

2022

Global
Future

Industry
Index

Executive Summary

In 2022, the highly contagious mutated virus Omikron ravaged the world, further exacerbating the already struggling economies of various countries that had not fully recovered from the pandemic. Many central banks attempted to address the greatly underestimated inflation by implementing monetary tightening policies.

In the midst of this predicament, the development of science and technology is the key to humanity's breakthrough. ICV, as an international consulting firm specializing in cutting-edge technology fields, released the first annual global future industry development index report (GFII 2022), providing reference for people from all walks of life around the world.

“Future industry” refers to industries that have a significant impact on human production and life, have a driving effect on progress of society and economy, and are characterized by forward-looking and disruptive features. The future industries play a significant role in terms of leading global economic growth, guiding human social progress, and enhancing national competitiveness.

ICV has referenced the standards and definitions of organizations such as the National Institute of Standards and Technology (NIST), then defined the 2022 annual “future industry” as six major fields: Quantum information, green energy, AI robot, metaverse, advanced communication, and biotechnology.

How we define the industries of the future?

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Quantum Information

The progress of quantum technology has the potential to completely change the fields of computation, medicine, manufacturing, artificial intelligence, communication, and defense. Quantum information science includes quantum computing, quantum precise measurement and quantum encryption.

Green Energy

Also known as renewable energy, compared to traditional energy, the biggest feature is that it does not produce environmental pollution. The focus is on solar energy, tidal energy, ocean thermal energy, nuclear energy, hydrogen energy, fuel cells, and energy storage devices. Green energy has the advantages of environmental protection and no possibility of energy depletion, so it is valued by many countries, especially those with energy shortages.

AI Robot

Covering two major branches, industrial robots and intelligent robots, including all mechanical devices that simulate human behavior or thinking and simulate other organisms (such as robots and robot cats). The “future industry” focuses on intelligent robots, which are based on artificial intelligence (AI) technology and have the ability to learn, communicate, perceive, use tools, and manipulate machinery like humans.

Metaverse

Refers to a virtual reality space built on the basis of the real world, with a complete operating economic system, its high degree of openness and inclusiveness provide a good environment for creating value. The underlying technology support includes network communication (5G/6G), cloud computing, blockchain, digital twins, etc. Through the disruptive changes of productivity, the metaverse will bring humanity “the fourth industrial revolution”.

Advanced Communication

Represented by the 6th generation wireless communication network, the deployment of faster and more reliable next-generation communication technology, and the use of satellite communication technology, will greatly improve the communication capabilities of various industries and fields, and provide a good foundation for the development of the Internet of Things and 5G/6G networks.

Biotechnology

Includes biopharmaceuticals, genetic engineering, gene therapy, bio-manufacturing, biofuels, and more. Bioscience plays an important role in medicine, agriculture, environmental protection, pharmaceuticals, and energy. For example, biopharmaceuticals can be used to treat cancer and other serious diseases, bio-manufacturing can be used for producing food and other products, and biofuels can be used to generate energy in a sustainable way.

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Where is the
source of energy
for future industrial
transformation?

How will the
industries of the
future drive
development?

Chapter 1

Future Industry:
Current Situation
& Expectations

Topic 1.1

The Latest Trends in Future Industrial Development

"Future industries" have become a new field of competition among major countries, with global powers vying for dominance in key cutting-edge technologies.



In February 2022, the United States National Science and Technology Council (NSTC) released a new version of its list of Critical and Emerging Technologies (CETs). The list, based on the United States' 2020 National Strategic Plan for Critical and Emerging Technologies, updates and revises the list of key and emerging technology fields and specifically lists the core technology sub-fields within each field.

The 2022 fiscal year's U.S. Government R&D Budget Priorities also mention the need to strongly support basic and applied research in fields such as national security, future industries, energy and the environment, and aerospace technologies.



China has clearly stated in the "Outline of the 14th Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Vision for 2035" that it will organize and implement plans for incubating and accelerating future industries in cutting-edge technology and industrial transformation fields such as brain-inspired intelligence, quantum information, genetic technology, future networks, deep-sea and aerospace development, hydrogen energy and energy storage, and plan the layout of a batch of future industries.



