

The background is dark with abstract, flowing patterns of small purple dots. The logo is centered and consists of a stylized 'C' with a dot, followed by 'M', 'C', 'I', and 'A' in a bold, sans-serif font.

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Where will GaN Power Semiconductors find success in the 2020s?

Richard Eden

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Omdia, part of Informa Tech*

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The Omdia logo, featuring the word "OMDIA" in a bold, black, sans-serif font, with a stylized circular icon to the left.

Agenda

- Introduction to the Omdia Wide Bandgap Power Semiconductor Intelligence Service
- Recent changes to the Gallium Nitride power semiconductor market
- Gallium Nitride (GaN) device manufacturers and foundry providers
- Key drivers and barriers for growth for Gallium Nitride
- Market forecasts by technology, product and sector
- Discussion: Where will Gallium Nitride power semiconductors find success in the 2020s?



Your Presenter



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Since 2010, Richard Eden has been the market analyst for discretes and modules in what is now the Semiconductor group in Omdia (a division of Informa Tech).

Richard is the main analyst for the Wide Bandgap Power Semiconductor Intelligence Service, launched in 2023, covering SiC and GaN power semiconductors.

Omdia Semiconductor Service Area Coverage

About Omdia's Semiconductor Service Area Coverage

Omdia's semiconductor research covers 4 pillars:

- Memory and Storage (DRAM, NAND, SSD & HDD, etc.)
- Semiconductor Components (see below)
- Semiconductor Manufacturing (Foundries, Wafers, etc.)
- Semiconductor Markets (CLT, AMFT, China, etc.)

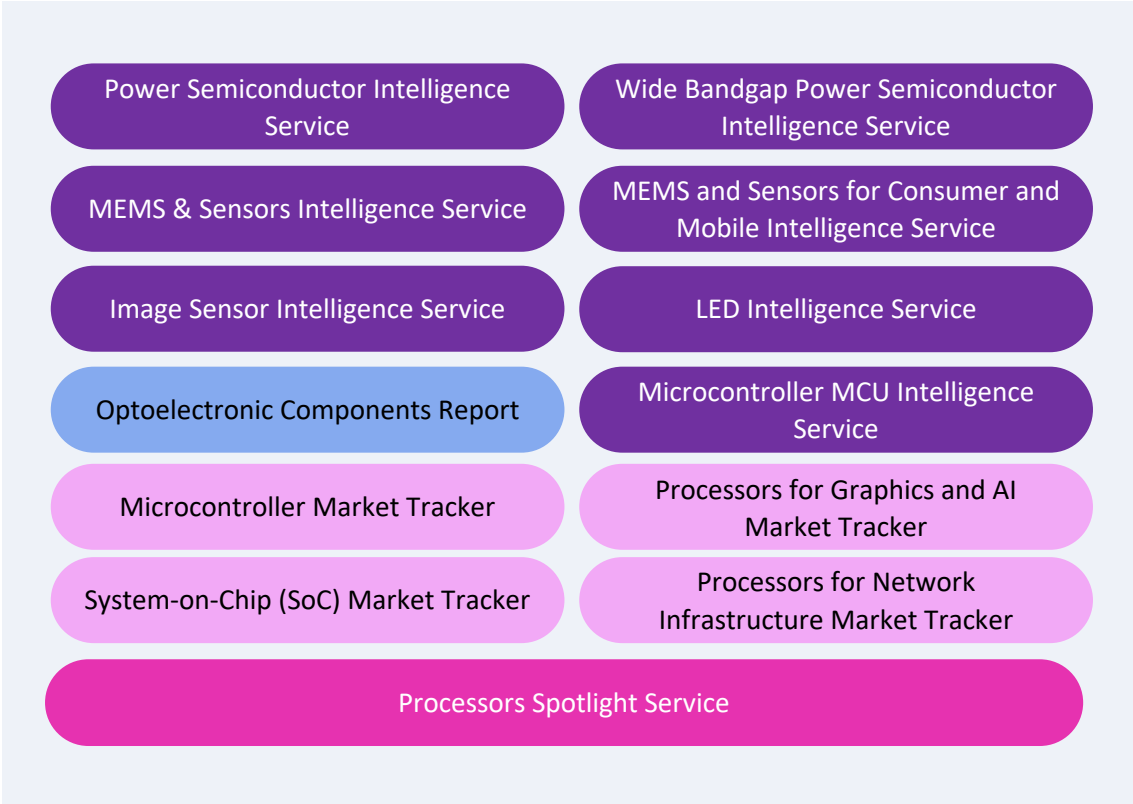
About Omdia's Semiconductor Components Research

