

# GAS AND PARTICLE SENSORS - TECHNOLOGY AND MARKET TRENDS 2021

Market & Technology Report - July 2021

*Vehicles still use most gas sensors, but the consumer market is accelerating the digitalization of smell.*

## WHAT'S NEW

- New market forecast up to 2026 in value and units by application for gas and particle sensors
- Market trends for each segment described in both gas and particle sensors
- Updated market shares and technology breakdown
- Updated ecosystem of players and market shares
- New part about digital olfaction, or electronic noses, with market forecasts and trends, players, and technology
- Additional information on the technology trends from combo sensors to e-noses and artificial intelligence

## KEY FEATURES

- Gas sensor market forecast 2019-2026 (volume, value)
- Particle sensor market forecast 2019-2026 (volume, value)
- Market shares of gas sensor players
- Market share of particle sensor players
- Market share and trend by gas sensors technologies
- Main challenges for gas and particle sensors (miniaturization, power consumption, ...)
- Roadmap for new products and technologies

## A \$2.2B MARKET WITH MOMENTUM IN CONSUMER AND INDOOR AIR MONITORING MARKETS

The quality of the air we breathe remains a major global issue for the health and safety of people. The World Health Organization links 4.2 million deaths per year to pollution issues and exposure to toxic or dangerous gases. The cost of pollution is also a significant economic impact. The World Bank estimates it to be 4.8% of global GDP.

But outdoor pollution is not the only concern today. Growing interest in indoor air monitoring has been amplified by the COVID-19 pandemic. Studies have shown correlations between the presence of exhaled aerosols of micro-droplets and the possible transmission of the virus carried by its aerosols. This fosters the need to control enclosed spaces such as classrooms, offices and public places.

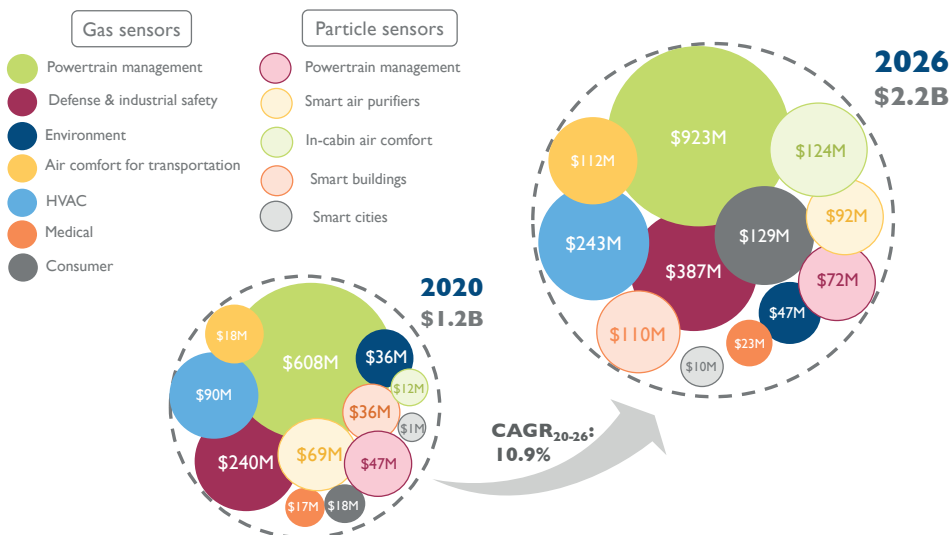
Environmental sensors, such as gas sensors and particle sensors, are more interesting in areas of indoor air management. In total, gas and particle sensors are expected to be worth \$2.2B in 2026, up from \$1.2B in 2020, with a compound annual growth rate of 10.9%.

The very established automotive powertrain, industrial and Heating, Ventilation and Air Conditioning markets still dominate, generating

around 80% of gas and particle sensor sales. But consumer applications seem finally ready to take off, thanks to the development of smart home and wearables. Such products make it possible to monitor both indoor and outdoor air quality, enabling consumers to act according to information measured. This is the market where the biggest momentum is expected, with nearly 40% growth over the period 2020-2026. The development of automotive in-cabin solutions is also an expanding market, showing interest in terms of both comfort and safety.

