

NanoMarkets Report

Radiation Detection Markets: 2014–2021

Nano-725

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SUMMARY

This report follows on from NanoMarkets' successful reports on radiation detection equipment and radiation detection materials in 2013. It identifies the new opportunities that continue to emerge from the sales of equipment designed to detect ionization radiation. In many ways the medical detection equipment market is quite mature. But its customers can often be found in areas that change with shifting socioeconomic conditions. For example, a major market for radiation detection is in the nuclear power industry; a sector that rises and falls according to the energy policies of the day. Another major purchaser of radiation detection gear is healthcare, a demand that is boosted by the aging population in developed countries.

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The customer base for radiation detection equipment is very broad and includes the food, pharmaceutical and mining industries, as well as the medical and nuclear power sectors mentioned above. In addition, radiation detection is used in both the military and domestic security. The bottom line is that while radiation detection may be settled technology, it continues to deliver value and evolve with changing needs.

In this report, we explore the revenue potential for radiation detection over the next eight years in three diverse market sectors: industrial and laboratory, security, and medical. The report also includes eight-year (volume and value) forecasts for key sensors used in radiation detection applications, such as medical gamma cameras, RIIDS, portal monitors, PET detectors, oil exploration and scientific sensors, etc. As in NanoMarkets' previous reports in this space, all demand forecasts in this report are segmented by device type and world region. In addition, this report analyzes the products and marketing strategies of the leading suppliers of radiation detection equipment in the markets covered.

NanoMarkets believes that business development executives and product management professionals, as well as investors and entrepreneurs, involved with radiation detection equipment will benefit from the comprehensive analysis of the radiation detection equipment included in this report which:

- Identifies major sectors using radiation detection systems.
- Lists out opportunities for devices in traditional and un-conventional applications.
- Points out technological advancements in the field and identifies detectors beneficial for developing efficient systems and devices.
- Analyzes different types of detectors, their advantages and limitations for certain applications.
- Details the dynamics of the radiation-based industry.

- Discusses products available in the market and continual endeavors of their manufacturers.
- Analyzes the geographical pattern of usage of radiation detectors in coherence with certain applications and their respective domains.
- Signifies new opportunities and challenges in this sector.
- Discusses the role of prominent regulations and regulatory authorities in monitoring radiation levels and exposures
- Assesses forecasts of detectors in various applicative domains for the next eight years.

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RELATED REPORTS

- [Markets for Radiation Detection Equipment](#)
- [Radiation Detection Materials Markets-2013](#)
- [Radiation Detection Materials Markets - 2011](#)

Chapter One: Introduction

1.1 Background to the Report

NanoMarkets believes that radiation detection systems continue to offer attractive opportunities in many application domains. Technologies for monitoring, mapping, detecting and quantification of ionizing radiations emitted from nuclear and radiological materials are continually advancing and are being exploited in many industries. Exhibit 1-1 shows some of the breadth of products and applications that already make up today's radiation detection market.

Exhibit 1-1: Classification of Selected Radiation Detection Systems by Functionality and Markets			
Product Class	Product Type	Functionality	Markets
Survey meters	Geiger-Muller counters	Indicate presence of radiation. Advanced models can infer background signals from main radiation of particles, neutrons and gamma if any	These are vital in checking for the presence of radiation from alpha, beta, gamma and neutron emitting materials. Their variety makes them essential in almost all application domains of detectors.
	Ionization chambers		
	Film badges		
Dosimeters	Electronic personal devices (EPDs)	Measure exposure rate and total cumulative radiation. EPDs display the total reading electronically, while others given indication using a meter	Highly useful in HazMat applications, first responders and environmental applications
	Film badges		
	Quartz Fluorescent devices		
	Thermoluminescent devices (TLDs)		
Imaging systems		Useful in healthcare settings, help by detecting radiation in the form of photographic films that are used for analysis.	A highly active research field for exploring scintillators and semiconductor materials that convert their signal to an image format while using advanced computational technology
Spectrometers		Novel systems measuring distribution of radiation in relation to energy, helps in identification of source	These are useful in advanced studies and military operations
Radiation isotope identification devices (RIIDs)		RIIDs are spectrometers that provide information on the type of radioactive element that lies in the close vicinity of the device operator	Offer considerable market potential in military, defense, nuclear energy, food and medical sector.

