LYON, France – April 24, 2018: In 2016, *Yole Développement* (Yole) already pointed out the impressive growth of the EV/HEV\(^1\) industry and its huge impact on the power electronics industry with numerous technical issues. Two years later, cards have been handling, the playground is ready and the game should reveal some surprises. In a dynamic context showing a 28% CAGR\(^2\) between 2017 and 2023, Chinese car manufacturers become today major players in the EV/HEV industry while European companies, strongly involved in the development of power modules and components announce their leadership with innovative technologies. As an example Infineon Technologies presented at PCIM 2017 its first double sided cooling power module especially designed for automotive inverters. This module has been analyzed by *System Plus Consulting*, part of Yole Group of Companies including Yole Développement, Knowmade, PISEO and Blumorpho\(^3\).

So the face to face naturally promise to be explosive. What will be the evolution of the EV/HEV supply chain? Yole’s analysts investigate this sector and announce today first results in the new report, *Power Electronics for EV/HEV*.

In this report, they provide updated market metrics and forecasts for electrified vehicles and analyze the differences between geographical areas, as well as the incentives and deterrents for market growth. This technology & market report also presents the main technological trends and ongoing developments for power electronics that target automotive at inverter, power

---

\(^1\) EV/HEV: Electric Vehicle/Hybrid Electric Vehicle  
\(^2\) CAGR: Compound Annual Growth Rate  
\(^3\) *Infineon FF400R07A01E3 Double Side Cooled IGBT Module report*, System Plus Consulting, 2018
module and power device levels. It also includes an overview of the battery pack evolution and its impact on power electronics and highlights business model evolution and supply-chain moves.

Who will benefit from the EV/HEV market’s explosive growth? Yole offers you today a relevant snapshot of the market.

EV/HEV sales continue to surge. In 2017, people bought 1.2 million BEV\(^4\) and PHEV\(^5\), a 52% increase compared to 2016. Full and mild HEV sales accounted for 2.8 million units last year, a 22% year-to-year increase.

Several European car manufacturers also launched their 48V mild hybrid models in 2017. This cost-effective solution, which electrifies vehicle auxiliary systems and at the same time reduces CO\(_2\) emissions, will proliferate in 2018-2019 among all European carmakers, followed by the Chinese ones.

“48V system will rapidly boost the market”, explains Mattin Grao Txapartegi, Technology & Market Analyst from Yole. “We forecast a 50% CAGR for the 2017-2023 period, for mild hybrids, because these low cost electrified vehicle models are attractive. Their approach can be easily implemented in any car, from city cars to higher end luxury models.”

In terms of the geographical split for the potential of the EV/HEV market, Yole’s analysts describe the evolution of the main markets and highlight the main divergences.

For instance, China today is strongly focused on BEV and PHEV segments. Last year China accounted for 50% of global sales in these categories, confirms the market research and strategy consulting company.

And, looking at the evolution of the giant Asian country, it seems that this predominance will continue in the future. Countries like Japan or the USA are more focused on full HEV than these full EV models. It’s also interesting to highlight that even if China represents a huge market for EV/HEV, local companies are involved in car manufacturing, but much less at tier-1 component or power module supplier level. At these stages European, American and Japanese companies are predominant, even in the Chinese supply chain.

Having assessed how each type of electrified vehicle market will evolve, Yole expects double-digit CAGR between 2018 and 2023. This means some 10 million EV/HEVs will be sold by around 2020, and up to 18 million by 2023, across all categories.

Pushed by aggressive legislation, car manufactures select the way of electrification. The full HEV segment will drive the IGBT\(^6\) power module market, with IGBT modules used for EV/HEV. The market for

---

\(^4\) BEV : Battery Electric Vehicle  
\(^5\) PHEV: plug-in hybrid vehicles  
\(^6\) IGBT : Insulated-Gate Bipolar Transistor
IGBTs in the EV/HEV sector is expected to be worth almost US$2.3 billion by 2023.

“In a compact car the maximum power of the motor is 60kW, while the hybrid systems used in medium and large vehicles have inverter power exceeding 160kW,” explains Dr. Elena Barbarini, Project Manager, Power Electronics and Compound Semiconductors, System Plus Consulting. However, when converting an existing petrol vehicle to a hybrid version, the available space in the engine compartment is often so limited that it is difficult to accommodate a PCU. Thus, it is necessary that the PCU, which controls the traction motors of HEVs, get smaller, with higher power density. To achieve these targets, manufacturers have developed different solutions, such as reducing wire bonding or using a double-sided cooling structure to efficiently cool the power semiconductor chips.