It is the question of usage and use case that has held back the interest of gas and particle sensors in the consumer sector for a long time. The traditional applications of these sensors are mainly linked to regulations at international, national or local levels, as well as security rules in the industrial or defense field. But what are the possible uses for consumers? How can gas and particle sensors help consumers act on the information collected by the sensors? And where does the race towards electrification's threat to demand in the automotive powertrain sector come in? All of these issues are addressed in the new Gas and Particle Sensors 2021 report.

### 2020-2026 gas and particle sensors forecast - Breakdown by application (\$M)



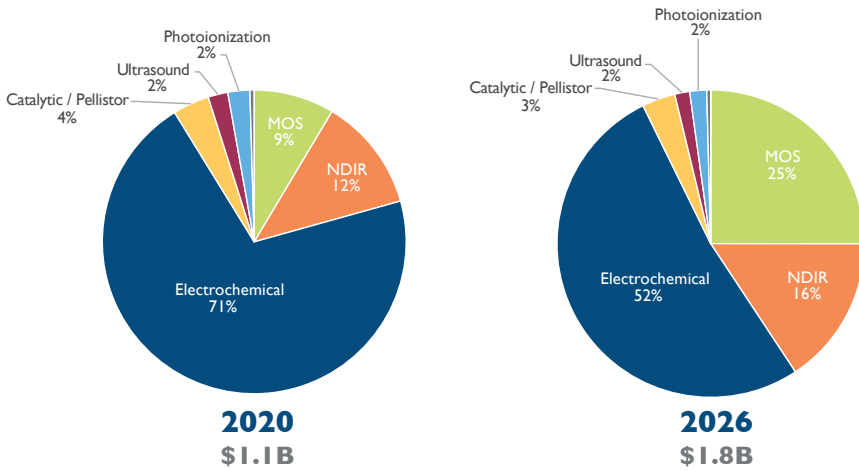
(Yole Développement, July 2021)

### SERVING GROWING MARKETS

Automotive players remain unequivocally the main suppliers of gas sensors with more than 55% market share. Bosch is still the leader with 22% of the global market share.

The last two to three years have built the ecosystem around the players offering solid-state gas sensor solutions. This shows once again the interest of diversifying towards new markets whose need small, low power, battery-based applications. We find big names in the semiconductor and MEMS field strengthening their technological knowledge or their access to the market via acquisitions. Renesas bought IDT and Sensirion recently bought the gas analyzer company Qmicro. ams AG has also re-organized its gas sensor activity via a joint venture creating Sciosense. These companies are positioning themselves in these new volume markets of automotive in-cabin comfort, domestic ventilation or even home appliances and consumer devices. Infineon and TDK Invensense are also set to join the gas sensor market in the course of 2021 with the commercialization of their new solutions. In the particle sensor market, Plantower dominates by revenue earned, and is closely behind Sharp in terms of shipments. Sensirion is expected to be a strong player in coming years.

**Gas sensor technology breakdown – 2020 vs. 2026**



Lambda probes are included in electrochemical technology ; other technologies like chemiluminescence are representing less than 1% but are described in the report.

(Yole Développement, July 2021)

### APPLICATION-DRIVEN TECHNOLOGIES: MOS AND NDIR TAKE SIGNIFICANT SHARE

The trend for needs of Metal Oxide Semiconductor (MOS) and Non-Dispersive infrared (NDIR) technologies is confirmed in domestic applications such as air purifiers, air monitoring stations in

