Scholar Publishing Group
Academic Journal of Energy
https://doi.org/10.38007/RE.2020.010401
ISSN 2790-2714 Vol. 1, Issue 4: 1-12

# *Profound Impact of the Development and Application of Nanomaterials on Economic Development*

**Hossein Bonakdari***

*Ain Shams University, Cairo 11566, Egypt*

**corresponding author*

***Keywords:*** Nanomaterials Development, Development and Application, Economic Development, Far-Reaching Impact

***Abstract:*** Nanotechnology, as a new type of material, has attracted attention from all walks of life since its inception. Especially in recent years, various circles have invested a lot of money in the development of nanomaterials, and it is not yet known whether they can bring much economic benefits. The purpose of this article is to discuss the far-reaching impact of the development and application of nanomaterials on economic development. After consulting relevant materials, the current status of the development of nanomaterials at home and abroad and the application of various nanomaterials and related latest developments are elaborated in detail. Through the use of literature inquiries, online surveys and design questionnaires, a detailed survey and analysis of the current status of nanotechnology applications in medicine and biology, energy development, electronic information industry, and their far-reaching impact on economic development trends. The research results show that at present, my country attaches great importance to the research and development of high materials, especially the development of nano materials. After a detailed investigation, my country's investment in nano-material development funds has been increasing. Last year alone, the funding support and investment increased by 12% compared with previous years. Moreover, the application ratio of nanomaterials in the medical and biological, energy development, and electronic information industries has reached 27%, 55.6%, and 32.5%, and the economic income directly brought by it has reached 70-8.56 billion.

## 1. Introduction

Since the emergence of the nano concept in the middle of the last century, the nano world has attracted widespread attention. Nanometer (nm) is a unit of length. Nanometer is equal to one billionth of a meter ($1nm = 10^{-9}m$). Nanotechnology research is a technical study of the chemical properties and comprehensive applications of various materials with structural and dimensional

lengths ranging from 0.1 to 100 nanometers. It is precisely because of the special radiation size of macro-nano materials that they may have many special radiation effects compared to other macro-nano material products. And for the future development of nano-materials provides a broad industrial application development prospect. In recent years, the wide application of nanomaterials in molecular biology and engineering medicine has attracted extensive academic attention and has become one of the rapidly developing research fields.

Broadly speaking, nanomaterials mainly refer to various micro-solid ultra-fine fiber materials, and the micro-fiber structure needs to be directly adjusted by a nano-space scale (1nm~100nm) at least in one spatial dimension [1]. They usually include a zero-dimensional nano-atom cluster (a cluster of dozens of two-dimensional atoms) and a nano-three-dimensional particle. One-dimensional programming modulation controllable nano multilayer silicon film; two-dimensional programming modulation controllable nano two-dimensional particle film (coating) [2]. And three-dimensional controllable modulation nano-related materials. In short, it generally refers to any material made of a tiny granular particle with a particle size of about 0 nanometers. The particle size should generally not be less than 100 nanometers, and usually the particle size should not be less than 10 nanometers [3].

This article aims to discuss the current status of the development and application of nanomaterials and their profound impact on economic development. Among them, Ciric gave a detailed introduction to the current development technology of nanomaterials, analyzed the material properties and development difficulties of nanomaterials, described the detailed data of China's investment in nanomaterials development, and the significance of its development investment and value [4]. In his article, Hannah puts forward the application status of nanomaterials in various fields, and introduces the economic benefits brought by the application of nanomaterials in various industries, and puts forward research methods on its impact on economic development [5]. In the article, Wang elaborated on the current status of the application of nanomaterials in the medical field, and elaborated on its impact on the development of the medical industry and its direct benefits and indirect benefits on the economic development of my country in this field [6]. A pointed out that my country's investment in the development of nanomaterials has been increasing, and last year alone it increased by 12% compared to previous years, moreover, the application rate of nanomaterials in medicine and biology, energy development and electronic information industry has reached a lot, and the economic income directly brought by it is very considerable [7].

The main research content of this article is to explore the profound impact of the development and application of nanomaterials on economic development. Different from previous research, this article has many innovations based on the research results of previous scholars: First, the questionnaire is distributed by means of random survey, which is more scientific and reasonable. Secondly, using big data statistical methods, using Internet technology and network survey software to conduct a detailed statistical survey on the application of nanomaterials in various industries. In addition, using mathematical models, a mathematical model for the economic impact of nanomaterials has been reasonably constructed.

