadmap to 2034
  - 5.8.1.2 SWOT analysis
  - 5.8.1.3 Global market
    - 5.8.1.3.1 Revenues
    - 5.8.1.3.2 Tons
- 5.8.2 Market players

## **5.9 THERMAL MANAGEMENT**

- 5.9.1 Market overview
  - 5.9.1.1 Applications
    - 5.9.1.1.1 Applications roadmap to 2034
  - 5.9.1.2 SWOT analysis
  - 5.9.1.3 Global market
    - 5.9.1.3.1 Revenues
    - 5.9.1.3.2 Tons
- 5.9.2 Market players

## 5.10 ADDITIVE MANUFACTURING

- 5.10.1 Market overview
  - 5.10.1.1 Applications
    - 5.10.1.1.1 Applications roadmap to 2034
  - 5.10.1.2 SWOT analysis
  - 5.10.1.3 Global market
    - 5.10.1.3.1 Revenues
    - 5.10.1.3.2 Tons
- 5.10.2 Market players
- 5.11 ADHESIVES
  - 5.11.1 Market overview
    - 5.11.1.1 Applications
      - 5.11.1.1.1 Applications roadmap to 2034
    - 5.11.1.2 SWOT analysis
    - 5.11.1.3 Global market



- 5.11.1.3.1 Revenues
- 5.11.1.3.2 Tons
- 5.11.2 Market players
- 5.12 AEROSPACE
  - 5.12.1 Market overview
    - 5.12.1.1 Applications
    - 5.12.1.1.1 Applications roadmap to 2034
    - 5.12.1.2 SWOT analysis
    - 5.12.1.3 Global market
      - 5.12.1.3.1 Revenues
      - 5.12.1.3.2 Tons
  - 5.12.2 Market players
- 5.13 AUTOMOTIVE
  - 5.13.1 Market overview
    - 5.13.1.1 Applications
      - 5.13.1.1.1 Applications roadmap to 2034
    - 5.13.1.2 SWOT analysis
    - 5.13.1.3 Global market
      - 5.13.1.3.1 Revenues
      - 5.13.1.3.2 Tons
  - 5.13.2 Market players
- 5.14 CONSTRUCTION AND BUILDINGS
  - 5.14.1 Market overview
    - 5.14.1.1 Applications
      - 5.14.1.1.1 Cement
      - 5.14.1.1.2 Asphalt bitumen
      - 5.14.1.1.3 Aerogels
        - 5.14.1.1.3.1 3D printed aerogels
        - 5.14.1.1.3.2 Carbon-based aerogel composites
      - 5.14.1.1.4 Applications roadmap to 2034
    - 5.14.1.2 SWOT analysis
    - 5.14.1.3 Global market
      - 5.14.1.3.1 Revenues
      - 5.14.1.3.2 Tons
  - 5.14.2 Market players
- 5.15 MEMORY DEVICES
  - 5.15.1 Market overview
    - 5.15.1.1 Applications
      - 5.15.1.1.1 Applications roadmap to 2034



- 5.15.1.2 SWOT analysis
- 5.15.1.3 Global market
  - 5.15.1.3.1 Revenues
  - 5.15.1.3.2 Tons
- 5.15.2 Market players
- 5.16 FUEL CELLS
  - 5.16.1 Market overview
    - 5.16.1.1 Applications
      - 5.16.1.1.1 Applications roadmap to 2034
    - 5.16.1.2 SWOT analysis
    - 5.16.1.3 Global market
      - 5.16.1.3.1 Revenues
      - 5.16.1.3.2 Tons
  - 5.16.2 Market players
- 5.17 BIOMEDICINE AND HEALTHCARE
  - 5.17.1 Market overview
    - 5.17.1.1 Applications
      - 5.17.1.1.1 Applications roadmap to 2034
    - 5.17.1.2 Drug delivery
    - 5.17.1.3 Imaging and diagnostics
    - 5.17.1.4 Implants
    - 5.17.1.5 Medical biosensors
    - 5.17.1.6 Woundcare
    - 5.17.1.7 Medical wearables
    - 5.17.1.8 Gene delivery
    - 5.17.1.9 SWOT analysis
    - 5.17.1.10 Global market
      - 5.17.1.10.1 Revenues
      - 5.17.1.10.2 Tons
  - 5.17.2 Market players
- 5.18 LIGHTING
  - 5.18.1 Market overview
    - 5.18.1.1 Applications
      - 5.18.1.1.1 Applications roadmap to 2034
    - 5.18.1.2 SWOT analysis
    - 5.18.1.3 Global market
      - 5.18.1.3.1 Revenues
      - 5.18.1.3.2 Tons
  - 5.18.2 Market players