Source: NanoMarkets, LC

The market for such systems is highly fragmented. However, NanoMarkets believes that there continue to be interesting opportunities throughout the radiation detection market.

1.1.1 Healthcare, Military, Domestic Security: Opportunities Continue to Increase

These are all relatively mature markets for radiation detectors. However, opportunities remain. The development of efficient combinatorial diagnosis and easier accessibility to healthcare procedures throughout the world continues to result in greater utilization of radiation detection systems. The market for detectors has also benefited from advancements in the science of radiology and from better understanding of device and diagnostic systems by medical professionals.

Current trends also suggest that radiotherapy procedures will increase. Super-specialized hospitals in developed nations are already building financial and resource infrastructure for radiation induced treatments, particularly for cancer. Gamma scintillation and X-ray detectors are priority areas of growth.

The defense sector has been challenged by illegal activities, with every nation facing political and socio-economic turmoil. Hence, it is important to detect and identify the transportation of illicit nukes and other radioactive materials. Radiation detectors have a stabilized market in this sector since the industry is impervious to recession. Heavy funding has propelled the greater use of survey meters, personal dosimeters, and area monitors of both fixed and mobile types.

Radiation detectors of a similar kind are used in war zones. Organizations dealing with domestic security concerns continue to deploy radiation detectors for ports, civilian areas, airports, borders, and highways. NanoMarkets believes that these functions—traditionally exclusively carried out by governments—are expanding to meet the needs of some large corporations, which have started employing fixed portal monitors to secure their perimeters.

In addition to primary equipment, we think that the market will also benefit from the fact that personal radiation measurement is highly recommended for people who are constantly exposed to radiation, thus making personal dosimeters and survey meters essential for specific work environment.

NanoMarkets believes that these market segments are primary revenue generators for radiation detectors and will continue to be so. Their market growth is certain and is expanding with new applications appearing. We also see the

addressable markets in these sectors increasing as systems become more efficient and sensitive.

1.1.2 Expanding Business in Workplace and Environmental Monitoring

Several industrial processes already regularly utilize radioactive elements leading to a demand for radiation detection equipment for measuring leaky or faulty production lines. It is also typically important to constantly check personnel radiation exposures. Industries where all this is important include energy generation, radiopharmacy, automotive, aerospace, oil and mining, and resource drilling.

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NanoMarkets believes that the demand from industry for radiation detection will increase in the coming years based on continuing globalization and further industrialization in developing countries. We think that this driver will be an important upward force of the market for survey meters-Geiger counters, scintillation based small pocket-sized dosimeters and fixed portals.

Food industry: Apart from the traditional concepts of industrial radiography, the food industry is also opening up as a market for radiation detectors, and in a big way. With food irradiation becoming acceptable as a sterilizing method, the use of detectors is becoming crucial.

In our opinion, food processing industries create a large opportunity for the utilization of radiation generators and detectors for monitoring permissible levels of radiation for food and beverage de-contamination. However, it is important to note that this market is heavily regulated by governments around the world.

Scrap metal: Scrap metal recycling and waste units are other important segments utilizing radiation detection. Radiation dump zones are heavily guarded and their requirements for measuring radiation levels turn them into a niche but strong market for these detectors. All of this constitutes an opportunity in that environmental considerations are coming more to the forefront.

1.1.3 Technology and the Drive for New and Better Materials

Many of the opportunities that NanoMarkets see emerging in the radiation detection space will be driven by improved technology especially new materials and better electronics/software. As shown in Exhibit 1-2, the range of technology in the radiation detection space is already fairly diverse.

