

***Mid IR Sensors: -- Markets Reach \$30 Billion By 2022***

LEXINGTON, Massachusetts (July 9, 2016) – WinterGreen Research announces that it has published a new study *Mid IR Sensors: Market Shares, Strategy, and Forecasts, Worldwide, 2016 to 2022*. Next generation Mid IR Sensors are leveraging new technology. The 2016 study has 885 pages, 390 tables and figures. Worldwide mid IR sensor markets are poised to achieve significant growth as the Internet of things creates demand for more and more sensors. Everything needs a sensor to be connected to the Internet and available to smart phone apps.

Mid IR sensors can measure chemical composition of materials and gas. The efficiency is unmatched by any other technology; cost is increasingly competitive. Mid IR is extending use beyond military applications to commercial systems, including the Internet of things where sensors become part of network systems.

Mid IR sensors are the base of the Internet of Things initiatives, they form the building blocks for all different types of imaging and controls. Drones, robots, industrial robots, machines, cameras, buildings, fire departments, traffic lights, traffic control, the military, the border patrol, law enforcement, healthcare, asthma treatment, virtually everyone will increasingly use mid IR sensors.

The Internet of Things (IoT) does not work without sensors, mid IR sensors provide a significant aspect of modern visualization and sensing. Drones use mid IR sensors for cameras and for navigation. Robots use mid IR cameras for navigation. The intelligence community has used this mid IR sensor technology for a long time and the technology is now gaining traction in the commercial markets.

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Mid-IR QCL systems have achieved price performance levels that are increasingly attractive. Vendors bring sensing capabilities to a broad range of applications, including: spectroscopic and bio-medical imaging; materials characterization; standoff explosive detection; microscopy; and non-destructive testing. Spectroscopy and imaging



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measurements are easier, faster and more cost-effective leveraging advances in mid IR sensing.

Mid-infrared sensors and imaging applications depend on quantum cascade laser (QCL) technology. Daylight Solutions quantum cascade laser (QCL) technology has been delivered to more systems for more customers in more applications than all other QCL-based solutions combined. Advances in QC laser technology and spectrometer hardware are combined with spectroscopic techniques. Intra pulse spectroscopy and similar techniques provide a major step change in sensitivity, speed of operation, fingerprinting capability, size and cost. They offer a major improvement on methods of gas detection. Recent advances in spectrometer hardware relate to QC gas sensors. Advances exploit recent technological advances including miniaturized integrated electronic systems, plug and play interfaces and micro optics. These will progressively replace unwieldy, fragile and expensive instrumentation.

The lasing wavelength for QCL's is determined by the choice of semiconductor material. By adjusting the physical thickness of the semiconductor layers new functionality is achieved. This removes the material barriers associated with conventional semiconductor laser technology.

An infrared spectroscopic laser source has no need for cryogenic cooling, provides high output powers, has large spectral coverage, provides excellent spectral quality, and has good tunability. The removal of the noise floor provides competitive advantage because it can be implemented without the need of complex fringe removal techniques. It can be done without expensive optical isolators. The feature that allows manageable removal of the noise floor enables the laboratory performance of technology to be commercialized.

Mid IR analyzers in process control are expected to save trillions of Btus annually in the petrochemical sector. Process control and environmental monitoring potential applications are evolving for this technology.

Examples of mid IR applications follow.

- Combustion emissions analysis
- Fugitive emissions control
- Contraband detection
- Improved safety conditions for plant workers
- On-site detection of chemicals

Medical applications include human breath monitoring, glucose sensing, cancer detection and diagnostics, eye surgery, and environmental health monitoring. Medical and industrial monitoring utilizes trace detection of benzene, toluene or xylene. Medical



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applications account for a growing mid-IR laser market. The medical area is evolving in both diagnostics and treatment. Improved diagnostics are made possible through photonic technologies. Mid IR sensors deliver a better understanding of disease: Optical molecular imaging is anticipated to be significant.

Mid IR sensors hold the possibility of making medicine much more advanced because of the visibility into patient conditions that will be possible. As visibility into patient condition is refined, so also remedies will be much more refined. Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse set of energy technologies.

Mid-IR sensor systems have achieved price to performance levels adequate to assure rapid adoption. Capabilities address a broad range of applications, including: location of people as targets, spectroscopic and bio-medical imaging; materials characterization; standoff explosive detection; microscopy; non-destructive testing. Spectroscopy, and imaging measurements. These are easier, faster, and cost-effective.

Military applications account for a significant portion of mid IR sensor markets. The remaining part of revenue comes from CO2 sensors, building sensors, and units for a range of different markets. Markets at \$4.19 billion in 2015 are anticipated to reach \$30 billion by 2022 as price performance increases and unit costs decrease from \$3,000 per unit to \$2,000 per high end unit. \$300 per mid-range sensor has dropped to \$200. \$8 has dropped to \$6 per unit providing price points that make the sensors affordable. or less per unit on average drive further interest from commercial buyers.

The decrease in size of units from bench size devices to portable units makes them more useful across the board in every industry.

WinterGreen Research is an independent research organization funded by the sale of market research studies all over the world and by the implementation of ROI models that are used to calculate the total cost of ownership of equipment, services, and software. The company has 35 distributors worldwide, including Global Information Info Shop, Market Research.com, Research and Markets, electronics.ca, and Thompson Financial.



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WinterGreen Research is positioned to help customers facing challenges that define the modern enterprises. The increasingly global nature of science, technology and engineering is a reflection of the implementation of the globally integrated enterprise. Customers trust wintergreen research to work alongside them to ensure the success of the participation in a particular market segment.

WinterGreen Research supports various market segment programs; provides trusted technical services to the marketing departments. It carries out accurate market share and forecast analysis services for a range of commercial and government customers globally. These are all vital market research support solutions requiring trust and integrity.

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