## 5.19 LUBRICANTS

5.19.1 Market overview

5.19.1.1 Applications

5.19.1.2 SWOT analysis

5.19.1.3 Global market

5.19.1.3.1 Revenues

5.19.1.3.2 Tons

5.19.2 Market players

5.20 OIL AND GAS

5.20.1 Market overview

5.20.1.1 Applications

5.20.1.1.1 Applications roadmap to 2034

5.20.1.2 SWOT analysis

5.20.1.3 Global market

5.20.1.3.1 Revenues

5.20.1.3.2 Tons

5.20.2 Market players

## 5.21 PAINTS AND COATINGS

5.21.1 Market overview

5.21.1.1 Applications

5.21.1.1.1 Applications roadmap to 2034

5.21.1.2 SWOT analysis

5.21.1.3 Global market

5.21.1.3.1 Revenues

5.21.1.3.2 Tons

5.21.2 Market players

5.22 PHOTONICS

5.22.1 Market overview

5.22.1.1 Applications

5.22.1.1.1 Applications roadmap to 2034

5.22.1.2 SWOT analysis

5.22.1.3 Global market

5.22.1.3.1 Revenues

5.22.1.3.2 Tons

5.22.2 Market players

5.23 PHOTOVOLTAICS

5.23.1 Market overview

5.23.1.1 Applications

5.23.2.1.1 Applications roadmap to 2034



5.23.1.2 SWOT analysis

5.23.1.3 Global market

5.23.1.3.1 Revenues

5.23.1.3.2 Tons

5.23.2 Market players

5.24 RUBBER AND TYRES

5.24.1 Market overview

5.24.1.1 Applications

5.24.1.1.1 Applications roadmap to 2034

5.24.1.2 SWOT analysis

5.24.1.3 Global market

5.24.1.3.1 Revenues

5.24.1.3.2 Tons

5.24.2 Market players

5.25 TEXTILES AND APPAREL

5.25.1 Market outlook

5.25.1.1 Applications

5.25.1.1.1 Applications roadmap to 2034

5.25.1.2 SWOT analysis

5.25.1.3 Global market

5.25.1.3.1 Revenues

5.25.1.3.2 Tons

5.25.2 Market players

5.26 OTHER MARKETS

5.26.1 Audio equipment

5.26.2 Sporting goods and apparel

5.26.3 Carbon capture and utilization

5.26.3.1 CO2 utilization pathways

5.26.3.2 Carbon storage

5.26.3.2.1.1 Passive storage

5.26.3.2.1.2 Enhanced oil recovery

5.26.3.3 Transporting CO2

5.26.3.3.1 Methods of CO2 transport

5.26.3.3.1.1 Pipeline

5.26.3.3.1.2 Ship

5.26.3.3.1.3 Road

5.26.3.3.1.4 Rail

5.26.3.3.1.5 Safety

5.26.3.4 Costs



- 5.26.3.5 Market map
- 5.26.3.6 Point-source carbon capture for blue hydrogen
  - 5.26.3.6.1 Transportation
  - 5.26.3.6.2 Global point source CO2 capture capacities
  - 5.26.3.6.3 By source
  - 5.26.3.6.4 By endpoint
  - 5.26.3.6.5 Main carbon capture processes
    - 5.26.3.6.5.1 Materials
    - 5.26.3.6.5.2 Post-combustion
    - 5.26.3.6.5.3 Oxy-fuel combustion
    - 5.26.3.6.5.4 Liquid or supercritical CO2: Allam-Fetvedt Cycle
    - 5.26.3.6.5.5 Pre-combustion
- 5.26.3.7 Carbon utilization
  - 5.26.3.7.1 Benefits of carbon utilization
  - 5.26.3.7.2 Market challenges
  - 5.26.3.7.3 Co<sub>2</sub> utilization pathways

## **6 GRAPHENE COMPANY PROFILES 482 (362 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 813 (19 company profiles)

## 9 RESEARCH METHODOLOGY



## **10 REFERENCES**



## **List Of Tables**

#### LIST OF TABLES

- Table 1. Types of advanced carbon materials.
- Table 2. Graphene market developments 2020-June 2023.
- Table 3. Graphene funding and investments 2020-2023.
- Table 4. Publicly listed graphene companies.
- Table 5. Main graphene producers by country, annual production capacities, types and main markets they sell to.
- Table 6. Global graphene demand by type of graphene material, 2018-2034 (tons).
- Table 7. Global graphene revenues, by market, 2018-2034 (Millions USD).
- Table 8. Global graphene production, tons, 2018-2034.
- Table 9. Global graphene revenues, by region, 2018-2034 (Millions USD).
- Table 10. Global graphene demand, by region, 2018-2034 (Tons).
- Table 11. Main graphene producers in North America.
- Table 12. Main graphene producers in Europe.
- Table 13. Commercial products incorporating graphene.
- Table 14. Graphene industrial collaborations, licence agreements and target markets.
- Table 15. Graphene market challenges.
- Table 16. Properties of graphene, properties of competing materials, applications thereof.
- Table 17. Applications of GO and rGO.
- Table 18. Comparison of graphene QDs and semiconductor QDs.
- Table 19. Advantages and disadvantages of methods for preparing GQDs.
- Table 20. Applications of graphene quantum dots.
- Table 21. Markets and applications for graphene quantum dots in electronics and photonics.
- Table 22. Markets and applications for graphene quantum dots in energy storage and conversion.
- Table 23. Markets and applications for graphene quantum dots in sensors.
- Table 24. Markets and applications for graphene quantum dots in biomedicine and life sciences.
- Table 25. Markets and applications for graphene quantum dots in electronics.
- Table 26. Market and technology challenges for graphene quantum dots.
- Table 27. Prices for graphene quantum dots.
- Table 28. Assessment of graphene production methods.
- Table 29. Regulations and rulings related to graphene in Europe.
- Table 30. Regulations and rulings related to graphene in North America.