In March 2020, the European Union released the "European New Industrial Strategy" which supports the development of key enabling technologies that have strategic significance for the future industries of Europe:

robotics, microelectronics technology, high-performance computing and data cloud infrastructure, blockchain, quantum technology, photonics, industrial biotechnology, biomedicine, nanotechnology, pharmaceuticals, advanced materials and technologies

, in order to enhance the EU's competitiveness in global industrial competition and strategic autonomy in geopolitical contests.



The "6th Basic Plan for Science and Technology Innovation" released by the Japanese government in 2021 proposed to stimulate the intrinsic motivation of researchers, constantly produce new knowledge and new technologies, and establish a comprehensive knowledge system for solving social problems.

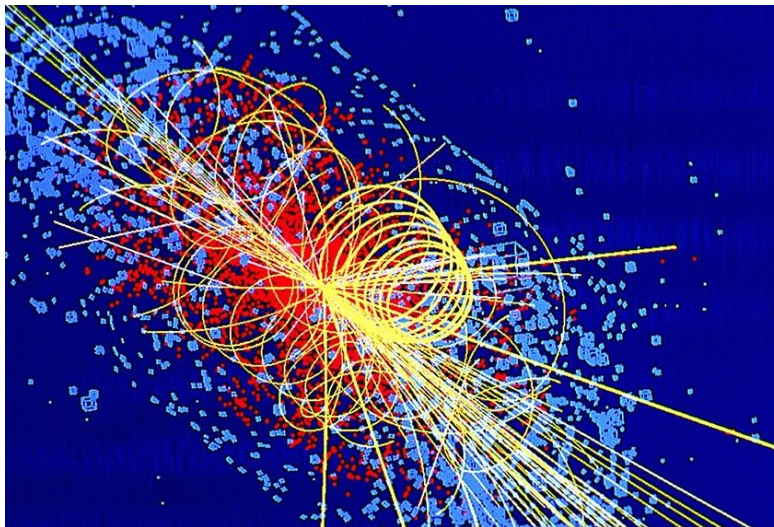
In March 2022, Japanese Prime Minister Fumio Kishida announced that a national strategy would be formulated to promote the development of quantum technology and artificial intelligence through cooperation between government departments and private companies.

Disruptive technology development is rapidly advancing, driving the gradual application prospects of future industries.

Breakthroughs in basic scientific research are constantly supplying energy to the development of future industries.

In the field of elementary particle, international research teams composed of scientists from countries such as Germany, Japan, the United States, and China announced in a paper published in the journal Nature in 2022 that they had obtained the clearest evidence to date of the existence of a substance called “tetra-neutron”.

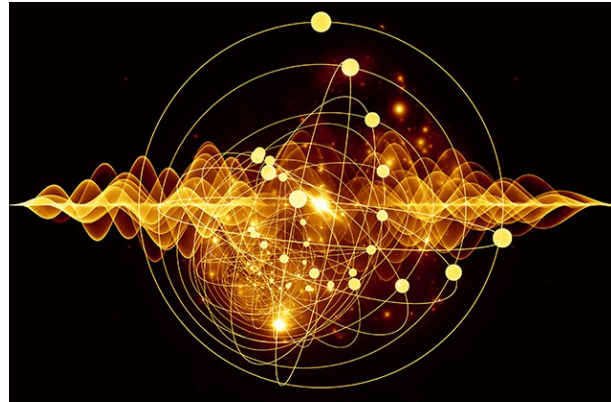
Particle Physics



Source: University of Vienna

In the field of quantum, physicists at JILA in Colorado, USA, used a combination of entanglement and decoherence to suppress noise that had previously made it impossible to sense accelerations below what is known as the quantum limit.

Quantum Mechanics



Source: Stanford Online

This limit is set by the quantum noise of individual particles, and has long been a major constraint on the precision of quantum sensors. Therefore, overcoming it is a big step forward for technology.

In the field of green energy, the National Ignition Facility (NIF) announced a milestone breakthrough: for the first time in human history, it successfully achieved “net energy” in a fusion ignition experiment.

Nuclear Energy



Source: Yale Environment 360

Application technology innovation further promotes the development of future industries.