Omdia's leading semiconductor components research is provided by a highly experienced team of analysts. Many are industry veterans with deep technical background as well as hands-on market and product experience in their coverage area. Key component areas are processors and microcontrollers, MEMS and sensors, power discretes and modules, power ICs, LEDs and optical components are covered across numerous device categories and applications.

Their expertise is augmented and supported by the wide array of end equipment application and demand reporting.



Service Area Package: **Semiconductor Components**



Wide Bandgap Power Semiconductor IS

Part of the Semiconductor Components Service Area

New in 2023

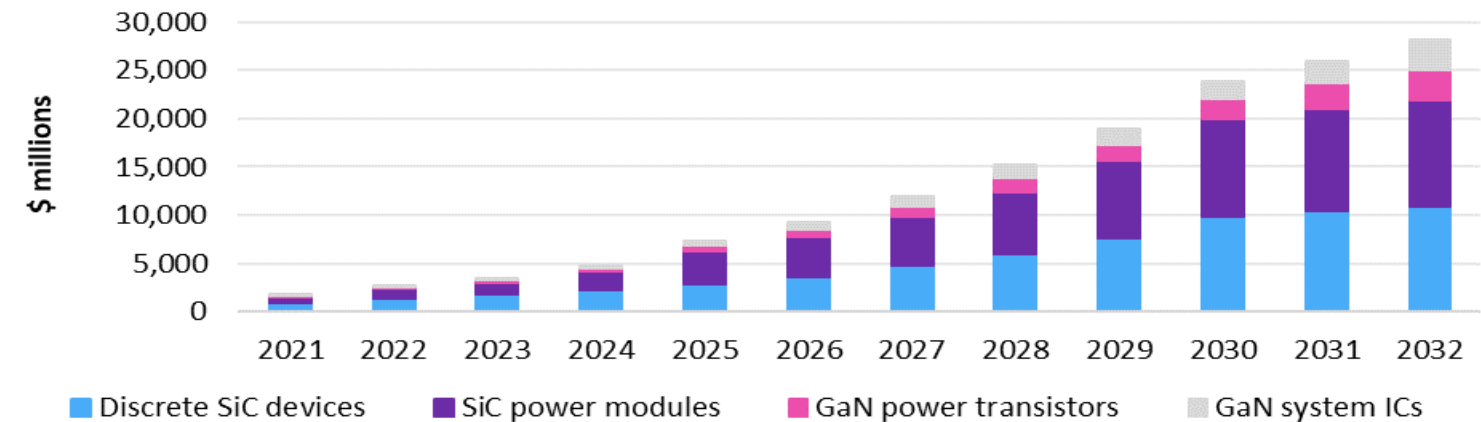
How Omdia helps you

- This new service from Omdia focusses in detail on the emerging technologies of SiC and GaN power semiconductors.
- It looks at the products, device pricing and target application sectors
- It will provide 10-year forecasts
- Data for five geographical regions

Annual Publications:

- Silicon Carbide Market Tracker
- Silicon Carbide Wafer Demand Forecast Tool
- Gallium Nitride Market Tracker
- Gallium Nitride Wafer Demand Forecast Tool
- Wide Bandgap (SiC & GaN) Supplier Market Share Database
- Wide Bandgap Supply Chain Analysis (wafers, epitaxy, cost breakdown analysis, supply vs. demand, supplier relationships)
- Other ad-hoc reports and analyst insights

Overall SiC and GaN semiconductor revenue by product



Source: Omdia

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Gallium Nitride market players and developments