## 2. Development and Application of Nanomaterials and Economic Development

### 2.1. Policy Guidance for the Development and Application of Nanomaterials in Countries around the World

In the nanotechnology projects of various countries, in addition to nanomaterials as important projects, nanotechnology projects are also listed as key nanomaterials in specific nanotechnology projects. The united states announced the launch of the national nanomaterials program (NNI), which allocated $495 million in fiscal year 2001 [8]. The government’s reason is that today’s

nanotechnology is like a transistor in the 1950s: its scientific and industrial applications will further promote the development of the US economy and prepare for technical talents in the new century. Enhance the competitiveness of US international materials; save resources and energy to ensure the future sustainable development of the US; nanotechnology is the technical foundation for the future development of micro-weapons and defense industries [9]. Participating institutions include the national science foundation, the department of defense and energy, the national institutes of health, the national aeronautics and space administration, the department of commerce, and the national institute of technical standards [10]. The initiative will prioritize support for five areas: basic research; innovative applications; 10 nano-centric centers (6 have been established) and networks; infrastructure; personnel education and training, nanotechnology-induced. Research on moral, legal and social issues of the eight research priorities listed in the US energy program, six are nanomaterials. Germany plans to establish or reorganize six government-enterprise R&D centers and launch a national research plan. France recently decided to invest 800 million francs to build a center with an area of 60,000 square meters and an area of 8 hectares that can accommodate 3500 people. It was used to invent micrometer-scale nanomaterials equipped with advanced equipment and super batteries, and established the center [11]. Committed to processing patent applications and working hard to help corporate research staff successfully build innovative companies. In addition to continuing its new nanomaterials research and development program that Japan has formally started every year, Japan also invests an additional US $200 million each year in new nanometer national plans and new nanotechnology research centers [12]. Obviously, the strategic goal of western developed countries should be the first to carry out strategic deployment in the two fields of technology with strategic foresight, the theoretical basis and application of intellectual property rights, and basic technology research, occupying a strategic commanding height, and close to domestic enterprises [13]. Cooperation to promote biological science and technology research to quickly bring it to market and achieve success [14].

Currently, nanomaterials produced on a commercial scale in the world include: diamonds, magnetic materials, metals, ceramics, composite materials, semiconductor materials, biomedical materials [15]. The most advanced nanomaterials in the world are the united states, japan, Germany and the United Kingdom. According to the investigation, the New York University laboratory developed a nanosphere robot with two arms made of DNA rotating between fixed positions. Research staff believes that the results of this research are also likely to eventually lead to a nanomolecular robot successfully manufacturing nano molecules in advanced molecular factories of tens of thousands of nanometers [16]. Therefore, the important significance of the development of nanomaterials in China lies in: first, nanomaterials will have a major strategic impact on the safe development of our human society, economy, and society in the 21st century [17].

## 2.2. Nanomaterials Development and Application Fields and Prospects

At present, whether at home or abroad, nanotechnology is a forward-looking, strategic basic technology, still focusing on basic research. Nanotechnology has left a lot of room for scientific research, including nanotechnology, which makes qualitative differences between chips and magnetic disks; nanotechnology enables machines to reach the nanometer level; and nanotechnology enables the development of new materials unknown in nature. Nanotechnology research needs the input of the whole society [18]. In the United States, private investment in nanotechnology far exceeds government spending. With the reorganization of Chinese scientific research institutions, nano-research also needs more investment from enterprises [19]. However, some companies in the market blindly invest or use the concept of "nano" to promote products and mislead consumers, which is harmful to the future development of nanotechnology. Any conceptual