- Table 31. Regulations and rulings related to graphene in Asia-Pacific.
- Table 32. Accumulated number of patent publications for graphene, 2004-2019.
- Table 33. Graphene oxide production capacity by producer, 2014-2022.
- Table 34. Graphene nanoplatelets capacity in tons by producer, 2010-2022.
- Table 35. CVD graphene film capacity by producer, 2014-2022 in 000s m2.
- Table 36. Types of graphene and typical prices.
- Table 37. Pristine graphene flakes pricing by producer.
- Table 38. Few-layer graphene pricing by producer.
- Table 39. Graphene nanoplatelets pricing by producer.
- Table 40. Graphene oxide and reduced graphene oxide pricing, by producer.
- Table 41. Multi-layer graphene pricing by producer.
- Table 42. Graphene ink pricing by producer.
- Table 43. Graphene producers and types produced.
- Table 44. Graphene producers target market matrix.
- Table 45. Graphene product developers target market matrix.
- Table 46. Applications of nanomaterials in batteries.
- Table 47. Market outlook for graphene in batteries.
- Table 48. Market drivers for use of graphene in batteries.
- Table 49. Applications of nanomaterials in flexible and stretchable batteries, by materials type and benefits thereof.
- Table 50. Market and applications for graphene in batteries.
- Table 51. Global revenues for graphene in batteries, 2018-2034 (Millions USD).
- Table 52. Global demand for graphene in batteries (tons), 2018-2034.
- Table 53. Markets players in graphene batteries.
- Table 54. Market overviewfor graphene in supercapacitors.
- Table 55: Comparative properties of graphene supercapacitors and lithium-ion batteries.
- Table 56. Market and applications for graphene in supercapacitors.
- Table 57. Global revenues for graphene in supercapacitors, 2018-2034 (Millions USD).
- Table 58. Demand for graphene in supercapacitors (tons), 2018-2034.
- Table 59. Market players in graphene supercapacitors.
- Table 60. Market outlook for graphene in polymer additives.
- Table 61. Market and applications for graphene polymer additives.
- Table 62. Global revenues for graphene in polymer additives, 2018-2034 (Millions USD).
- Table 63. Global market demand for graphene in polymer additives, 2018-2034, tons.
- Table 64. Market players in graphene polymer additives.
- Table 65. Market overview for graphene in sensors.
- Table 66. Market overview for graphene in sensors.
- Table 67. Market and applications for graphene in sensors.



- Table 68. Global revenues for graphene in sensors, 2018-2034 (Millions USD).
- Table 69. Global demand for graphene in sensors (tons), 2018-2034.
- Table 70. Market players in graphene sensors.
- Table 71. Market outlook for graphene in conductive inks.
- Table 72. Market and applications for graphene in conductive inks.
- Table 73. Comparative properties of conductive inks.
- Table 74. Global revenues for graphene in conductive inks, 2018-2034 (Millions USD).
- Table 75. Global demand for graphene in conductive ink (tons), 2018-2034.
- Table 76. Product developers in graphene conductive inks.
- Table 77. Market outlook for graphene in transparent conductive films.
- Table 78. Market and applications for graphene in transparent conductive films.
- Table 79. Comparison of ITO replacements.
- Table 80. Global revenues for graphene in transparent conductive films, 2018-2034 (Millions USD).
- Table 81. Global demand for graphene in transparent conductive films (tons), 2018-2034.
- Table 82. Market players in graphene transparent conductive films.
- Table 83. Comparative properties of silicon and graphene transistors.
- Table 84. Market outlook for graphene in transistors.
- Table 85. Market and applications for graphene transistors.
- Table 86. Global revenues for graphene in transistors and integrated circuits,
- 2018-2034 (Millions USD).
- Table 87. Global demand for graphene in transistors and integrated circuits (tons), 2018-2034.
- Table 88. Market players in graphene transistors and integrated circuits.
- Table 89. Market outlook for graphene in filtration membranes.
- Table 90. Market and applications for graphene in filtration membranes.
- Table 91. Global revenues for graphene in filtration membranes, 2018-2034 (Millions USD).
- Table 92. Global demand for graphene in filtration membranes (tons), 2018-2034.
- Table 93. Market players in filtration.
- Table 94. Market and applications for thermal management.
- Table 95. Global revenues for graphene in thermal management, 2018-2034 (Millions USD).
- Table 96. Global demand for graphene in thermal management (tons), 2018-2034.
- Table 97. Market players in graphene thermal management.
- Table 98. Market outlook for graphene in additive manufacturing.
- Table 99. Market and applications for graphene in additive manufacturing.
- Table 100. Global revenues for graphene in additive manufacturing, 2018-2034 (Millions