Starlink has completed the launch and orbit of 2600 Starlink satellites, covering four continents, 32 countries and regions, can replace some of the "ground fiber" transmission network channels, and the integration of information network development has entered a new stage of development.



IBM has released the most powerful quantum computer processor to date, named Osprey, which is a machine with 433 quantum bits, three times the number of quantum bits announced in the previous year by the Eagle machine.



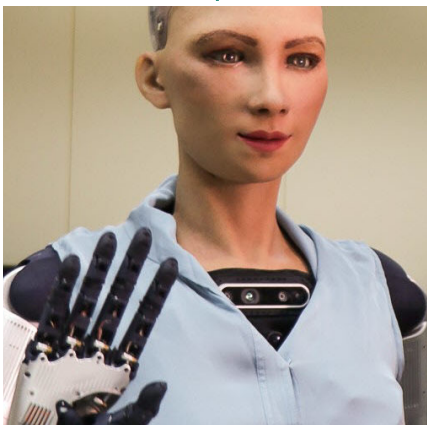
In 2022, Israeli scientists successfully created synthetic mouse embryos for the first time without using sperm or eggs and grew them successfully outside the uterus.

Future industries such as Metaverse, humanoid robots, and satellite internet are rapidly advancing.

In 2021, the concept of **Metaverse** swept the world, the global technology giants accelerated their layout. With the promotion of digital technologies such as AR/VR, blockchain, and the Internet of Things, the meta-universe industry is expected to show a high-speed growth trend.



Source: Insurance Journal



Source: Hanson Robotics

The realism of **humanoid robots** is increasing at an astonishing rate, and the next ideal carrier for artificial intelligence is the humanoid robot, which will complete the technology landing in a more cost-effective and larger form. The combination of artificial intelligence and humanoid robots is opening up a broader market.

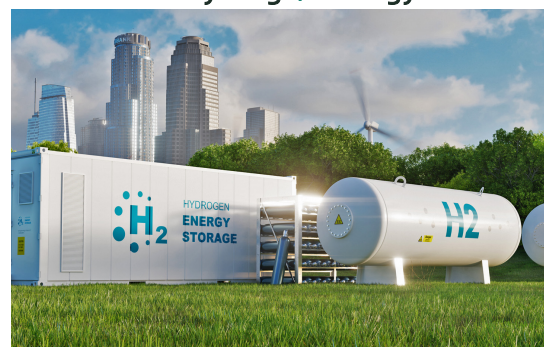
Satellite Internet



Source: lesFurets

Technological progress is changing the global wireless communication landscape and development prospects, and the Low-earth orbit (LEO) broadband communication constellation (orbital height of 200 kilometers to 2000 kilometers) is rising with its advantages of full coverage, large bandwidth, and low cost, becoming a new solution for global network coverage. The satellite internet upstream and downstream industrial chain will usher in a new development peak.

Hydrogen Energy



Source: the United Nations

The zero-emission target is forcing an energy revolution, accelerating the grid connection of the fourth-generation high-temperature gas-cooled reactor nuclear power project, also the hydrogen energy industry is starting.

The COVID-19 pandemic, the digital divide, and climate change are increasingly prominent global issues, objectively accelerating the pace of fostering future industries.

The COVID-19 pandemic has exacerbated existing digital divides between and within countries in terms of age, disability, gender, geography, and socio-economic status. As many basic services are pushed online, those without broadband internet access may be left behind, which poses a real danger.

To bridge the digital divide, major countries and regions around the world are accelerating the deployment of new digital infrastructure such as low-orbit broadband constellation systems, providing cost-effective and sustainable internet access for remote areas, solving the basic problem of internet access; on the other hand, increasing 5G network construction, to provide improved network support for personal information consumption, production and manufacturing, transportation, medical health and other fields by improving data transmission speed, reducing delay, increasing the number of connections.

The COVID-19 pandemic has objectively pushed the rapid development of biomedicine, with products such as the COVID-19 vaccine playing a significant role in combating the pandemic. The technology innovation includes vaccines, blood products, monoclonal antibodies, genetically engineered drugs, and in vitro diagnostics, among others.

mRNA Vaccines



Source: News Medical

Emerging technologies such as mRNA vaccines, AI-assisted drug development, and digital medicine have been increasingly adopted, providing new opportunities in the bio-medicine industry.