market hype will seriously damage modern nanotechnology research and modern industry, which will seriously break the normal social norms of industrial order, and will make real modern nanotechnology and modern industrial products lose more living space. We agree that in the face of the future of nanotechnology, the first thing we need to continue to do is to comprehensively and deeply analyze the importance of nanotechnology in the future to China, grasp the development trend of nanotechnology in the future from the international global strategy, and rationally arrange nanometers [20]. Of course, as a very comprehensive technology, nanotechnology and nanotechnology research in this field, applied technology research and development research of the nano-industry chain are also underway at the same time, and these three must be coordinated with each other [21]. At present, there are still vacancies in the technical product quality and technical standards of China's modern nanotechnology and related product industries. At present, China's nanotechnology products are only preliminary test products, for China's nanotechnology industry to develop like modern information and electronic technology, it must have a broad and profound social impact. It still takes decades, so it cannot be said that the nano age has come. In a special report in the UK, experts predict that some nanomaterials will take five to fifteen years to be marketed. Hard cutting tools have a service life of 5 to 15 years; long-life biological implants require 5 to 15 years; chips with a 100nm function take about 7 years. Therefore, in terms of the current market size, although nanomaterials are not considered an emerging industry, nanomaterials will become a vibrant emerging industry in the next 5 to 10 years [22].

The application technology and industrialization level of nanomaterials may enter the world's advanced level, rather than lagging behind other countries and losing development opportunities such as microelectronics. Differentiate the levels, highlight the main points, give play to advantages, and form characteristics. It is necessary to strengthen the construction of scientific research bases, improve infrastructure conditions, increase special scientific and technological input, and attach great importance to the protection of intellectual property rights [23]. At present, the research on nanometers should focus on the preparation and preparation of nanomaterials with excellent performance, the design and preparation of various nanodevices and devices, and the detection and analysis of the properties and phenomena of nanometer regions. Nanomaterials are the foundation of nanotechnology, and my country has considerable strength. In this regard, the layout should pay more attention to industrialization, especially the combination with traditional industries, and actively absorb the participation and investment of enterprises. Regional quality inspection and characterization are the experimental basis and necessary conditions for the research and development of nanomaterials and nanodevices. At present, there are many domestic companies engaged in the development of nanomaterials application technology, but due to the lack of perfect intensive planning and planning system, and lack of information exchange and communication, it is necessary to establish national nanotechnology information. Network, strengthen information exchange and communication, avoid duplication, and at the same level of soldier concentration will quickly overcome some technical problems and speed up industrialization. Adopt the method of scientific research organization to carry out joint research on "government scientific research achievements". The university has strong scientific research strength, solid theoretical foundation, advanced scientific research methods and high scientific research level, but the engineering development and industrialization experiments are not as powerful as scientific research institutes [24].

### 2.3. Problems and Countermeasures in the Development and Application of Nanomaterials and Industrialization

This article points out that the following aspects should be paid attention to during the

industrialization of nanomaterials in my country: adhere to market orientation and demand orientation. Practitioners engaged in research related to industrial nanomaterials application technology should generally be combined with relevant professional researchers in various fields. Related professional researchers engaged in nanomaterials application technology should be combined with individual operators of small and medium-sized enterprises, and will be engaged in the industrial development of nanomaterials-related technologies is combined with the macro guidance of local government policies. Give priority to the development of some new nanomaterials with greater application market potential and feasible application technologies; we also need to pay special attention to the protection of intellectual property rights [25]. Through an in-depth and detailed analysis of the development status of China's nanomaterial technology industrialization and some existing problems, it is pointed out that the key to the development of my country's nanomaterial technology industrialization lies in the innovation of policies and systems. It pointed out that my country should actively carry out reform and innovation of the fiscal and taxation system to promote the industrialization of China's application of nanomaterial technology. Establish a spring venture investment and industrial financing cooperation platform to promote the effective transformation of spring technology innovation and scientific research achievements, continue to accelerate the pace of integration, reorganization and adjustment of technology mergers and acquisitions in the spring industry, accelerate the incubation and cultivation of leading technology companies; continue to strengthen national political policy support for springs. Create a good internal and external environment for the rapid industrialization of nanomaterials in China.