Recent changes to the GaN market

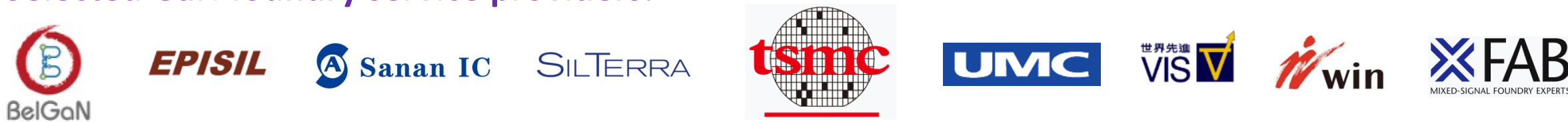
In 2015	<ul style="list-style-type: none">Innoscience of Suzhou, China, was founded with the aim of becoming the world's largest GaN semiconductor manufacturer. It opened a 2nd fab in 2020 and has established offices in the US and Europe recently.
In 2020	<ul style="list-style-type: none">Transphorm Inc., went public and has been traded on the NASDAQ stock exchange since 2022.
In 2021	<ul style="list-style-type: none">Infineon and Panasonic announced that they are jointly developing second generation normally-off GaN transistors.Following the acquisition of GaN developer Exagan, STMicroelectronics launched its first MasterGaN® products.Navitas Semiconductor debuted on the NASDAQ stock exchange.ROHM Semiconductor announced its first 3 GaN transistors and Nexperia launched its first 6 GaN transistors.
In 2022	<ul style="list-style-type: none">The Oudenaarde GaN foundry operation of onsemi in Belgium was sold-off and acquired by BelGaN.Odyssey Semi became the first company to achieve 1200V operation of a vertical GaN power FET device.
In 2023	<ul style="list-style-type: none">Infineon Technologies (Germany) acquired fabless GaN Systems (Canada) for US\$830 million.
In 2024	<ul style="list-style-type: none">Renesas Electronics Corp. (Japan) announced its intention to acquire Transphorm, Inc. (USA) for approx. \$339 million.The UK Government approved Vishay's acquisition of the Newport Wafer Fab from Nexperia on national interest and security grounds.Vertical GaN start-up Odyssey Semiconductor agrees to sell itself to an unnamed large semiconductor company.

Omdia recently identified 2 additional Chinese manufacturers of GaN power semiconductors: Prisemi and Galaxy Microelectronics.

Gallium Nitride (GaN) device manufacturers and foundry providers



Selected GaN foundry service providers:



Gallium Nitride key market drivers and barriers

- Growth drivers and inhibitors

Key drivers and barriers for growth for Gallium Nitride



Drivers

- Improved power conversion efficiency
- Very high switching frequencies
- Enables smaller systems; size, weight and cost reductions
- Wide operating temperature
- Robust, reliable, radiation-hard
- Easier to manufacture than SiC
- Cheaper to manufacture than SiC
- Selling prices closer to Si
- No body diode
- Ease of device integration with Si
- Several GaN foundry service providers

Inhibitors

- Design inertia, perception, fear
- Price perception: high epi material costs
- Not drop-in swap for Si or SiC
- Normally-off switches preferred
- Proof of reliability
- High-temperature, high-frequency packaging
- Availability; few 2nd sources exist
- GaN defects
- GaN-on-Si material mismatch
- Narrower operating temperature than SiC