## USD).

- Table 101. Global demand for graphene in additive manufacturing (tons), 2018-2034.
- Table 102. Market players in additive manufacturing.
- Table 103. Market outlook for graphene in adhesives.
- Table 104. Market and applications for graphene in adhesives.
- Table 105. Global revenues for graphene in adhesives, 2018-2034 (Millions USD).
- Table 106. Global demand for graphene in adhesives (tons), 2018-2034.
- Table 107. Market players in graphene adhesives.
- Table 108. Market assessment for graphene in aerospace.
- Table 109. Market and applications for graphene in aerospace.
- Table 110. Global revenues for graphene in aerospace, 2018-2034 (Millions USD).
- Table 111: Global demand for graphene in aerospace (tons), 2018-2030.
- Table 112: Market players in graphene for aerospace.
- Table 113. Market outlook for graphene in automotive.
- Table 114. Market and applications for graphene in automotive.
- Table 115. Market and applications for graphene in automotive.
- Table 116. Global revenues for graphene in automotive, 2018-2034 (Millions USD).
- Table 117. Global demand for graphene in automotive (tons), 2018-2034.
- Table 118. Market players in the graphene automotive market.
- Table 119. Market outlook for graphene in construction.
- Table 120. Graphene for concrete and cement.
- Table 121. Graphene for asphalt bitumen.
- Table 122. Global revenues for graphene in construction & buildings, 2018-2034 (Millions USD).
- Table 123. Global demand for graphene in construction (tons), 2018-2034.
- Table 124: Market players in graphene in construction.
- Table 125. Market outlook for graphene in memory devices.
- Table 126. Market and applications for graphene in memory devices.
- Table 127. Global revenues for graphene in memory devices, 2018-2034 (Millions USD).
- Table 128. Global demand for graphene in memory devices, 2018-2034.
- Table 129. Market players in graphene memory devices.
- Table 130. Market overview for graphene in fuel cells.
- Table 131. Market and applications for graphene in fuel cells.
- Table 132. Global revenues for graphene in fuel cells, 2018-2034 (Millions USD).
- Table 133. Global demand for graphene in fuel cells (tons), 2018-2034.
- Table 134. Market players in graphene fuel cells.
- Table 135. Market and applications for graphene in biomedicine and healthcare.
- Table 136. Market overview for graphene in drug delivery.



- Table 137. Market overview for graphene in imaging and diagnostics.
- Table 138. Market overview for graphene in medical implants.
- Table 139. Market overview for graphene in medical biosensors.
- Table 140. Market overview for graphene in woundcare.
- Table 141. Global revenues for graphene in biomedicine & healthcare, 2018-2034 (Millions USD).
- Table 142. Global demand for graphene in biomedicine and healthcare (tons), 2018-2034.
- Table 143. Market players in graphene in biomedicine and healthcare.
- Table 144. Market overview for graphene in lighting.
- Table 145. Market and applications for graphene in lighting.
- Table 146. Global revenues for graphene in lighting, 2018-2034 (Millions USD).
- Table 147. Global demand for graphene in lighting, 2018-2034 (tons).
- Table 148. Market players in graphene lighting.
- Table 149. Nanomaterial lubricant products.
- Table 150. Market overview for graphene in lubricants.
- Table 151. Market and applications for graphene in lubricants.
- Table 152. Global revenues for graphene in lubricants, 2018-2034 (Millions USD).
- Table 153. Global demand for graphene in lubricants (tons), 2018-2034.
- Table 154. Market players in graphene lubricants.
- Table 155. Market overview for graphene in oil and gas.
- Table 156. Market and applications for graphene in oil and gas.
- Table 157. Global revenues for graphene in oil and gas, 2018-2034 (Millions USD).
- Table 158. Global demand for graphene in oil and gas (tons), 2018-2034.
- Table 159. Market players in graphene oil and gas.
- Table 160. Market overview for graphene in paints and coatings.
- Table 161. Market and applications for graphene in paints and coatings.
- Table 162. Global revenues for graphene in paints & coatings, 2018-2034 (Millions USD).
- Table 163. Global demand for graphene in paints and coatings (tons), 2018-2034.
- Table 164. Market players in graphene paints and coatings.
- Table 165. Market overview for graphene in photonics.
- Table 166. Market and applications for graphene in photonics.
- Table 167. Global revenues for graphene in photonics, 2018-2034 (Millions USD).
- Table 168. Demand for graphene in photonics, 2018-2034.
- Table 169. Market players in graphene photonics.
- Table 170. Market overview for graphene in photovoltaics.
- Table 171. Market overview for graphene in photovoltaics.
- Table 172. Market and applications for graphene in photovoltaics.



- Table 173. Global revenues for graphene in photovoltaics, 2018-2034 (Millions USD).
- Table 174. Global demand for graphene in photovoltaics (tons), 2018-2034.
- Table 175. Marker players in graphene solar.
- Table 176. Market overview for graphene in rubber and tyres.
- Table 177. Market outlook for graphene in rubber and tyres.
- Table 178. Market and applications for graphene in rubber and tyres.
- Table 179. Global revenues for graphene in rubber & tyres, 2018-2034 (Millions USD).
- Table 180. Global demand for graphene in rubber and tyres (tons), 2018-2034.
- Table 181. Market players in rubber and tyres.
- Table 182. Market overview for graphene in smart textiles and apparel.
- Table 183. Market outlook for graphene in smart textiles and apparel.
- Table 184. Market and applications for graphene in smart textiles and apparel.
- Table 185. Global revenues for graphene in textiles & apparel, 2018-2034 (Millions USD).
- Table 186. Global demand for graphene in textiles & apparel (tons), 2018-2034.
- Table 187. Market players in smart textiles and apparel.
- Table 188. Graphene audio equipment producers and products.
- Table 189. Graphene sporting goods producers and products.
- Table 190. Methods of CO2 transport.
- Table 191. Carbon capture, transport, and storage cost per unit of CO2
- Table 192. Estimated capital costs for commercial-scale carbon capture.
- Table 193. Point source examples.
- Table 194. Assessment of carbon capture materials
- Table 195. Chemical solvents used in post-combustion.
- Table 196. Commercially available physical solvents for pre-combustion carbon capture.
- Table 197. Carbon utilization revenue forecast by product (US\$).
- Table 198. CO2 utilization and removal pathways.
- Table 199. Market challenges for CO2 utilization.
- Table 200. Example CO2 utilization pathways.
- Table 201. Performance criteria of energy storage devices.
- Table 202. 2D materials types.
- Table 203. Comparative analysis of graphene and other 2-D nanomaterials.
- Table 204. Comparison of top-down exfoliation methods to produce 2D materials.
- Table 205. Comparison of the bottom-up synthesis methods to produce 2D materials.
- Table 206. Properties of hexagonal boron nitride (h-BN).
- Table 207. Electronic and mechanical properties of monolayer phosphorene, graphene and MoS2.
- Table 208. Properties and applications of functionalized germanene.
- Table 209. GDY-based anode materials in LIBs and SIBs