Infineon Technology, after its acquisition of International Rectifier in 2014, is showing a strong leadership in the power electronics industry. The HybridPACK Double Sided Cooled power module is the first DSC IGBT module from Infineon Technology. The module drives 700A and uses a molded structure optimized for cooling, thus improving its thermal cycling capability and extending the lifetime of the power module. These results are part of the Infineon FF400R07A01E3 Double Side Cooled IGBT Module report from System Plus Consulting.

For the 6th consecutive year, Yole Développement organizes its Power Electronics Market Briefing during the PCIM Europe show. Entitled “Automotive Power Modules, Design Changes and Technology Innovations to Come?”, the 2018 edition will take place on June 6, 2018 in the Industry Forum Area of PCIM Europe (Nuremberg, Germany), from 10:00 to 11:30 AM.

Yole Group of Companies will be also part of SCAPE 2018 (From June 10 to 12 – Stockholm, Sweden), previously known as ISiCPEAW and IWBGPEAW. It is a three-day event, consisting of two-day workshop and one-day tutorial session. The event will cover the latest results and innovations in power electronics applications of WBG materials, such as SiC and GaN.

To meet our team of analysts, contact us or click here to find more information about the conferences.
ABOUT THE REPORTS:

POWER ELECTRONICS FOR EV/HEV 2018

Who will benefit from the EV/HEV market’s explosive growth? – Produced Yole Développement (Yole).

Companies cited in the report:
BAIC, Beiqi, BWM, Bosch, BYD, Chery, Continental, CRRC/Dynex, Daimler, Delphi, Denso, Dongfeng, DAW, Fiat, Ford, Fuji Electric, Geely, General Motors, Hitachi, Honda, Huanghai, Hyundai, Infineon Technology/International Rectifier, JAC, Kandi, Kia, Macmic, Mitsubishi Electric… Full list

Author:
Mattin Grao Txapartegi is a Technology & Market Analyst | Power Electronics at Yole Développement (Yole). He is engaged in many custom studies and reports dedicated to the evolution of inverters architecture and passive components, from capacitors to protection devices. Today, he investigates power packaging solutions to analyze the latest technical challenges, market growth and competitive landscape. Getting a deep understanding of the technology evolution, the market trends and the strategies of each player are part of his mission at Yole. Indeed Mattin is daily driving technology and market scouting, roadmap definition, disruptive technologies and market opportunities identification and competitive landscape analysis. Previously he acquired a comprehensive expertise in the design of power converters for EV at Renault. As an engineer, Mattin is graduated from Grenoble INP (FR) with specialization in embedded systems for transportation. He has also an advanced master in aeronautics from the Arts & Métiers ParisTech (FR).

INFINEON FF400R07A01E3 DOUBLE SIDE COOLED IGBT MODULE

Discover Infineon’s first double sided cooling power module for automotive – Produced by System Plus Consulting

Authors:
As a Project Manager, Power Electronics and Compound Semiconductors, Dr. Elena Barbarini is in charge of costing analyses for MEMS, IC and Power Semiconductors. She has a deep knowledge of Electronics R&D and Manufacturing environment. Elena holds a Master in Nanotechnologies and a PhD in Power Electronics. Véronique Le Troadec has joined System Plus Consulting as a laboratory engineer. Coming from Atmel Nantes, she has extensive knowledge in failure analysis of components and in deprocessing of integrated circuits.

ABOUT SYSTEM PLUS CONSULTING

System Plus Consulting specializes in the cost analysis of electronics, from semiconductor devices to electronic systems. Created more than 20 years ago, System Plus Consulting has developed a complete range of services, costing tools and reports to deliver in-depth production cost studies and estimate the objective selling price of a product. System Plus Consulting engineers are experts in Integrated Circuits - Power Devices & Modules - MEMS & Sensors - Photonics – LED - Imaging - Display - Packaging - Electronic Boards & Systems.

Through hundreds of analyses performed each year, System Plus Consulting offers deep added-value reports to help its customers understand their production processes and determine production costs. Based on System Plus Consulting’s results, manufacturers are able to compare their production costs to those of competitors. System Plus Consulting is a sister company of Yole Développement. More info on www.systemplus.fr.

ABOUT YOLE DEVELOPPEMENT

Founded in 1998, Yole Développement (Yole) has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide covering MEMS and image sensors, Compound Semiconductors, RF Electronics, Solid-
state lighting, Displays, Software, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Nanomaterials, Power Electronics and Batteries & Energy Management.

The “More than Moore” market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business. For more information, visit www.yole.fr and follow Yole on LinkedIn and Twitter.

* Consulting & Financial Services: Jean-Christophe Eloy (eloy@yole.fr)
* Reports: David Jourdan (jourdan@yole.fr)

Yole Group of Companies - Press Relations & Corporate Communication: Sandrine Leroy (leroy@yole.fr)

###