Exhibit 1-2: Radiation Detectors: Selected Market Opportunities			
Device	Sub-category	Application	Opportunities
Gas filled devices	Geiger-Muller counters	Used for detecting charged particles, gamma radiations, and self-powered neutron detection.	Opportunities are immense. GM counters are widely used in numerous applications
	Ionization chambers		
	Proportional counters		
Scintillation	Inorganic and organic	Produce flashes of light in response to the passage of charged particles or high-energy photons through specially chosen solid or liquid materials called scintillators. Inorganic ones are more useful for gamma detection while organic ones are quicker in response.	Inorganic scintillation devices are prominent and the market for both material and device is very large. They are useful in military, healthcare and environmental monitoring for gamma radiations
	Liquid	New systems in study involving solvent, photosensor system. Research shows they are good enough for making spectrometers	
Semiconductor	Solid state materials	Solid ionization chambers	They are small and used for accurate position monitors
Tetrahertz Detectors	Solid materials	Made primarily of Na(Tl) scintillators that give a different range of non-ionizing electromagnetic radiation.	These have become important in the medical and military field as these non-ionizing radiations can easily pass through clothing, detect various biological elements or illicit material depending on use.

Source: NanoMarkets, LC

As NanoMarkets sees it, much of the innovation for radiation detection going forward will come out of the materials labs. In this context, development of semiconductors is the foremost priority at the present time and these will increasingly replace the gas-filled chambers that currently rule the market owing to their cost effectiveness. Semiconductor material-based devices are smaller and smarter than simple GM tubes and NanoMarkets expects to see a lot more innovation in this field. Many companies like Fuji Electronics, Nuctech, Berkeley Nucleonics have already added silicon, gallium arsenide (GaAs), silicon carbide (SiC), cadmium zinc tellurium (CdZnTe) and high purity germanium (HPGe) based detectors to their product line. In the future, there will be many other products of this kind.

NanoMarkets is also expecting some important developments in the nanomaterials space that could lead to a new class of radiation detector. Nanomaterials famously have larger surface areas owing to the small size of nanoparticles and this significantly improves their detection efficacy. Metal organic frameworks (MOFs), nanophotonics, quantum dots and nanocomposites with polymeric matrices are being studied by various research institutes with radiation detection in mind.

The size of the market opportunity here will depend heavily on how cost effective such novel nanomaterials can be made in the context of radiation detection.

1.1.4 Opportunities for Electronics and Software

NanoMarkets also believes that there will be growing opportunities for the electronics and software industry in the radiation detection space. There are two areas, where we expect to see some significant new revenue generation during the course of the forecast period: smaller systems and better algorithms.

Smaller electronics, improved photomultipliers: The device characteristics are moving towards smaller systems with embedded electronics that will eventually improve the portability and handiness of devices. Pancake models of GM counters are ideal systems illustrating the simplest model for detectors.

Circuits are primarily drawn from standard CMOS technology, but now integrated systems with imaging and spectroscopic capabilities are being worked on. In addition to general electronic readout modalities, imaging systems that use pixel detectors fabricated from semiconductors along with scintillator hybrids are the next big thing. Smaller batteries are also an important trend.

Advanced algorithms, complex software: New algorithms and software for separating analysis radiations from the background noise are entering the market. Many companies such as Fluke Biomedical Division of Fluke Electronics, Berkeley Nucleonics, RapiScan Systems, Thermo Fisher Scientific, and Canberra Industries now have a dedicated 'App' library so that they can choose desired software for the individual or networked detector.

We believe that this trend will result in smart detector devices for healthcare and the defense sector where both imaging and electronics reading will be able to distinguish noise from signals. The trend seems more profound for neutron detection systems where it is difficult to separate background gamma radiation from signals.

1.2 Objective and Scope of this Report

This latest report from NanoMarkets quantifies the market for radiation detection equipment. The goal of the report is to identify the key opportunities for all the major types of radiation detection systems and their applications, including novel applications.