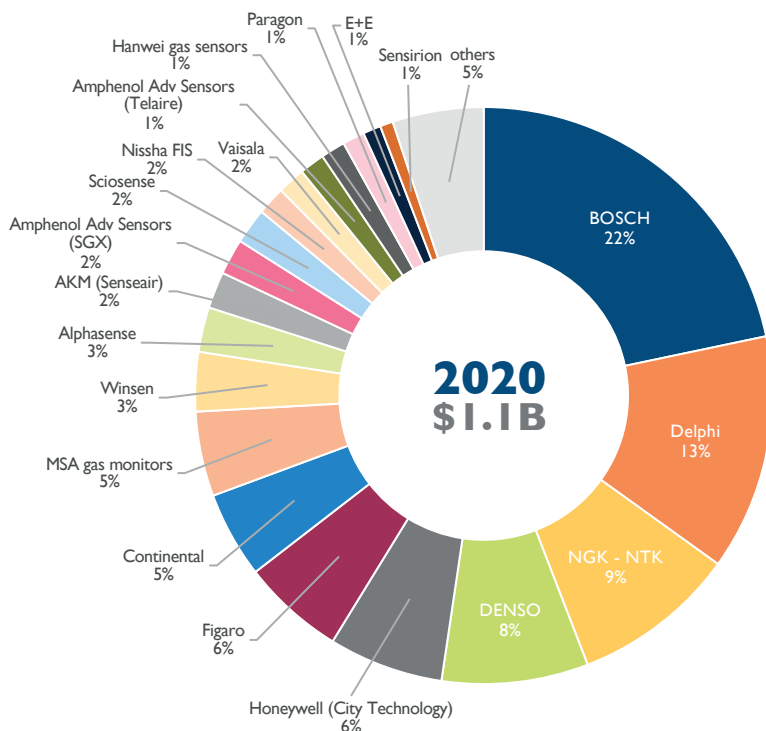
smart homes or even in automotive cabins. Gases such as CO<sub>2</sub>, NO<sub>x</sub> or VOCs are the main targets for these technologies. The lack of selectivity of MOS technologies and the bulkiness of NDIR sensors has slowed down the adoption of MOS and NDIR based sensors for a long time..

Together, both technologies represent about a quarter of the market share in 2020. We expect this to grow to 41% of global revenues in 2026, thanks to emerging applications and technological advances that are more selective and smaller. MOS and NDIR are expected to decrease the historical market share of electrochemical detectors.

In the field of particle sensors, a transition has already started concerning optical detection through optical scattering. In particular this means the use of laser sources instead of LEDs, allowing better measurement of both higher concentration and smaller size particles.

The 2021 release of the Gas and Particles Sensors report also describes development towards environmental combos (Bosch, TDK Invensense, ...) and electronic noses (Aryballe, AlphaMOS, ...) to measure not only gases but more complex odors. Artificial intelligence is embedded in certain new sensors. Here too, new applications could benefit from advances in digital olfactometry to the benefit of applications like food safety or early detection of diseases and even comfort in autonomous and shared transport.

**Gas sensor industry - 2020 market shares by company**



(Yole Développement, July 2021)

**REPORT OBJECTIVES**

Identification and analysis of the applications:

- Determination of the applications using gas and particle sensors
- Technical and economic requirements, by main applications
- Trends identified in each application
- Sensor market size and market forecast 2019 - 2026, in \$M and Munits

Description of player ecosystem and dynamic:

- Identification of key players and market shares
- Identification of M&A, collaborations

Analysis and description of the technologies involved:

- Existing and future gas and particle sensing technologies
- Who is developing what?
- Competing technologies and organizations, per application
- Main challenges: sensitivity, selectivity, packaging
- New technology trends: manufacturing, AI, combos, e-nose

**COMPANIES CITED IN THE REPORT (non exhaustive list)**

AerNos, Air Liquide, AKM, AlphaMOS, AlphaSense, Amphenol, ams AG, APIX, aromabit, Aryballe, Bosch, Calyx, DD Scientific, Delphi, DENSO, Dynament, E+E, Edinburgh Sensors, eLichens, FaradaIC, Figaro, Foobot, GSS, Habitat Map, Hanwei, Honeywell, Infineon, IOS, I-Pex, IQAir, KWJ Engineering, Legrand, LG, Membrapor, Micro-Hybrid electronic GmbH, Mipex, MirSense, Mitsu, MSA, Murata, MyDx life, Nanoz, Nenvitech, Netatmo, NGK - NTK, Nissha FIS, NXP, Optosense, Paragon, Plantower, Plasmion, Piera Systems, PSS, Purple Air, Renesas, Roboscientific Samyoung, Schneider, Sciosense, Sensata, Sensigent, Sensirion, Sharp, Sorex Sensors, SPEC, Spectral engines, Stoneridge, TDK Invensense, TellSpec, Tera systems Vaisala, Vaporsense, Wise, Winsen, Xiaomi, and more.