Table 210. Physical and electronic properties of Stanene.

Table 211. 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. Global graphene demand by type of graphene material, 2018-2034 (tons).
- Figure 4. Global graphene revenues, by market, 2018-2034 (Millions USD).
- Figure 5. Global graphene production, tons, 2018-2034.
- Figure 6. Global graphene demand by market, 2018-2034 (tons).
- Figure 7. Global graphene revenues, by region, 2018-2034 (Millions USD).
- Figure 8. Global graphene demand, by region, 2018-2034 (Tons).
- Figure 9. Main graphene producers in Asia-Pacific.
- Figure 10. Graphene layer structure schematic.
- Figure 11. Illustrative procedure of the Scotch-tape based micromechanical cleavage of HOPG.
- Figure 12. Graphite and graphene.
- Figure 13. Graphene and its descendants: top right: graphene; top left: graphite = stacked graphene; bottom right: nanotube=rolled graphene; bottom left: fullerene=wrapped graphene.
- Figure 14. Types of CVD methods.
- Figure 15. Schematic of the manufacture of GnPs starting from natural graphite.
- Figure 16. Green-fluorescing graphene quantum dots.
- Figure 17. 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 18. Graphene quantum dots.
- Figure 19. Top-down and bottom-up graphene QD synthesis methods.
- Figure 20. Revenues for graphene quantum dots 2019-2034, millions USD
- Figure 21. Dotz Nano GQD products.
- Figure 22. InP/ZnS, perovskite quantum dots and silicon resin composite under UV illumination.
- Figure 23. Quantag GQDs and sensor.
- Figure 24. Fabrication methods of graphene.
- Figure 25. 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 26. (a) Graphene powder production line The Sixth Element Materials Technology Co. Ltd. (b) Graphene film production line of Wuxi Graphene Films Co. Ltd.



- Figure 27. Schematic illustration of the main graphene production methods.
- Figure 28. Published patent publications for graphene, 2004-2021.
- Figure 29. CVD Graphene on Cu Foil.
- Figure 30. Annual cobalt demand for electric vehicle batteries to 2031.
- Figure 31. Annual lithium demand for electric vehicle batteries to 2031.
- Figure 32. Costs of batteries to 2031.
- Figure 33. Applications of graphene in batteries.
- Figure 34. Applications roadmap to 2034 for graphene in batteries.
- Figure 35. SWOT analysis for graphene in batteries.
- Figure 36. Global revenues for graphene in batteries, 2018-2034 (Millions USD).
- Figure 37. Global demand for graphene in batteries (tons), 2018-2034.
- 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 2034 for graphene in supercapacitors.
- Figure 45. SWOT analysis for graphene in supercapacitors.
- Figure 46. Global revenues for graphene insupercapacitors, 2018-2034 (Millions USD).
- Figure 47. Demand for graphene in supercapacitors (tons), 2018-2034.
- Figure 48. KEPCO's graphene supercapacitors.
- Figure 49. Skeleton Technologies supercapacitor.
- Figure 50. Zapgo supercapacitor phone charger.
- Figure 51. Applications roadmap to 2034 for graphene in polymer additives.
- Figure 52. Applications of graphene in polymer additives.
- Figure 53. SWOT analysis for graphene in polymer additives.
- Figure 54. Global revenues for graphene in polymer additives, 2018-2034 (Millions USD).
- Figure 55. Demand for graphene in polymer additives (tons), 2018-2034.
- Figure 56. Graphene bike.
- Figure 57. Graphene lacrosse equipment.
- Figure 58. Graphene-based suitcase made from recycled plastic.
- Figure 59. Aros Create.
- Figure 60. Grays graphene hockey sticks.
- Figure 61. Graphene-based sensors for health monitoring.
- Figure 62. Applications of graphene in sensors.
- Figure 63. Applications roadmap to 2034 for graphene in sensors.
- Figure 64. SWOT analysis for graphene in sensors.