Key drivers and barriers for growth for Gallium Nitride



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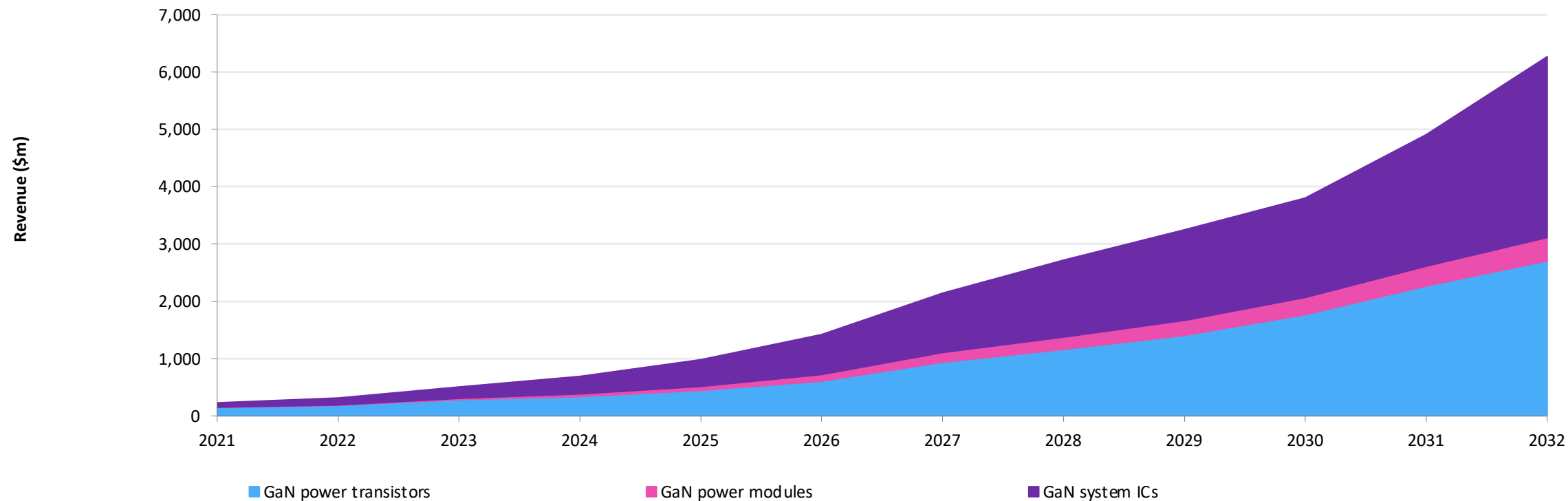
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Gallium Nitride market forecasts

- GaN market by applications and products
- Market size variance over time

The GaN market by product type

Overall GaN revenue by product



Source: Omdia

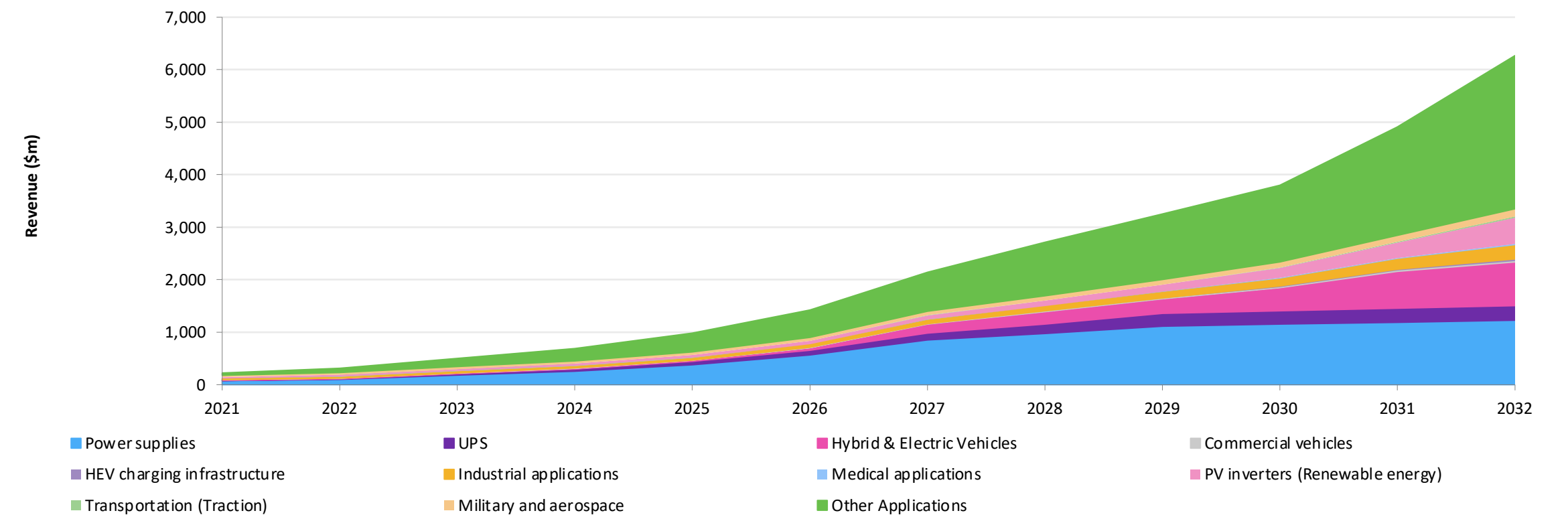
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Data: Gallium Nitride Market Tracker – Database – 2023 Final
Omdia Wide Bandgap Intelligence Service