Climate change is having an unprecedented impact worldwide. Most countries have set targets for net zero emissions to align with the global trend towards net zero emissions. The European Union has proposed a Carbon Border Adjustment Mechanism (CBAM) that requires imported products to pay for CBAM certificates based on their carbon content, to accelerate the carbon reduction process of countries.

Energy transition is accelerating globally and new clean energy sources such as hydrogen are expected to play a larger role in future energy supply. In recent years, hydrogen has gained attention from governments worldwide. China, the United States, Japan, France, the United Kingdom, and Germany have placed hydrogen as a national energy strategy. Many countries and regions have also developed hydrogen development strategies, accelerating the innovation and development of hydrogen technology and industry.

Hydrogen Generating Plant



Source: Suzhou Green Hydrogen Energy

Topic 1.2

Prospects for future industrial development trends

Future industry development trends: intelligent, green, and health.

Fundamentally, the development of future industries is to better serve humanity, where intelligence, low-carbon, and health are long-term goals for humanity.

To have a more intelligent life, we need to further break down the barriers between the atomic world and the bit world with information technologies such as sensing, connection, and computation. New breakthroughs in artificial intelligence, humanoid robots, satellite internet, quantum information, advanced computing, and human-computer interaction are expected to reshape information infrastructure and comprehensively improve intelligence levels.

Green low-carbon is a sustainable development model characterized by low energy consumption, low pollution, and low emissions, which is of great significance for the sustainable development of human society. Key technologies for carbon-free emissions such as advanced nuclear energy, hydrogen energy, and energy storage technologies represent the key to achieving carbon neutralization and building low-carbon green energy systems, achieving net zero emissions targets, and will also be the focus of global technological innovation and industrial change in the future.

With the rapid development of modern life sciences and the acceleration of the integration of biotechnology with information, energy materials and other technologies, modern biotechnology breakthroughs and rapid industrialization of high-throughput sequencing, genome editing and bioinformatics analysis. The COVID-19 pandemic has accelerated the arrival of the bioeconomy era, and the convergence of biology, information, and matter is underway. In the future, organizations will focus on areas such as medical biotechnology, brain-machine interface, bioinformatics, vaccine development, and gene technology.

Governments of various countries will implement more robust industrial policies, continuously promoting the accelerated development of their "future industries."

The new round of technological revolution is experiencing multi-point explosive development, represented by frontier technologies such as quantum information technology, artificial intelligence + robots, advanced communication, biotechnology, and green energy. These are expected to form new global economic growth poles and drive economic and social transformative development. To offset the adverse effects of COVID-19, the Russia-Ukraine conflict and other multiple factors, countries around the world have adopted short-term economic stimulus measures and are laying the foundation for new economic growth drivers in the long term.

As the international situation changes, the role and importance of industrial policies led by the government have become more prominent in various countries, and the relationship between the government and the market is also changing. Developed countries such as the United States, China, Japan, the European Union, and the United Kingdom attach great importance to the role of industrial policies and continue to strengthen the use of industrial policy tools, especially focusing on frontier technology and future industries.

The intervention of the government in the market is expected to become more aggressive. It is also expected that related policies such as national security, domestic market regulation, and international trade rules will also undergo more radical changes.

The international environment is becoming increasingly complex and severe, protectionism and unilateralism are on the rise, and this increases more uncertainty for the global development of "future industries".

Faced with an increasingly complex and severe international environment, the trend of maximizing individual country and small-scale regional group interests has become increasingly apparent, further exacerbating the resurgence of protectionism and unilateralism in the global arena, especially in the West.

For example, after taking office, President Biden has not returned to the global order of economic liberalism, but has adopted a series of policies such as “buying American goods,” strengthening technology export controls, increasing support for the return of manufacturing, and ensuring the security of domestic industrial chains, which are essentially a version of “America first” strategy under Biden. The European Union has repeatedly emphasized the need to master autonomy in the economic, technological, and industrial fields, and has established a comprehensive policy system covering industrial strategy, trade policy, financial architecture, and other fields since 2020.