- Figure 65. Global revenues for graphene in sensors, 2018-2034 (Millions USD).
- Figure 66. Global demand for graphene in sensors (tons), 2018-2034.
- Figure 67. AGILE R100 system.
- Figure 68. Graphene fully packaged linear array detector.
- Figure 69. GFET sensors.
- Figure 70. Graphene is used to increase sensitivity to middle-infrared light.
- Figure 71. Applications roadmap to 2034 for graphene in conductive inks.
- Figure 72. Applications of graphene in conductive inks.
- Figure 73. SWOT analysis for graphene in conductive inks.
- Figure 74. Global revenues for graphene in conductive inks, 2018-2034 (Millions USD).
- Figure 75. Global demand for graphene in conductive ink (tons), 2018-2034.
- Figure 76. BGT Materials graphene ink product.
- Figure 77. Printed graphene conductive ink.
- Figure 78. Textiles covered in conductive graphene ink.
- Figure 79. Applications roadmap to 2034 for graphene in transparent conductive films and displays.
- Figure 80. SWOT analysis for graphene in conductive inks.
- Figure 81. Global revenues for graphene in transparent conductive films, 2018-2034 (Millions USD).
- Figure 82. Global demand for graphene in transparent conductive films (tons), 2018-2034.
- Figure 83. Moxi flexible film developed for smartphone application.
- Figure 84. Applications of graphene transistors.
- Figure 85. Applications roadmap to 2034 for graphene transistors.
- Figure 86. SWOT analysis for graphene in transparent conductive films.
- Figure 87. Global revenues for graphene in transistors and integrated circuits,
- 2018-2034 (Millions USD).
- Figure 88. Demand for graphene in transistors and integrated circuits (tons), 2018-2034.
- Figure 89. Graphene IC in wafer tester.
- Figure 90. Schematic cross-section of a graphene based transistor (GBT, left) and a graphene field-effect transistor (GFET, right).
- Figure 91. Applications of graphene in filtration membranes.
- Figure 92. Applications roadmap to 2034 for graphene filtration membranes.
- Figure 93. SWOT analysis for graphene in filtration membranes.
- Figure 94. Global revenues for graphene in filtration membranes, 2018-2034 (Millions USD).
- Figure 95. Global demand for graphene in filtration (tons), 2018-2034.
- Figure 96. Graphene anti-smog mask.
- Figure 97. Graphene filtration membrane.



- Figure 98. Graphene water filer cartridge.
- Figure 99. Applications of graphene in thermal management
- Figure 100. Applications roadmap to 2034 for graphene in thermal management.
- Figure 101. SWOT analysis for graphene in thermal management.
- Figure 102. Global revenues for graphene in thermal management, 2018-2034 (Millions USD).
- Figure 103. Demand for graphene in thermal management (tons), 2018-2034.
- Figure 104. Graphene IC in wafer tester.
- Figure 105. Schematic cross-section of a graphene based transistor (GBT, left) and a graphene field-effect transistor (GFET, right).
- Figure 106. Applications of graphene in additive manufacturing
- Figure 107. Applications roadmap to 2034 for graphene in additive manufacturing.
- Figure 108. SWOT analysis for graphene in additive manufacturing.
- Figure 109. Global revenues for graphene in additive manufacturing, 2018-2034 (Millions USD).
- Figure 110. Global demand for graphene in additive manufacturing (tons), 2018-2034.
- Figure 111. CNCTArch lightweight mounting for digital signalling.
- Figure 112. Applications of graphene in adhesives.
- Figure 113. Applications roadmap to 2034 for graphene in adhesives.
- Figure 114. SWOT analysis for graphene in adhesives.
- Figure 115. Global revenues for graphene in adhesives, 2018-2034 (Millions USD).
- Figure 116. Global demand for graphene in adhesives (tons), 2018-2034.
- Figure 117. Graphene Adhesives.
- Figure 118. Applications of graphene in aerospace.
- Figure 119. Applications roadmap to 2034 for graphene in aerospace.
- Figure 120. SWOT analysis for graphene in aerospace.
- Figure 121. Global revenues for graphene in aerospace, 2018-2034 (Millions USD).
- Figure 122. Global demand for graphene in aerospace (tons), 2018-2034.
- Figure 123. Orbex Prime rocket.
- Figure 124: Graphene enhanced aircraft cargo container.
- Figure 125: Graphene aircraft.
- Figure 126. Summary of graphene in automobiles.
- Figure 127. Applications of graphene in automotive.
- Figure 128. SWOT analysis for graphene in automotive.
- Figure 129. Global revenues for graphene in automotive, 2018-2034 (Millions USD).
- Figure 130. Global demand for graphene in automotive (tons), 2018-2034.
- Figure 131. Supercar incorporating graphene.
- Figure 132. Graphene anti-corrosion primer.
- Figure 133. Graphene-R Brake pads.



- Figure 134. Antistatic graphene tire.
- Figure 135. Graphene engine oil additives.
- Figure 136. Comparison of nanofillers with supplementary cementitious materials and aggregates in concrete.
- Figure 137. Applications roadmap to 2034 for graphene in construction.
- Figure 138. SWOT analysis for graphene in construction.
- Figure 139. Global revenues for graphene in construction & buildings, 2018-2034 (Millions USD).
- Figure 140. Global demand for graphene in construction (tons), 2018-2034.
- Figure 141. Graphene asphalt additives.
- Figure 142. OG (Original Graphene) Concrete Admix Plus.
- Figure 143. Applications roadmap to 2034 for graphene in memory devices.
- Figure 144. SWOT analysis for graphene in memory devices.
- Figure 145. Global revenues for graphene in memory devices, 2018-2034 (Millions USD).
- Figure 146. Global demand for graphene in memory devices, 2018-2034.
- Figure 147. Layered structure of tantalum oxide, multilayer graphene and platinum used for resistive random-access memory (RRAM).
- Figure 148. Applications of graphene in fuel cells.
- Figure 149. Applications roadmap to 2034 for graphene in fuel cells.
- Figure 150. SWOT analysis for graphene in fuel cells.
- Figure 151. Global revenues for graphene in fuel cells, 2018-2034 (Millions USD).
- Figure 152. Global demand for graphene in fuel cells (tons), 2018-2034.
- Figure 153. Graphene-based E-skin patch.
- Figure 154. Applications of graphene in biomedicine and healthcare.
- Figure 155. Applications roadmap to 2034 for graphene in biomedicine and healthcare.
- Figure 156. Flexible and transparent bracelet that uses graphene to measure heart rate, respiration rate etc.
- Figure 157. SWOT analysis for graphene in biomedicine & healthcare.
- Figure 158. Global revenues for graphene in biomedicine & healthcare, 2018-2034 (Millions USD).
- Figure 159. Global demand for graphene in biomedicine and healthcare (tons), 2018-2034.
- Figure 160. Graphene medical biosensors for wound healing.
- Figure 161. Hememics' handheld reader with a disposable test chip containing a 32-plex graphene-based biosensor.
- Figure 162. GraphWear wearable sweat sensor.
- Figure 163. BioStamp nPoint.
- Figure 164. Applications of graphene in lighting.