This study found that through an in-depth analysis of the small and medium-sized nanotechnology R&D industrialization construction model, it is proposed that the shortage of R&D funds and technical talents is still the two major bottlenecks in the development of China's nanomaterial technology industrialization construction, and the relevant national departments are clearly targeted. Efforts should be made to ensure stable investment in R&D industry funds related to small and medium-sized nanotechnology, and adopt a series of relevant policy measures to encourage small and medium-sized enterprises to actively participate in the research and development of nanomaterials-related technologies and improve the enterprise risk investment management system; through horizontal research on the traditional nanomaterials research fusion, establish a national nano-materials professional training plan. Compared with the level of developed countries, China still has a large gap in the reasonable investment of nano-application technology research and development technology funds compared with developed countries. There have been prominent problems such as false news hype on nano materials and false advertising publicity reports. The latest progress of the research on the application of nanofiber coatings in China's academy of Industrial. Technology has analyzed the current status of development and industrialization of modern nano-engineering coatings research in China: current technical concepts, standards, and production of modern nano-engineering coatings in China. There are still some problems in various aspects such as process technology and research and application fields, which restrict the rapid development of the technical research and application industrialization of modern nano-engineering coatings in China. It is proposed to expand the field of industrial research and innovation, and strongly support research and innovation to develop various functional and ecological fiber coatings. In strengthening product quality testing and evaluation, a new set of strict nanofiber coatings should be gradually established and launched. The quality evaluation standard system, standardize market transaction order and other policy measures.

## 2.4. Economic Growth and Economic Development Theory

The rapid economic growth is generally widely understood as a constantly changing movement

process of the national economic and social activity development level, which is characterized by a certain gross economic indicator level such as agricultural gross national product or industrial national income. Even if it refers to a variety of reasons such as accumulation of social capital, continuous technological advancement, and continuous population growth (including the continuous increase in labor production input), the continuous increase of economic indicators in the quantity of the economy can also be said to be the society of a large country. The scale of economic development continues to expand in number, and its two main economic indicators are GDP per capita and national income per capita. Economic and social development has a much broader meaning than the basic concepts of economic and social growth. It is about the whole process of the continuous transformation of a developed country's market economy from my country's traditional industrial form to my country's modern economic form. It also includes rapid and major changes in various levels of per capita income and output, as well as profound economic structural optimization and social institutional structural changes within human political, economic and cultural life and human social and cultural life; therefore, "development" not only. It also includes more per capita output income levels, and also includes various major technological and institutional changes that companies need to base on production and income distribution; not only this includes the efficiency of enterprise productivity, but also the entire industrial structure. Changes and changes, as well as changes in the distribution of the amount of common input among various industrial sectors. In a nutshell, the economic structure development status is a comprehensive change performance of a social country and its economic, political, social, cultural, natural and other social conditions and economic forces and its economic structure development status.

Based on the analysis of the nanotechnology industrialization model, it pointed out that the problem of capital and talents is the bottleneck in the process of nanomaterials industrialization, and pointed out that the state should guarantee the investment of nanotechnology research and development funds, take relevant measures to encourage enterprises to participate in nanomaterials technology. Research and development to improve the risk investment system. By crossing traditional disciplines, fusion to establish a talent training program for nanomaterials. Compared with developed countries, China still has a large gap in investment in applied R&D funds, and there are problems such as news hype and false propaganda of nanomaterials. This paper analyzes the current status and existing problems of the nano-paint industrialization in my country. At present, there are still some problems in the concept, standards, production technology and research fields of nano-paint in China, which restrict the development of nano-coating research and industrialization. It is proposed to expand the research field, vigorously research and develop functional and ecological coatings, and gradually establish a new and strict nano coating product evaluation and evaluation system to standardize the market order.

## 3. The Influence of Nanomaterials Development and Application on Economic Development

### 3.1. The Calculation Model of the Contribution of the Development and Application of Nanomaterials to Economic Growth

This paper establishes a feeder model to estimate the impact of the development and application of nanomaterials on economic growth. The impact of the development and application of nanomaterials on economic growth can be divided into direct and indirect effects. In order to measure the impact of both on economic growth contribution, this paper proposes an analytical framework that divides the two sectors of the entire economic sector into development and application sectors and defines the entire production activity. The economic fields of the two sectors of the economy, and assuming the marginal factor productivity of the development and application

sectors, thereby establishing the production functions of the development and application sectors, and thereby constructing the production functions of the development and application sectors respectively, as shown in equations 1 and 2 show:

$$N = F(K_N, G_N, L) \tag{1}$$

$$E = G(K_E, L) \tag{2}$$

Among them: N is the output of the development department; E is the income of the application department.