In addition, countries such as China, representing emerging countries, are also actively using the "overtaking on a bend" opportunities brought by the new round of technological revolution and industrial change to vigorously layout the development of future industries, and from seeking single breakthroughs to overall improvement, in order to get rid of the "low-end lock" and "high-end restriction" of the global value chain.

In the future, the competition in the fields of advanced communications, quantum information, artificial intelligence and robotics, biotechnology, and other fields between countries, especially the Western world led by the United States and the emerging developed countries led by China, will further intensify, and may form a breaking point of the flow of technology, talents, finance, and industry, which will affect the global development of future industries and even bring threats.

This section offers insights into how the world's economies performed in the six fields of Future Industry.

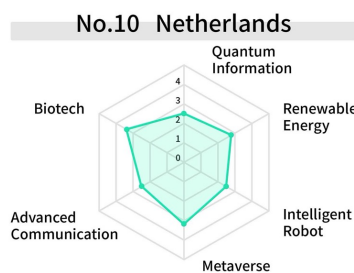
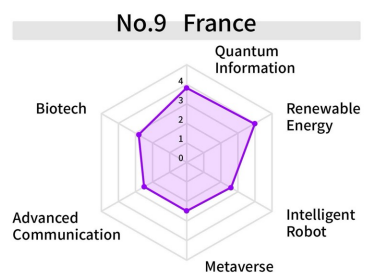
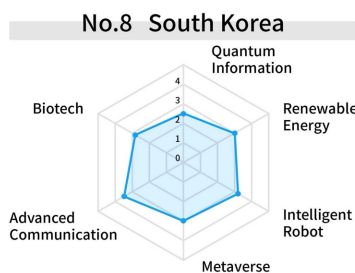
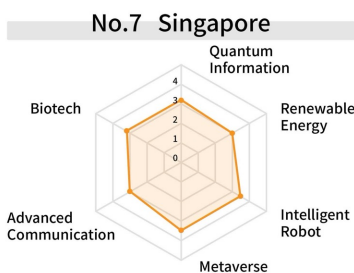
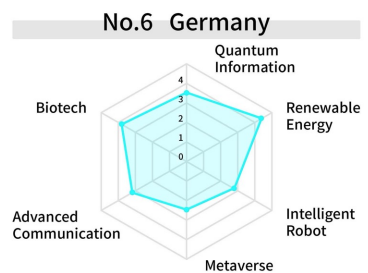
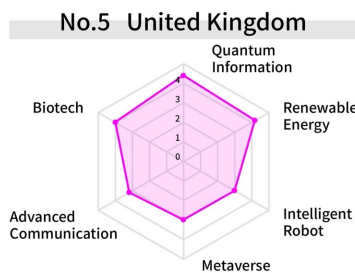
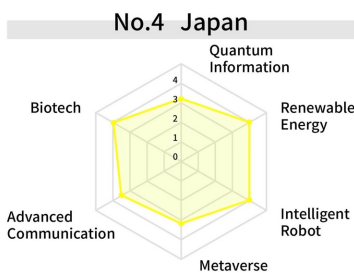
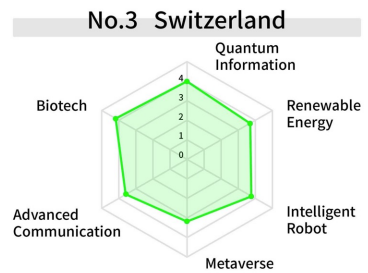
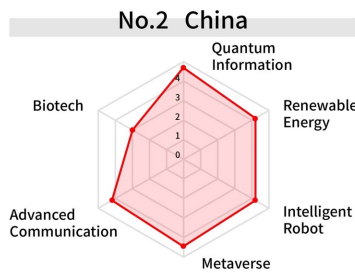
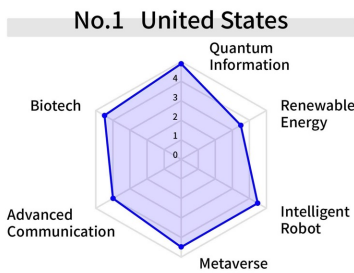
ICV conducts comprehensive evaluations aiming to generate ranking objectively and fairly.