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**RELATED REPORTS, MONITORS & TRACKS**



- MEMS Pressure Sensors – Technology and Market Trends 2021
- Status of the MEMS Industry 2020
- Power Electronics for E-mobility 2021
- Neuromorphic Computing and Sensing 2021
- Particle Sensor comparison 2019

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**AUTHORS**

**Jérôme Mouly** is Team Lead Analyst in the Sensing & Actuating team within the Photonic & Sensing Division at Yole Développement (Yole). Jérôme manages the expansion of the technical expertise and market know-how of the team. He actively supports and assists in the development of a dedicated collection of market & technology reports as well as custom consulting projects. He has conducted more than 100 marketing and technological analyses for industrial groups, start-ups, and institutes in the field of MEMS and sensing technologies. Jérôme is regularly involved in international conferences, with presentations and keynotes. Jérôme Mouly earned a Master of Physics degree from the University of Lyon (FR).

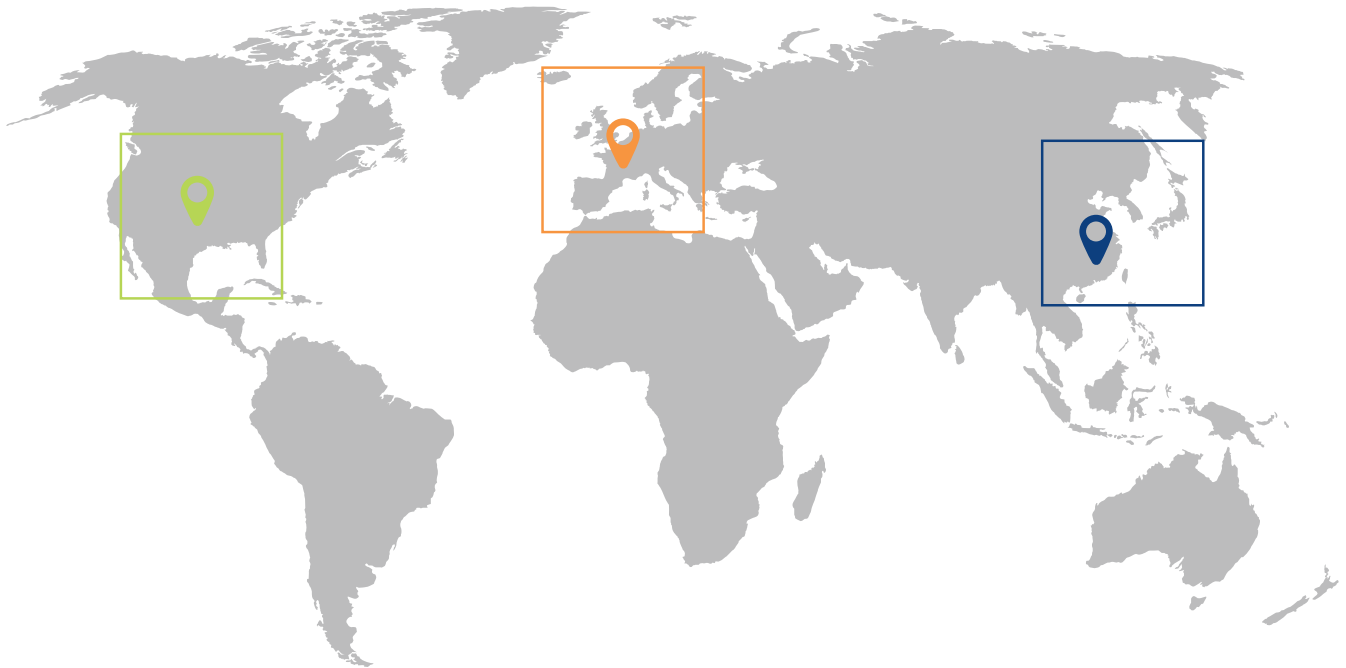


**Dimitrios Damianos**, Ph.D., is a Technology & Market Analyst, part of the Photonics & Sensing division at Yole Développement (Yole). Based on solid technical expertise in imaging, sensing, display, lighting, and photonics, Dimitrios oversees the day-to-day production of valuable technology & market reports and custom consulting projects. Dimitrios also serves as a member of the Custom Project Business Development division (CPBD), supporting the development of strategic projects and following Yole's leading customers within the semiconductor industry. Dimitrios holds a BSc in Physics and an MSc in Photonics, both from the University of Patras (GR), and a Ph.D. in Optics & Microelectronics from the University of Grenoble-Alpes (FR).



**Pierre Delbos** is a Technology & Market Analyst in the Photonics & Sensing division at Yole Développement. Pierre is involved in the development of technology and market reports covering MEMS & sensing technologies, including inertial sensors, microphones, gas sensors and electronic noses. He also collaborates with his team on custom studies for key players in the MEMS Industry. Pierre is preparing his Microelectronics and Photonics Engineering degree at the Grenoble Institute of Technology PHELM (Grenoble, France).