It is undeniable that the development and application of nanomaterials based on the framework and ideas of the feeder model have a high practical application value for the economic growth model, but also have certain limitations. First, it divides the entire economic activity into two sectors, which is theoretically simplified. Second, the products of the nanomaterials development sector depend not only on the labor and capital allocated by the sector, but also on the products and services of the high-tech sector during the same period. Therefore, there is actually an assumption that the external impact of the high-tech industry on non-high-tech industries occurs simultaneously. This assumption is inconsistent with reality. But this defect can be supplemented by time series data. The time series data used are shown in Table 1.

*Table 1. Commonly used chronological table*

| Variety | Sequence | N | Data type |
|---|---|---|---|
| SUA1 | 1 | $1.75*10^7$ | Type A |
| SUG1 | 2 | $1.5*10^7$ | Type B |
| CUT1 | 3 | $1.23*10^7$ | Type C |

As can be seen from table 1, there are many types of time series data, involving numerical ranges up to $1*10^7$-$1.8*10^7$. It can be seen that the time series database is large and can meet the needs.

### 3.2. Determination of the Output Elasticity Coefficient R in the Development and Application of Nanomaterials

The estimation model for the R value of the elastic coefficient is analyzed from the above, and the nano-material development industry is introduced into the production function as an independent element to obtain a new C-D production function, as shown in Equation 3.

$$Y = F(\mathrm{t}) * K * L * H^G \tag{3}$$

Among them: Y is the type of nano-material development, K is the application field.

Based on the availability of data and the purpose of the study, the relevant data from eight regions from 2013 to 2017 were selected as samples.

In this model, total output Y is expressed as GDP, capital input K is expressed as fixed asset investment, labor input L is expressed as the number of employees, and nanomaterial development input. H is expressed as R&D expenditure. Y, K and L were obtained from "China Statistical Yearbook", and H was obtained from "Statistical Yearbook on development and application of nanomaterials". In order to eliminate the impact of the price level, the consumption index was used to convert the research and development expenditure of fixed asset investment K and the development and application of nanomaterials based on 2013 as the base year.

After effective calculation, the final results of the eight regions of R value all passed the F test, indicating that Y has a significant linear relationship with the independent variable, and the regression equation is very important. The sample determination coefficients 2R of all regions are

greater than 0.8 and greater than 0.9, indicating that the model has a high goodness of fit. The coefficients of the variable NH in the two regions of northwest and middle reaches of the Yangtze river did not pass the T-test, indicating that the independent variable has no significant effect on Lynx and can be considered to be eliminated.

### 3.3. Calculation of the Contribution of the Development and Application of Nanomaterials to Economic Development

Through detailed calculations and investigations, the contribution of nanomaterials to the regional economic growth level in the development and application of eight regions in China is as follows: the southern coastal region (45.87%), the northern coastal region (20.85%), and the southwestern region (18.73%). The east coast (14.35%), northeast (13.40%), in addition, due to the development and application of nanomaterials, the economic growth of the elastic coefficient of the northwest region and the middle reaches of the Yangtze River region is negative, so it has not yet shown its contribution to economic growth.

It can be seen that the regional development and application of nanomaterials in China has the largest contribution rate to the regional economic growth. The southern coastal areas (including Guangdong, Fujian and Hainan) are the economic center of Guangzhou. The development of materials development and application since the reform and opening up of nanometers in Guangzhou, sustained and rapid development, geographical location close to Shenzhen, Hong Kong, give full play to its geographical advantages, original industrial advantages, attract foreign investment, introduce suitable technologies and industries, not only caused many new developments and applications of nano-materials. The industry association effect has driven the overall development of related industries and promoted the optimization and upgrading of the industrial structure. At the same time, it has increased a lot of employment opportunities, attracted a large number of labor and technical personnel, accumulated and developed human resources for the region, and ultimately improved regional competitiveness. Second is the eastern coastal area (including Beijing, Tianjin, Hebei, Shandong, Beijing and Tianjin as the center). The main advantages are the advantages of science and technology resources and geographical advantages. Beijing has its own high-end talents, and the science and technology resources occupy the research and development of nanomaterials and application development. At the commanding heights, Tianjin is located in the center of the Bohai Rim region and has superior geographical advantages.

## 4. Comparison of Clinical Effects Between the Two Groups

### 4.1. Analysis of the Impact of Nanotechnology Application in Energy Development and Medical Field on Economic Development

Discovering the characteristics of high-density storage and ultra-fast transmission now provides a broad space for the application of nanotechnology and nanomaterials. With its unique characteristics, nanomaterials provide new opportunities for upgrading traditional industries. Nano-special functions and structural materials have promoted the upgrading of traditional industries, and their impact on the upgrading of traditional energy industries is shown in Table 2.