- Figure 165. Applications roadmap to 2034 for graphene in lighting.
- Figure 166. SWOT analysis for graphene in lighting.
- Figure 167. Global revenues for graphene in lighting, 2018-2034 (Millions USD).
- Figure 168. Global demand for graphene in lighting, 2018-2034 (tons).
- Figure 169. Graphene LED bulbs.
- Figure 170. Applications of graphene in lubricants.
- Figure 171. SWOT analysis for graphene in lubricants.
- Figure 172. Global revenues for graphene in lubricants, 2018-2034 (Millions USD).
- Figure 173. Global demand for graphene in lubricants (tons), 2018-2034.
- Figure 174. Tricolit spray coating.
- Figure 175. Graphenoil products.
- Figure 176. Applications of graphene in oil and gas.
- Figure 177. Applications roadmap to 2034 for graphene in oil and gas.
- Figure 178. SWOT analysis for graphene in oil and gas.
- Figure 179. Global revenues for graphene in oil and gas, 2018-2034 (Millions USD).
- Figure 180. Global demand for graphene in oil and gas (tons), 2018-2034.
- Figure 181. Directa Plus Grafysorber.
- Figure 182. Applications of graphene in paints and coatings.
- Figure 183. Applications roadmap to 2034 for graphene in paints and coatings.
- Figure 184. SWOT analysis for graphene in paints and coatings.
- Figure 185. Global revenues for graphene in paints & coatings, 2018-2034 (Millions USD).
- Figure 186. Global demand for graphene in paints and coatings (tons), 2018-2034.
- Figure 187. Cryorig CPU cooling system with graphene coating.
- Figure 188. Four layers of graphene oxide coatings on polycarbonate.
- Figure 189. 23303 ZINCTON GNC graphene paint.
- Figure 190. Graphene-enhanced anti-corrosion aerosols under their Hycote brand.
- Figure 191. 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 192. Schematic of graphene heat film.
- Figure 193. Applications roadmap to 2034 for graphene in photonics.
- Figure 194. Applications of graphene in photonics.
- Figure 195. SWOT analysis for graphene in photonics.
- Figure 196. Global revenues for graphene in photonicss, 2018-2034 (Millions USD).
- Figure 197. Demand for graphene in photonics, 2018-2034.
- Figure 198. All-graphene optical communication link demonstrator operating at a data rate of 25 Gb/s per channel.
- Figure 199. Applications of graphene in photovoltaics.
- Figure 200. Applications roadmap to 2034 for graphene in in photovoltaics.



- Figure 201. SWOT analysis for graphene in photovotaics.
- Figure 202. Global revenues for graphene in photovoltaics, 2018-2034 (Millions USD).
- Figure 203. Global demand for graphene in photovoltaics (tons), 2018-2034.
- Figure 204. Graphene coated glass.
- Figure 205. Applications of graphene in rubber and tyres.
- Figure 206. Applications roadmap to 2034 for graphene in rubber and tyres.
- Figure 207. SWOT analysis for graphene in rubber and tyres.
- Figure 208. Global revenues for graphene in rubber & tyres 2018-2034 (Millions USD).
- Figure 209. Global demand for graphene in rubber and tyres (tons), 2018-2034.
- Figure 210. Eagle F1 graphene tyre.
- Figure 211. Graphene floor mats.
- Figure 212. Vittoria Corsa G+ tire.
- Figure 213. Applications of graphene in smart textiles and apparel.
- Figure 214. Applications roadmap to 2034 for graphene in textiles and apparel.
- Figure 215. SWOT analysis for graphene in textiles and apparel.
- Figure 216. Global revenues for graphene in textiles & apparel, 2018-2034 (Millions USD).
- Figure 217. Global demand for graphene in textiles (tons), 2018-2034.
- Figure 218. 878 Project One jacket display.
- Figure 219. Colmar graphene ski jacket.
- Figure 220. Graphene dress. The dress changes colour in sync with the wearer's breathing.
- Figure 221. G+ Graphene Aero Jersey.
- Figure 222. Inov-8 graphene shoes.
- Figure 223. Graphene Functional Membranes UniTran GM.
- Figure 224. Graphene jacket.
- Figure 225. Callaway Chrome Soft golf and Chrome Soft X golf balls.
- Figure 226. Carbon dioxide utilization and removal cycle.
- Figure 227. Various pathways for CO2 utilization.
- Figure 228. Example of underground carbon dioxide storage.
- Figure 229. Transport of CCS technologies.
- Figure 230. Railroad car for liquid CO? transport
- Figure 231. Estimated costs of capture of one metric ton of carbon dioxide (Co2) by sector.
- Figure 232. CCUS market map.
- Figure 233. Global capacity of point-source carbon capture and storage facilities.
- Figure 234. Global carbon capture capacity by CO2 source, 2021.
- Figure 235. Global carbon capture capacity by CO2 source, 2030.
- Figure 236. Global carbon capture capacity by CO2 endpoint, 2021 and 2030.