The GaN market by application sector

Overall GaN revenue by sector

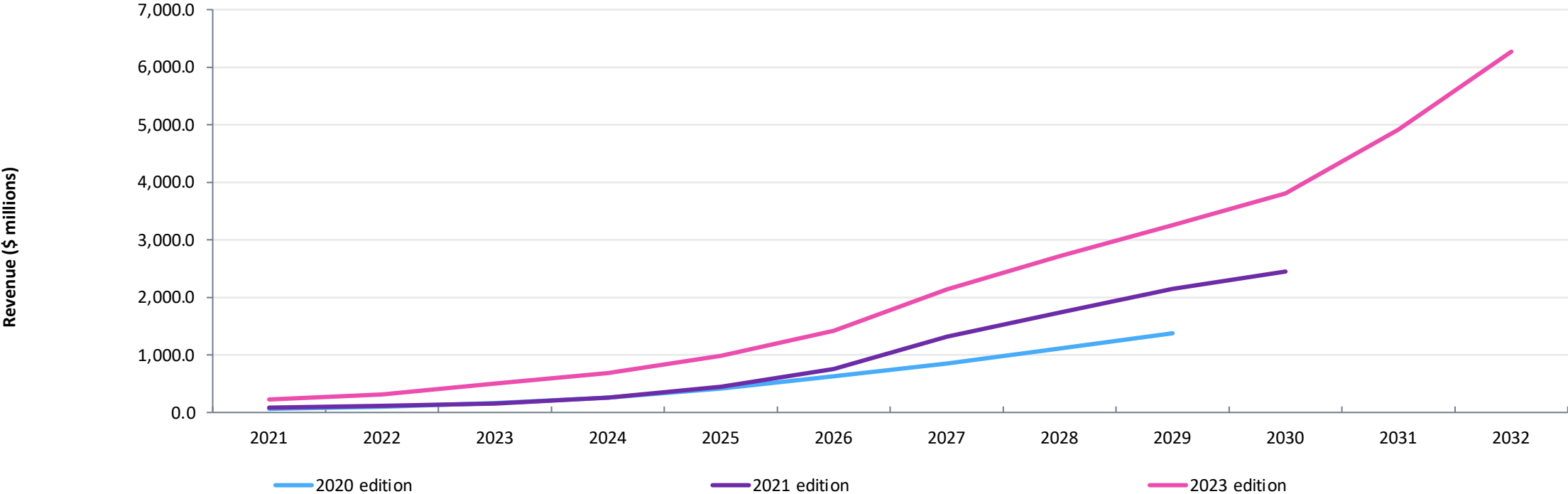


Source: Omdia © 2024 Omdia

Data: Gallium Nitride Market Tracker – Database – 2023 Final
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Variance between this and previous editions of the same data

Variance between 2023, 2021, and 2020 for GaN power semiconductor reports



Source: Omdia

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Data: Gallium Nitride Market Tracker – Database – 2023 Final
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Discussion