*Table 2. The influence of nanomaterial development on the upgrading of traditional energy industry*

| Firm name | Influence coefficient | Survey year segment |
|---|---|---|
| Coal enterprise | 11.03±0.91 | 2015-2017 |
| Natural gas enterprise | 15.81±0.15 | 2016-2018 |

As shown in Table 2, the impact on the upgrading of industries in various fields is obvious, and the impact index can reach 10-16.

In addition, the development of nano-energy material technology has alleviated China's energy shortage to varying degrees, and improved the efficiency of the use of existing energy, not only for China, but also for the development of the entire world to provide new impetus. Among them, nano solar cell materials, efficient energy storage materials and thermoelectric conversion materials have been widely used in various industries. Its application rate in various industries has reached 55.6%, and its direct economic income from energy is shown in Figure 1.

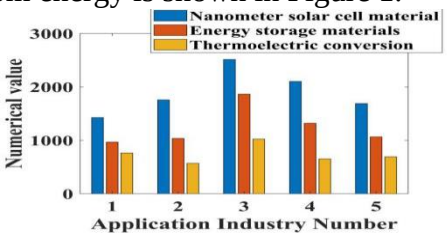


*Figure 1. The economic benefits of nanomaterials in terms of energy*

It can be seen from Figure 1 that the development of nano-energy material technology has brought China's direct economy in the energy field of 500-700 million, which has greatly promoted China's energy shortage and the development and utilization of new energy. Its application rate in various industries of energy has reached 55.6%, and this proportion is still increasing with each year.

And the investigation found that it was also widely used in medicine and biology. Related nanomaterials, micro processing, optical display, bioinformatics and molecular biology technologies are rapidly developing. Practical technologies such as expert systems for new biomolecular recognition, bed disease detection systems, drug screening systems and bio-industry activity monitoring systems are also continuing. This article predicts that by 2020, only the application of nanotechnology in the field of biomedicine, the market will reach 200 billion US dollars. The detailed data is shown in Figure 2.

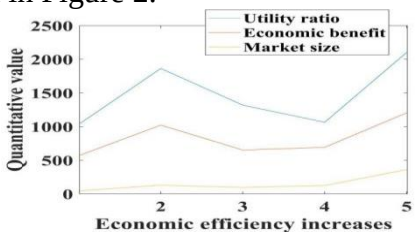


*Figure 2. The economic impact of nanotechnology in biomedicine*

It can be seen from Figure 2 that nanomaterials have been widely used in medicine and biology. It has brought about 1.2-2.7 billion in the direct economy of China in the medical field, and its application rate in various medical-related industries has reached 27 %.

### 4.2. Application of Nano-Materials in the Electronic Information and Environmental Protection Industries to Promote Economic Development

The investigation found that in the electronic information industry, the application of nanotechnology in the development of the electronic information industry overcomes the physical limitations represented by technology such as strong electric field effect and quantum tunneling effect, such as power consumption, interconnect delay. Restrictions and manufacturing costs are expensive, and economic constraints that users cannot bear, creating new nanoscale devices based

on quantum effects and fabrication techniques. In addition, nanomaterials with quantum effects will provide new functions that are different from traditional devices, thereby generating new economic growth points. The detailed promotion effects on economic growth points are shown in Figure 3.

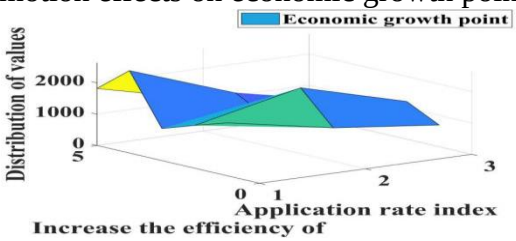


*Figure 3. Detailed effect of nanomaterials development and application on economic growth points*

As can be seen from Figure 3, the application of nanomaterials in the electronic information industry has also been very extensive, and has driven economic growth in this field. It has brought China's direct economy in the field of electronic information to 1.54-22.6 billion, which is in the application rate of related industries has reached 32.5%.