## CONTACT



### **Western US & Canada**

Steve Laferriere - [steve.laferriere@yole.fr](mailto:steve.laferriere@yole.fr)  
+1 310 600-8267

### **Eastern US & Canada**

Chris Youman – [chris.youman@yole.fr](mailto:chris.youman@yole.fr)  
+1 919 607 9839

### **Europe and RoW**

Lizzie Levenez – [lizzie.levenez@yole.fr](mailto:lizzie.levenez@yole.fr)  
+49 15 123 544 182

### **Benelux, UK & Spain**

Marine Wybraniez - [marine.wybraniez@yole.fr](mailto:marine.wybraniez@yole.fr)  
+49 69 96 21 76 78

### **India and RoA**

Takashi Onozawa – [takashi.onozawa@yole.fr](mailto:takashi.onozawa@yole.fr)  
+81-80-4371-4887

### **Korea**

Peter Ok - [peter.ok@yole.fr](mailto:peter.ok@yole.fr)  
+82 1040890233

### **Japan**

Miho Ohtake – [miho.ohtake@yole.fr](mailto:miho.ohtake@yole.fr)  
+81 34405-9204

Toru Hosaka – [toru.hosaka@yole.fr](mailto:toru.hosaka@yole.fr)  
+81 90 1775 3866

### **Japan and Singapore**

Itsuyo Oshiba – [itsuyo.oshiba@yole.fr](mailto:itsuyo.oshiba@yole.fr)  
+81-80-3577-3042

### **Greater China**

Mavis Wang – [mavis.wang@yole.fr](mailto:mavis.wang@yole.fr)  
+886 979336809 +86 136 61566824

### **Sales Coordination & Customers Service**

David Jourdan – [david.jourdan@yole.fr](mailto:david.jourdan@yole.fr)  
+33 472 83 01 90

Fayçal El Khamassi – [faycal.khamassi@yole.fr](mailto:faycal.khamassi@yole.fr)  
+33 472 83 01 95

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### **CONTACTS**

For more information about :

- Consulting & Financial Services: Jean-Christophe Eloy ([eloy@yole.fr](mailto:eloy@yole.fr))
- Reports & Monitors: David Jourdan ([david.jourdan@yole.fr](mailto:david.jourdan@yole.fr)) & Fayçal Khamassi ([faycal.khamassi@yole.fr](mailto:faycal.khamassi@yole.fr))
- Public Relations: Sandrine Leroy ([sandrine.leroy@yole.fr](mailto:sandrine.leroy@yole.fr))
- Marketing & Communication: Jean-Christophe Eloy ([eloy@yole.fr](mailto:eloy@yole.fr))