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In the context of further commercialization we also analyze technological advances in the field of radiation detection and point out detector trends beneficial to the development of the commercial market for radiation detection. Though the list of manufacturers of the products considered in this report is quite large, we have also discussed the product/market strategies of the key companies that supply to the major market segments.

This report is intended as a worldwide study. But we also discuss important differences in radiation detection equipment markets from region to region. This includes an analysis of the varying regulatory regimes that impact the radiation detection market in significant ways.

The coverage of this report includes the full range of detection equipment, much of which is used across all applications. However, we also provide analysis of specialized equipment used in conjunction with medical diagnostic modalities, industrial radiography and the oil industry.

1.3 Methodology of this Report

The analysts that compiled this report surveyed vast amount of fragmented secondary literature—research articles, news, blogs and presentations given on websites on radiation science and detection technology. Manufacturer's product lines, explanations of technical services, brochures, articles and highlighted news reports were also analyzed in order to understand the microeconomics of the market.

We also conducted personal discussions with entrepreneurs, business managers, technologists, medical professionals, radiologists, radiation scientists and engineers working in the area of making detector equipment and materials as well as using them as end users.

1.3.1 Market Forecasting Methodology

The data collected includes the number of units of detectors sold in a given market segment, average pricing for those devices, supply/demand considerations, emerging technology impacts and their impact on price inflation or erosion. We have used this data to compile our eight-year market forecast.

Pricing: Various ways to assess pricing can be used. In this report NanoMarkets has chosen to use estimation based on a whole unit approach. That is, we have chosen to include the other components as part of the detector, not just the detector chip or subsystem. This was the approach we used in our 2013 report on the same topic, so allows comparisons with last year's forecasts.

Macro-economic trends: Although our forecasts are not based directly on economic conditions, we tacitly assume that for much of the period for which we forecast the economies of the world's major nations will—on average—grow, but at rates that would be considered slow compared with the 1980s through to the financial crisis of 2008.

Currently, there do seem to be major uncertainties and no real clarity on how things will turn out. For example, the consensus is that world recovery will now be led by the developed countries, notably the U.S., and in this consensus account, the U.S. will grow this year by around 3 percent. And yet, it turns out that in Q1 2014, the U.S. economy contracted by 1 percent. Political uncertainty is a factor too, especially in Europe and China.

But while aggregate economic growth will impact the markets in this report, it will not entirely be determined by it. Most of the markets with which we are concerned in this report are experiencing and will experience growth above that projected in the macro forecasts.

1.4 Plan of this Report

Our latest report on radiation detection equipment is cataloged into six chapters each discussing different applications and market segmentation of these devices.

Chapter Two focuses on domestic security, the military industry and its requirement for radiation detection. Sections illustrate the continual need for these devices in not just military operations but also for securing the homeland from multiple targets. Details of different types of radiation detection machines, their growth drivers and applicability are provided. Manufacturers and vendors in this area are given special attention.

Chapter Three is dedicated to radiation detectors in diversified industrial and commercial applications. Relevance of these machines in conventional applications such as pharmacy, mining, and energy exploration is examined. Emerging applications of ionizing radiations in food along with scrap recycling set ups are given critical attention. Successive sections of this chapter also provide information on large-scale radiation detectors used in the big science projects of

the high-energy physics and medical markets. Additionally, the notable manufacturers in this segment are highlighted.

Chapters Four and Five sum up the medical applications of radiation detection equipment. The fourth chapter provides details of the imaging and diagnostic industry pertaining to X-ray detection. Market trends, growth drivers and technological advancements in research laboratories are discussed. These provide information on next-generation X-ray machines.

Chapter Five primarily concerns gamma detectors used for diagnostic and imaging in the medical and healthcare segment. Special attention has been focused on the technicalities of new-age industries that rely heavily on combinatorial diagnostic procedures, novel radiation-based treatment methodologies and safety issues of the nuclear medical industry.

Chapter Six is the summary of the forecasts carried out for each market segment of radiation detection equipment. Forecasting is summarized for the types of detectors, end-user sectors and by region/country.