In addition, the application of nanotechnology in the environmental protection industry has greatly promoted the development of the environmental protection industry. It will increase the efficiency of the "three wastes" treatment means by 200% and improve human living environment to a large extent. In addition, in order to achieve a sustainable development strategy and a green, China has put forward new urgent needs for new nano-environmentally friendly materials and technologies. Through detailed research in this article, it is expected that the market size of China's domestic "Eleventh Five-Year Plan" period can reach a demand scale of 3 billion yuan. The application rate and economic benefits of nanomaterials in the environmental protection industry are shown in Figure 4.

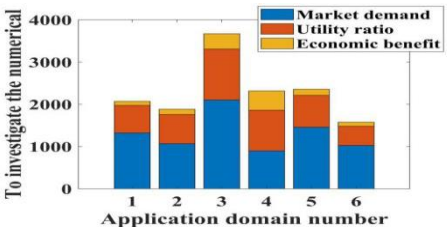


*Figure 4. The application rate and economic benefits of nanomaterials in environmental protection industry*

It can be seen from Figure 4 that the direct economy it has brought to my country in the field of environmental protection has reached 140-256 million, and its application rate in various related industries has reached 12.5%.

## 5. Conclusion

(1) This article analyzes the common problems that currently exist in the far-reaching impact of the development and application of nanomaterials on economic development, and discusses to solve these problems and proposes corresponding solutions. Introduced the development technology of nanomaterials and related application fields, and introduced in detail the mechanism and related calculation methods of the impact of the development and application of nanomaterials on economic development.

(2) An analysis of the impact of the nanotechnology researched in this paper on energy development and the application of medicine to the economic development. The investigation proves that the development of nano-energy material technology has brought China's direct

economy in the energy field to 5-700 million, which has greatly promoted China's energy shortage and the development and utilization of new energy. Its application rate in various energy industries has reached 55.6%, and this proportion is still increasing with each year. In addition, nanomaterials have been widely used in medicine and biology. The direct economy it has brought to my country in the medical field has reached 1.2-2.7 billion, and its application rate in various medical-related industries has reached 27%.

(3) Discuss and verify the mechanism and principle of the application of nanomaterials in the electronic information and environmental protection industries to promote economic development. After research and verification, the application of nanomaterials in the electronic information industry has also been very extensive, and has driven economic growth in this field. It has brought China's direct economy in the field of electronic information to 1.54-22.6 billion. The application rate of various industries has reached 32.5%. The survey shows that the direct economy it has brought to my country in the field of environmental protection has reached 140-256 million, and its application rate in related industries has reached 12.5%.

## Funding

This article is not supported by any foundation.

## Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

## Conflict of Interest

The author states that this article has no conflict of interest.

## References

*[1] Jan Černohorský. Types of bank loans and their impact on economic development: a case study of the Czech republic. E A M Ekonomie A Management, 2017, 20(4):34-48.*

*[2] Nguyen T H D, Lin M, Mustapha A. Toxicity of Graphene Oxide on Intestinal Bacteria and Caco-2 Cells. Journal of Food Protection, 2015, 78(5):996-1002.*

*[3] Eissa S, Almusharraf A Y, Zourob M. A comparison of the performance of voltammetric aptasensors for glycated haemoglobin on different carbon nanomaterials-modified screen printed electrodes. Materials Science & Engineering, 2019, 101(8):423-430. DOI: 10.1016/j.msec.2019.04.001*

*[4] Ciric-Marjanovic G, Pasti I, Mentus S. One-dimensional nitrogen-containing carbon nanostructures. Progress in Materials ence, 2015, 69(4):61-182. DOI: 10.1016/j.pmatsci.2014.08.002*

*[5] Hannah, Daniel C. Spectroscopic and Computational Studies of Light and Heat Generation in Semiconductor Nanomaterials. Dissertations & Theses - Gradworks, 2015, 19(1):68-71.*

*[6] Wang Z, Wang C, Liu S. Specifically Formed Corona on Silica Nanoparticles Enhances Transforming Growth Factor β1 Activity in Triggering Lung Fibrosis. Acs Nano, 2017, 11(2):1659-1672.*

*[7] A. Kurniewicz, P. Swianiewicz. Phantom pain or a real loss? The impact of the loss of regional capital status on economic development and position in the hierarchy of the settlement system. prace i studia geograficzne, 2016, 61(2):25-50.*