Chapter 2

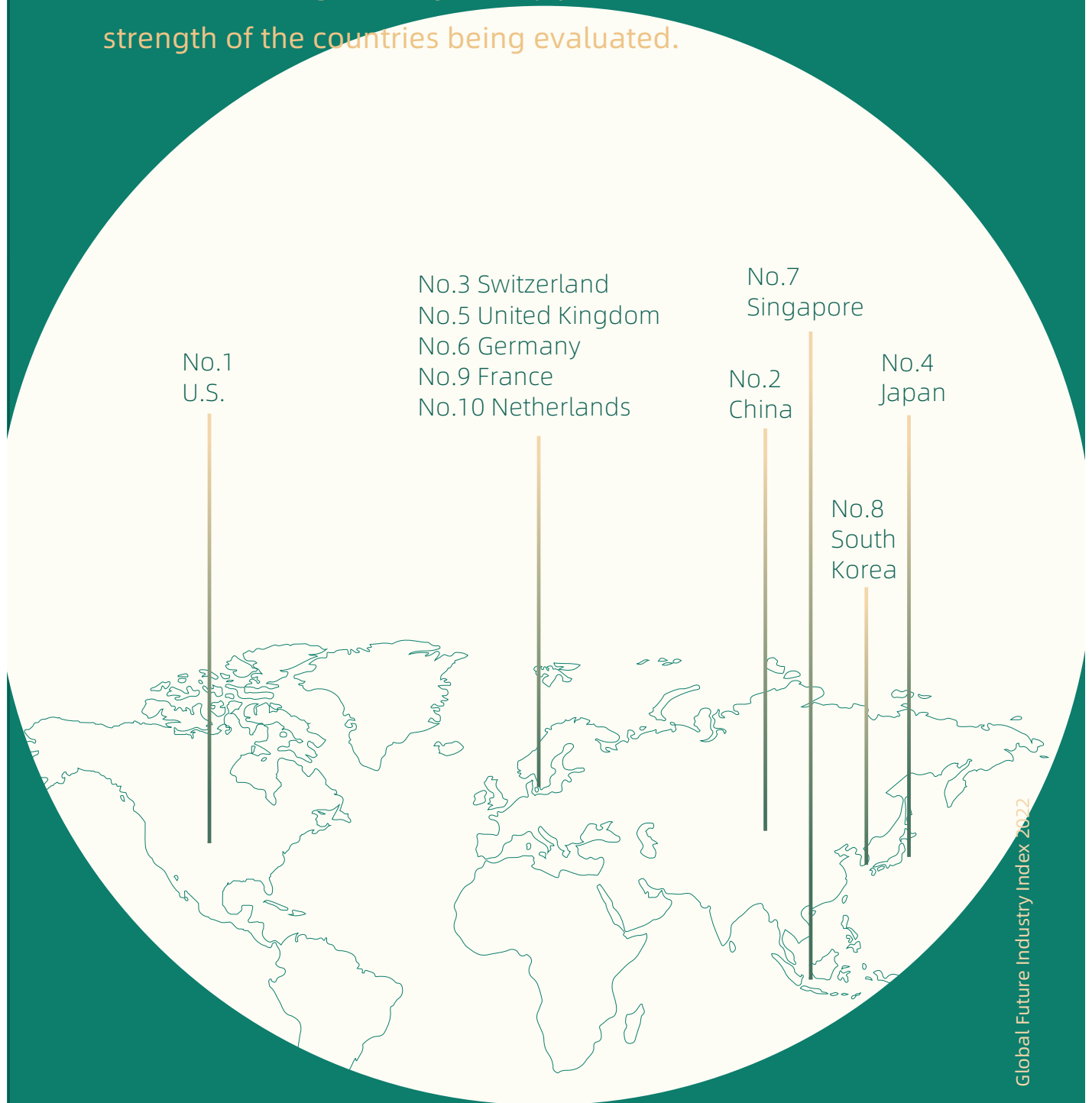
Overall GFII Ranking for Country and City

Topic 2.1

Overall GFII Ranking for Country



The overall ranking for world's economies takes into account factors such as population characteristics, cultural features, and economic strength to objectively present the S&T innovation strength of the countries being evaluated.



The United States has the highest overall ranking, with 43% of the most influential “future industry” enterprises are from the United States. In the ranking of “future industry” cities (clusters), 27.5% locate in the United States..