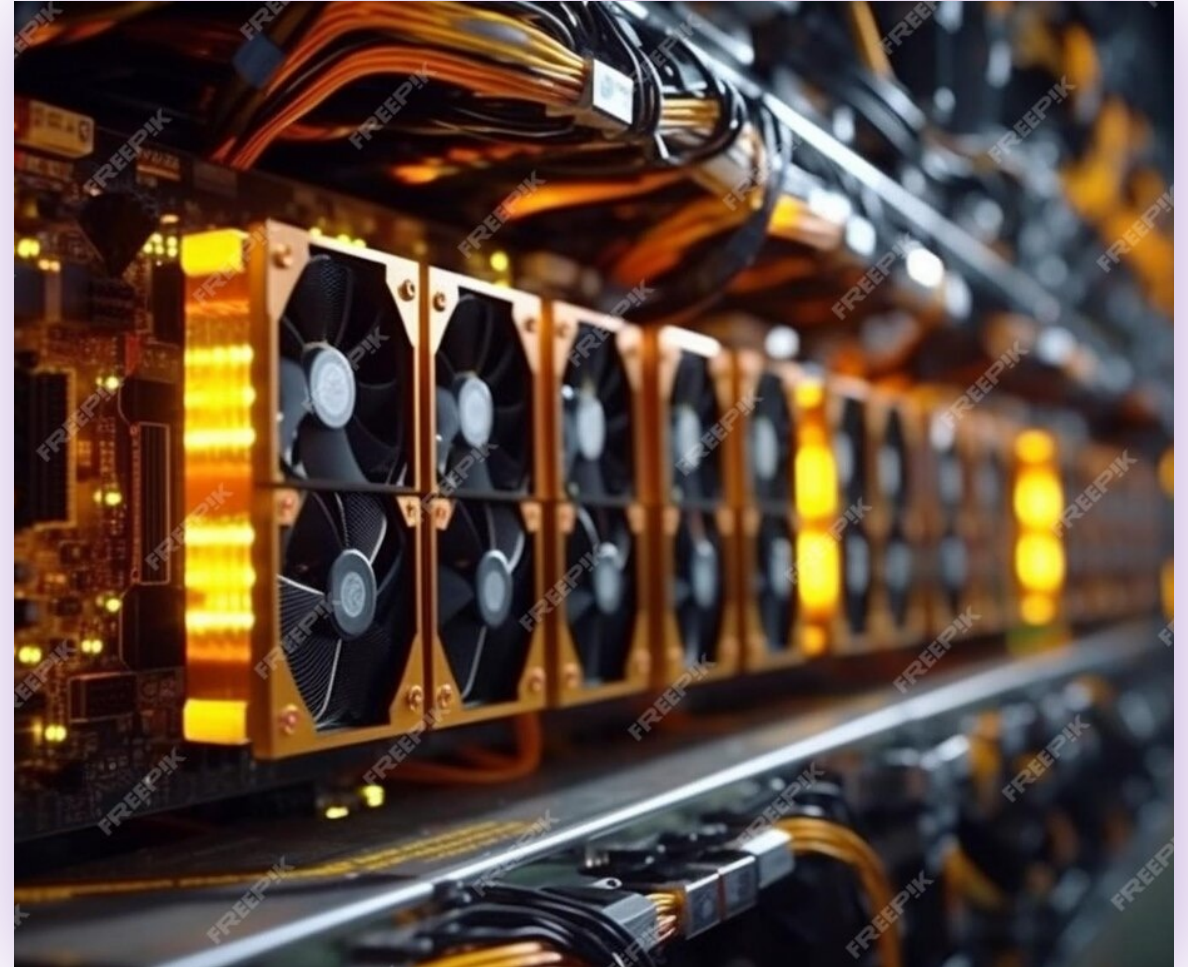
- Where will GaN Power Semiconductors find success in the 2020s?

Applications where GaN power semiconductors may be used

Power supplies:

1. Telecom PSUs, such as fast charging adaptors for cell phones, rectifier PSUs for cellular base-stations, etc.
2. Computing & server PSUs, such as Datacenter PSUs, AI server PSUs, 48V server bus PSUs, fast charging adaptors for portable PCs, computer office peripherals, etc.
3. Consumer PSUs for televisions and entertainment systems, fast charging adaptors for portable devices and cameras, set-top boxes, consumer audio equipment, etc.

UPS systems, especially for single-phase (<5.1 kVA) UPS systems.



Applications where GaN power semiconductors may be used

Automotive hybrid and electric vehicles (xEV):

1. Niche powertrain applications, like “microEVs” (96V batteries), “miniEVs” (400V batteries), 48V mild hybrid vehicles, etc. High potential in the long-term, not soon. (SiC will dominate in higher-end vehicles powertrain inverters.)
2. On-board chargers are already looking at GaN, with production ramping from 2026 onwards, replacing silicon in smaller, low-cost vehicles. (SiC will be used in higher-end vehicles.)
3. DC-DC converters, with similar production to OBCs, ramping from 2026 onwards, in smaller, low-cost vehicles.

Use of GaN in these applications should also occur in commercial electric vehicles such as electric busses and electric heavy trucks.

Automotive LIDAR systems, due to ADAS regulations (mainly China)



Applications where GaN power semiconductors may be used

Industrial applications:

1. Precision motor drives for use in delivery drones, robots, robotic lawn mowers, robotic vacuum cleaners, power tools, chargers for personal care appliances – likely to start from 2025.
2. Medical: Precision motor drives for surgical robots for operating theatres, medical imaging system PSUs, and other medical applications.
3. Industrial motor drives for automation and manufacturing, particularly for low-power, low-voltage applications.
4. Renewable energy: GaN power semiconductors will be used in smaller single-phase string inverters and microinverters. GaN power modules could be used in larger 3-phase PV inverters.