- Figure 237. Post-combustion carbon capture process.
- Figure 238. Postcombustion CO2 Capture in a Coal-Fired Power Plant.
- Figure 239. Oxy-combustion carbon capture process.
- Figure 240. Liquid or supercritical CO2 carbon capture process.
- Figure 241. Pre-combustion carbon capture process.
- Figure 242. CO2 non-conversion and conversion technology, advantages and disadvantages.
- Figure 243. Applications for CO2.
- Figure 244. Cost to capture one metric ton of carbon, by sector.
- Figure 245. Life cycle of CO2-derived products and services.
- Figure 246. Co2 utilization pathways and products.
- Figure 247. Graphene heating films.
- Figure 248. Graphene flake products.
- Figure 249. AIKA Black-T.
- Figure 250. Printed graphene biosensors.
- Figure 251. Prototype of printed memory device.
- Figure 252. Brain Scientific electrode schematic.
- Figure 253. Graphene battery schematic.
- Figure 254. Dotz Nano GQD products.
- Figure 255. Graphene-based membrane dehumidification test cell.
- Figure 256. Proprietary atmospheric CVD production.
- Figure 257. Wearable sweat sensor.
- Figure 258. InP/ZnS, perovskite quantum dots and silicon resin composite under UV illumination.
- Figure 259. Sensor surface.
- Figure 260. BioStamp nPoint.
- Figure 261. Nanotech Energy battery.
- Figure 262. Hybrid battery powered electrical motorbike concept.
- Figure 263. NAWAStitch integrated into carbon fiber composite.
- Figure 264. Schematic illustration of three-chamber system for SWCNH production.
- Figure 265. TEM images of carbon nanobrush.
- Figure 266. Test performance after 6 weeks ACT II according to Scania STD4445.
- Figure 267. Quantag GQDs and sensor.
- Figure 268. The Sixth Element graphene products.
- Figure 269. Thermal conductive graphene film.
- Figure 270. Talcoat graphene mixed with paint.
- Figure 271. T-FORCE CARDEA ZERO.
- Figure 272. Structures of nanomaterials based on dimensions.
- Figure 273. Schematic of 2-D materials.



- Figure 274. Diagram of the mechanical exfoliation method.
- Figure 275. Diagram of liquid exfoliation method
- Figure 276. Structure of hexagonal boron nitride.
- Figure 277. BN nanosheet textiles application.
- Figure 278. Structure diagram of Ti3C2Tx.
- Figure 279. Types and applications of 2D TMDCs.
- Figure 280. Left: Molybdenum disulphide (MoS2). Right: Tungsten ditelluride (WTe2)
- Figure 281. SEM image of MoS2.
- Figure 282. Atomic force microscopy image of a representative MoS2 thin-film transistor.
- Figure 283. Schematic of the molybdenum disulfide (MoS2) thin-film sensor with the deposited molecules that create additional charge.
- Figure 284. Borophene schematic.
- Figure 285. Black phosphorus structure.
- Figure 286. Black Phosphorus crystal.
- Figure 287. Bottom gated flexible few-layer phosphorene transistors with the hydrophobic dielectric encapsulation.
- Figure 288: Graphitic carbon nitride.
- Figure 289. Structural difference between graphene and C2N-h2D crystal: (a) graphene;
- (b) C2N-h2D crystal. Credit: Ulsan National Institute of Science and Technology.
- Figure 290. Schematic of germanene.
- Figure 291. Graphdiyne structure.
- Figure 292. Schematic of Graphane crystal.
- Figure 293. Schematic of a monolayer of rhenium disulfide.
- Figure 294. Silicene structure.
- Figure 295. Monolayer silicene on a silver (111) substrate.
- Figure 296. Silicene transistor.
- Figure 297. Crystal structure for stanene.
- Figure 298. Atomic structure model for the 2D stanene on Bi2Te3(111).
- Figure 299. Schematic of Indium Selenide (InSe).
- Figure 300. Application of Li-Al LDH as CO2 sensor.
- Figure 301. Graphene-based membrane dehumidification test cell.



## I would like to order

Product name: The Global Market for Graphene and 2D Materials 2024-2034

Product link: https://marketpublishers.com/r/G0EF24D1E8D2EN.html

Price: US\$ 1,250.00 (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:

To pay by Credit Card (Visa, MasterCard, American Express, PayPal), please, click button on product page <a href="https://marketpublishers.com/r/G0EF24D1E8D2EN.html">https://marketpublishers.com/r/G0EF24D1E8D2EN.html</a>

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

Last name:	
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 <a href="https://marketpublishers.com/docs/terms.html">https://marketpublishers.com/docs/terms.html</a>

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