China ranks second, with 17.5% of the most influential “ future industry” enterprises are from China. In the ranking of “future industry” cities (clusters), 16.7% are Chinese cities.

Switzerland ranks third in the overall country rankings, with Switzerland ranking among the world’s top in terms of per capita patents and per capita top academic awards. Besides, the well-developed financial industry provides strong support for Switzerland's innovative ecological environment.

From an industrial perspective, the United States has shown extraordinary competitiveness in the six fields of “future industry” , especially in the information technology industry (quantum information, intelligent robots, metaverse) with the leading power.

China has balanced development in the six fields, with particularly bright innovation strengths in quantum information, green energy, intelligent robots, and metaverse.

Other Asian S&T innovation powerhouses include Japan, South Korea, and Singapore, with Japan not only showing excellent strength in information technology industry, but also in biotechnology industry. Singapore’s favorable start-up environment has attracted a large number of companies from emerging industries, particularly in quantum information, metaverse, and biotechnology, while South Korea has strong technological innovation in advanced communications industry. European countries lag slightly behind in technological innovation in information technology-related industries, but excel in biotechnology industry.

Topic 2.2

Overall GFII Ranking: “Future City 20”

City/ Metropolitan Area	Overall	Academic Research	Innovative Enterprise
1 San Francisco-San Jose	93.61	88.75	98.47
2 Beijing	90.63	84.38	96.87
3 Guangdong-Hong Kong-Macao Greater Bay Area	88.76	79.83	97.69
4 New York MA	88.34	83.25	93.43
5 Boston MA	86.65	89.92	83.37
6 Tokyo-Yokohama	83.09	81.49	84.69
7 Shanghai	82.05	82.43	81.66
8 London-Oxford-Cambridge	79.91	85.42	74.39
9 Seattle-Tacoma-Bellevue	78.74	82.19	75.29
10 Paris MA	77.28	75.62	78.94
11 Seoul MA	76.02	74.39	77.64
12 Geneva	75.80	84.27	67.32
13 San Diego MA	75.58	81.68	69.47
14 Washington DC-Baltimore	74.79	84.29	65.29
15 Kyoto-Osaka-Kobe	73.91	72.49	75.33
16 Zurich	73.24	82.63	63.84
17 Los Angeles MA	72.26	76.32	68.19
18 Hefei	71.09	73.88	68.29
19 Singapore	66.45	63.48	69.42
20 Suzhou-Wuxi-Changzhou	65.82	62.37	69.26

About “Future City 20”

The GFII selected 20 cities (clusters) with the most technical innovation strength and potential for future industrial development, and the GFII named them "Future City 20".

GFII primarily evaluates the candidate cities through two dimensions: research strength and innovative enterprises. Some of them have already formed an industrial scale in the six fields of “future industry” , such as San Francisco-San Jose, famous for its IT innovation; while others may not have formed a certain scale, but have the foundation of technological innovation strength, and are highly likely to make progress in the future industrial fields, such as Hefei, known for its development in quantum information technology.

Research Strength

The cities (clusters) in Europe and America perform better on the evaluation indicators of innovative talent resources and high-value academic creations, while the cities (clusters) in Asia are more competitive in terms of research institutions (covering universities, laboratories, etc.) and research facilities (covering big-science facilities and supercomputers).

San Francisco-San Jose and Boston are both among the top five in the scores of innovation talents and high-value academic creations; New York ranks first in research institutions, and is also strong in innovation talents; China holds three of the top five spots in research institution rankings, which are Beijing, Guangdong-Hong Kong-Macau Greater Bay Area, and Shanghai, among which Beijing ranks first in research facilities; Hefei, with its leading position in big-science facilities, ranks in the top ten in research facility scores.

Innovative Enterprises

The GFII evaluates candidate cities based on quantitative indicators such as the number of innovative leading enterprises, the number of unicorn enterprises, and the number of patents in the annual "future industry" fields.

San Francisco-San Jose ranks in the top three in all three indicators, showing strong innovative enterprise strength; Beijing also performs exceptionally well, ranking in the top five in all three indicators, especially in the number of innovative leading enterprises; Tokyo-Yokohama far exceeds other cities (clusters) in the number of innovative leading enterprises and patents related to "future industries" ; cities in Western world and Asian cities are on par in the number of innovative enterprises, but Asian cities are slightly stronger in the number of patents in "future industry" fields.