*[8] Tian T, Guo B, Liao J, et al. Characterization, Specific Demand and Application of Nanomaterials in Bone Regeneration. Journal of Nanoence and Nanotechnology, 2016, 16(9):9381-9392.*

*[9] Kreitinger J M, Beamer C A, Shepherd D M. Environmental Immunology: Lessons Learned from Exposure to a Select Panel of Immunotoxicants. Journal of Immunology, 2016, 196(8):3217-3218. DOI: 10.4049/jimmunol.1502149*

*[10] Eymard-Vernain E, Luche S, Rabilloud T. Impact of nanoparticles on the Bacillus subtilis (3610) competence. Rep, 2018, 8(1):6486-6487. DOI: 10.1038/s41598-018-24841-x*

*[11] Jin Y, Wu S, Zeng Z. Effects of environmental pollutants on gut microbiota. Environmental Pollution, 2017, 222(3):1-9.*

*[12] Victor N, Nikolay D, Arseniy A. Ultrafast Spectroscopy of Fano-Like Resonance between Optical Phonon and Excitons in CdSe Quantum Dots: Dependence of Coherent Vibrational Wave-Packet Dynamics on Pump Fluence. Nanomaterials, 2017, 7(11):371-372.*

*[13] Gao X, Zhang X, Wang Y. Effects of morphology and surface hydroxyl on the toxicity of BiOCl in human HaCaT cells. Chemosphere, 2016, 163(11):438-445.*

*[14] Casals E, Gusta M F, Cobaleda-Siles M. Cancer resistance to treatment and antiresistance tools offered by multimodal multifunctional nanoparticles. Cancer Nanotechnology, 2017, 8(1):7-8.*

*[15] Chu Z, Han Y, Bian T. Supramolecular Control of Azobenzene Switching on Nanoparticles. Journal of the American Chemical Society, 2019, 141(5):1949-1960.*

*[16] Soria N G C, Aga D S, Atilla-Gokcumen G E. Lipidomics reveals insights on the biological effects of copper oxide nanoparticles in a human colon carcinoma cell line. Molecular BioSystems, 2019, 15(1):30-38. DOI: 10.1039/C8MO00162F*

*[17] Lyu W, Yu M, Feng J. Exploring Solvent Effects on the Dialysis‐Induced Self‐Assembly of Nanostructured Tetra(aniline). ChemistrySelect, 2018, 3(11):3338-3344.*

*[18] Dasari K, Wang J, Guinel J F. Visible photoluminescence and room temperature ferromagnetism in high In-content InGaN:Yb nanorods grown by molecular beam epitaxy. Journal of Applied Physics, 2015, 118(12):2177-2360.*

*[19] Donaldson P. Developments in Nanotechnology. Military technology, 2015, 39(10):52-53.*

*[20] Zaytseva O, Neumann, Günter. Carbon nanomaterials: production, impact on plant development, agricultural and environmental applications. Chemical & Biological Technologies in Agriculture, 2016, 3(1):17-18.*

*[21] Garner K, Suh S, Keller A A. Response to Comments on "Assessing the Risk of Engineered Nanomaterials in the Environment: Development and Application of the nanoFate Model". Environmental ence & Technology, 2018, 52(9):5511-5511. DOI: 10.1021/acs.est.8b01476*

*[22] .Meldrum K, Guo C, Marczylo E L. Mechanistic insight into the impact of nanomaterials on asthma and allergic airway disease. Particle and Fibre Toxicology, 2017, 14(1):45-46.*

*[23] Nai J, Kang J, Guo L. Tailoring the shape of amorphous nanomaterials: recent developments and applications. Science China Materials, 2015, 58(1):44-59.*

*[24] Liu Y, Nie Y, Wang J. Mechanisms involved in the impact of engineered nanomaterials on the joint toxicity with environmental pollutants. Ecotoxicology & Environmental Safety, 2018, 162(8):92-102.*

*[24] Balamurugan S, Resmi S P, Brightlin B C. Impact of Different Set of Precipitants on the Formation of BaFe12O19 Phase Nanomaterials. Journal of Nanoence and Nanotechnology, 2020, 20(6):3486-3495.*

*[25] Sacchdeva M. GDPR And Blockchain have Profound Impact on Businesses. Dataquest, 2018, 36(7):53-53.*