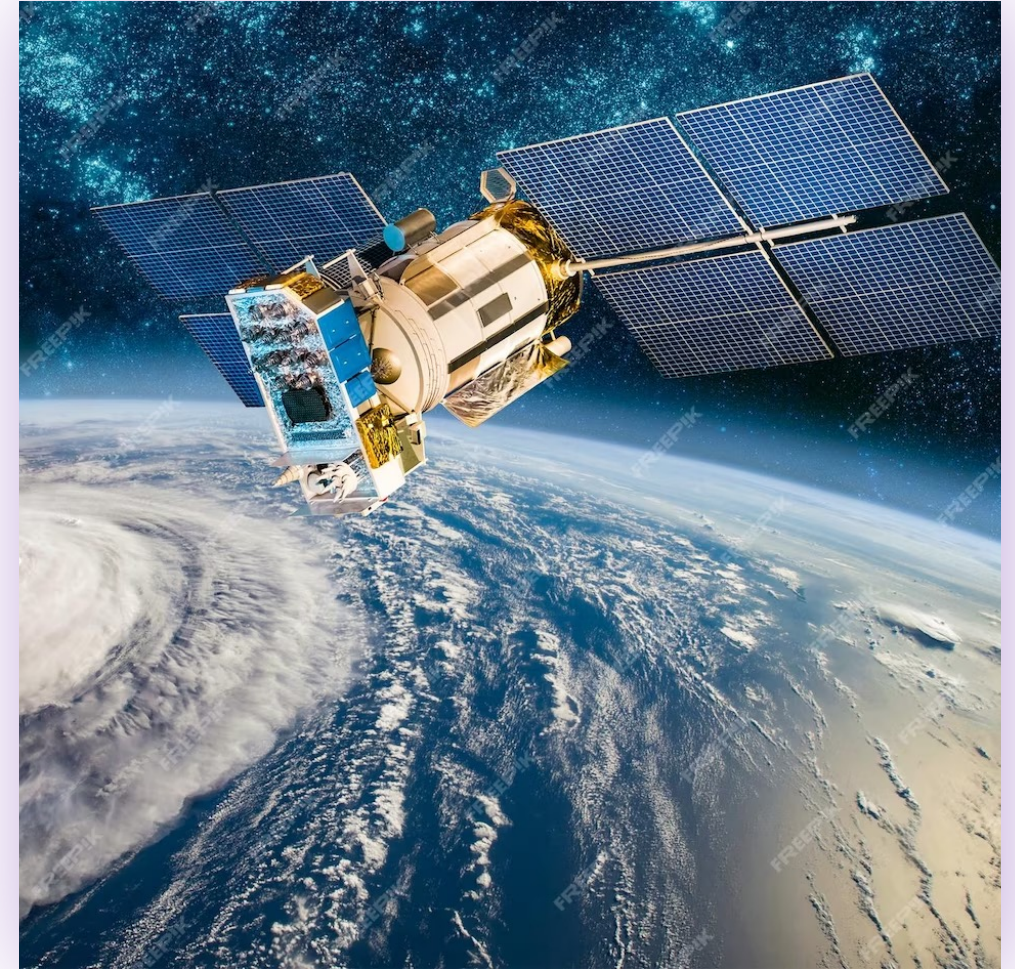


Applications where GaN power semiconductors may be used

Other applications:

1. GaN power semiconductors are penetrating various transportation or traction applications, such as electric bicycles (e-bikes), mobility scooters, forklift trucks, etc. (They are unlikely to feature in railway systems and ships, where SiC will remain dominant.)
2. It is possible that GaN power semiconductors may be used in electric vehicle charging stations, home automation systems, major home appliances, lighting ballasts & control systems, etc.
3. In military and aerospace applications, many commercial orbiting satellites already use GaN power transistors, due to their inherent radiation hardness, compared to silicon.

Basically, Gallium Nitride power semiconductors are so beneficial for power efficiency that they could potentially be used in anything that plugs into mains electricity.



Thank You!

17/04/2024

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