Today, it is crystal-clear that, from theoretical point of view, GaN offers fantastic technical advantages over traditional Si MOSFETs. Even though the current GaN power market remains tiny compared to $32.8B silicon power market, GaN devices are penetrating confidently into different applications: for example, LiDAR applications, which are high-end solutions that take full benefit of high-frequency switching in GaN power devices. The accumulation of the market growth in this application and other various applicative markets confirms a first scenario in which the GaN market is expected to grow steadily (base scenario).

However, this is not the only possibility. Is there any killer application that could cause the GaN power device market to explode?

As matter of fact, several industrial players confirm that Apple is interested in GaN technology for its wireless charging solution. It goes without saying that the potential adoption of GaN by Apple or another smartphone giant would completely change the market’s dynamics and finally provide a breath of life to the GaN power device industry. We imagine that after a company like Apple adopts GaN, numerous other companies would follow on the commercial electronics market.

Indeed, the biggest segment in the power GaN market is still power supply applications, i.e. fast charging for cellphones. In fact, this year Navitas and Exagan introduced 45W fast-charging power adaptors with an integrated GaN solution.

And what about the EV market, where SiC is replacing Si IGBTs in main inverters? What is GaN’s role here? Various players, such as EPC and Transphorm, have already obtained automotive qualification in preparation for GaN’s potential ramp-up. Moreover, BMW i Ventures’s investment in GaN Systems clearly demonstrates the auto industry’s interest in GaN solutions for EV/HEV technology.

Globally, Yole Développement’s (Yole) second scenario (bull scenario), which is more aggressive, projects that the GaN power business will reach around $423M by 2023, with a compound annual growth rate (CAGR) of 93%.

This report conveys Yole’s understanding of GaN implementation in different market segments, with two possible scenarios. Our report also delivers comprehensive market projections for GaN power discrete and the IC device market, and conveys our understanding of the market’s current dynamics and future evolution.
WHAT IS POWER GAN’S SUPPLY CHAIN STATUS?

Eight years have passed since the first release of commercial power GaN devices. People in the power industry are becoming increasingly familiar with the names of start-ups that are actively promoting GaN technology. Not surprisingly, the list of pure GaN start-up players is getting longer: Efficient Power Supply (EPC), GaN System, Transphorm, Navitas, and more are coming, according to Yole’s intelligence. Most of these start-up players choose the foundry model, mostly using TSMC, Epsil, or X-fab as their preferred partner. Meanwhile, other foundries might offer this service if the market takes off. The foundry model affords fabless or fab-lite start-ups the possibility of ramping up quickly if the market suddenly takes off, as discussed in the previous section.

It is fascinating to see that along with these start-up players, companies with very different profiles are competing in the same playground: industrial giants like Infineon, On Semi, STMicroelectronics, Panasonic, and Texas Instruments. Several news items caught our attention in 2018:

• Infineon announced it would start volume production for CoolGaN 400V and 600V e-mode HEMT products by the end of 2018
• STMicroelectronics and CEA Leti announced their cooperation in developing GaN-on-Si technologies for both diode and transistor on Leti’s 200mm R&D line, and expect to have validated engineering samples in 2019. In parallel, STMicroelectronics will create a fully qualified manufacturing line, including GaN-on-Si hetero-epitaxy, for initial production running in the company’s front-end wafer fab in Tours, France, by 2020.

These IDMs will leverage their vertically integrated structure and bring to market cost-competitive products.

This report furnishes an overview of the GaN power industry playground, covering the value chain from epitaxy and device design, to device processing. Also outlined is Yole’s understanding of the market’s current dynamics and future evolution.

IS GAN A COST-EFFECTIVE SOLUTION?

The integration of GaN solutions in a final electronics product is a very attractive idea: if properly designed, it will increase system efficiency, and passive components will be smaller because the system can work at higher frequencies. These are significant advantages for the final user…but is that true?

Cost is one of the key aspects to take into account when introducing a new technology to the market, and it is currently not one of GaN’s strong points. GaN’s principal competitor is silicon MOSFET, which has been on the market for many years and offers very competitive cost with high average efficiencies, excellent quality, and superb reliability. Currently, only one company, EPC claims to be at the same price level as silicon with its low-voltage wafer-level package products. However, when standard
packing is added and voltage is increased, the GaN product would cost more than the silicon alternative – and higher cost is often cited as a main barrier to adoption.

Many players have started building integrated systems to be cost-competitive at system level. This is happening not only with D-mode solutions, but also E-mode integrated solutions, which seem appealing for the end user as an easy-to-use product. We also find system-in-package solutions that include Si, i.e. Texas Instruments’ and Exagan’s products, as well as integrated solutions where the driver, ESD protections, and other functions are monolithically integrated i.e. Navitas solutions.

This report features a discussion on device technology and landscape from a cost point of view for the next several years, including not just Si and GaN products but also passive and integrated solutions.

COMPANIES CITED IN THE REPORT (non exhaustive list)


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Authors

Ana Villamor, PhD, Ezgi Dogmus, PhD, and Hong Lin, PhD, all part of the Power & Wireless division at Yole Développement co-authored the Power GaN 2018: Epitaxy, Devices, Applications and Technology Trends report.

Ana Villamor, PhD serves as a Technology & Market Analyst, Power Electronics & Compound Semiconductors. She is involved in many custom studies and reports focused on emerging power electronics technologies at Yole Développement, including device technology and reliability analysis (MOSFET, IGBT, HEMT, etc.). Previously Ana was involved in a high-added value collaboration related to SJ Power MOSFETs, within the CNM research center for the leading power electronic company ON Semiconductor. During this partnership and after two years as Silicon Development Engineer, she acquired a relevant technical expertise and a deep knowledge of the power electronic industry. She holds an Electronics Engineering degree completed by a Master in micro and nano electronics, both from Universitat Autonoma de Barcelona (SP).

Ezgi Dogmus, PhD is daily contributing to the development of these activities with a dedicated collection of market & technology reports as well as custom consulting projects. Prior Yole, Ezgi was deeply involved in the development of GaN-based solutions at IEMN (Lille, France). Ezgi also participated in numerous international conferences and has authored or co-authored more than 12 papers. Upon graduating from University of Augsburg (Germany) and Grenoble Institute of Technology (France), Ezgi received her PhD in Microelectronics at IEMN (France).

Hong Lin, PhD works as a Senior Technology and Market Analyst, Compound Semiconductors since 2013. She is specialized in compound semiconductors and provides technical and economic analysis. Before joining Yole Développement, she worked as R&D engineer at Newstep Technologies. She was in charge of the development of cold cathodes by PECVD for visible and UV lamp applications based on nanotechnologies. She holds a Ph.D in Physics and Chemistry of materials.

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