ICV identifies cutting-edge technological top clusters for six fields of “Future Industry” ,

trying to reveal the most potential cities/ MAs and the most influential enterprises.

Chapter 3

The GFII Ranking by Industry for City & Enterprise

Topic 3.1

GFI Ranking by Industry: “Future City 20”

 Quantum Information

Rank	City/ Metropolitan Area	Rank	City/ Metropolitan Area
1	New York MA	11	Boston MA
2	Hefei	12	Shanghai
3	London-Oxford-Cambridge	13	Tokyo-Yokohama
4	Beijing	14	Singapore
5	San Francisco-San Jose	15	Zurich
6	Guangdong-Hong Kong-Macao Greater Bay Area	16	Delft
7	Paris MA	17	Washington DC-Baltimore
8	Toronto-Burnaby	18	Helsinki
9	Munich-Stuttgart	19	Columbia
10	Los Angeles MA	20	Seattle-Tacoma-Bellevue

Quantum information is a strategic industry that major economies around the world are focusing on developing. In this “hardcore” technology field, the top five cities (clusters) are New York MA, Hefei, London-Oxford-Cambridge, Beijing, and San Francisco-San Jose. In the top 20 list, the US cities take 7 seats, European cities take 6 seats, Asian cities take 6 seats (4 are Chinese cities).

From the ranking results, the United States, represented by a number of technology giants such as IBM, Google, Quantinuum, etc., has an undisputed position as an industry leader. China has the first-class quantum technology research level in Asia, and has nurtured excellent quantum information technology companies such as QuantumCTek, CIQTEK, Origin Quantum (all three locate in Hefei), and is one of the strong competitors for the industry leader position.

 Green Energy

Rank	City/ Metropolitan Area	Rank	City/ Metropolitan Area
1	Beijing	11	Vancouver MA
2	Tokyo-Yokohama	12	Seoul MA
3	Austin MA	13	Copenhagen
4	Munich-Stuttgart	14	Oslo
5	Guangdong-Hong Kong-Macao Greater Bay Area	15	Stockholm
6	Paris MA	16	Dublin
7	Kyoto-Osaka-Kobe	17	Los Angeles MA
8	Houston MA	18	Suzhou-Wuxi-Changzhou
9	Phoenix MA	19	Amsterdam MA
10	London-Oxford-Cambridge	20	Barcelona MA

In this field, the top five cities (clusters) are Beijing, Tokyo-Yokohama, Austin MA, Munich-Stuttgart, and Guangdong-Hong Kong-Macau Greater Bay Area . In the top 20 list, European cities take 10 seats, Asian cities take 6 seats (China takes 3 seats), and US cities take 4 seats.

Green energy includes wind energy, solar energy, biomass energy, tidal energy, etc. Among them, wind energy and biomass energy-related technologies are relatively mature, so innovative technologies are mainly concentrated in solar energy, tidal energy, nuclear energy, hydrogen energy, etc. To avoid the adverse consequences of a relatively single energy source, several European governments have introduced relevant policies to support the development of tidal energy technology.

The ranking shows that the green energy technology companies are concentrated in the southern region of US, mainly in photovoltaics; the West Coast region represented by the San Francisco Bay Area has made breakthroughs in nuclear energy. Some western European coastal countries, in addition to developing offshore wind power, have also carried out technical research on wave power generation.

 AI Robot

Rank	City/ Metropolitan Area	Rank	City/ Metropolitan Area
1	Pittsburgh	11	Singapore
2	Tokyo-Yokohama	12	Geneva
3	Guangdong-Hong Kong-Macao Greater Bay Area	13	London-Oxford-Cambridge
4	San Francisco-San Jose	14	Munich-Stuttgart
5	Boston MA	15	Helsinki
6	Shanghai	16	New York MA
7	Zurich	17	Paris MA
8	Beijing	18	Tel Aviv
9	Seattle-Tacoma-Bellevue	19	Suzhou-Wuxi-Changzhou
10	Seoul MA	20	Kyoto-Osaka-Kobe

The future of the robotics industry will focus on the direction of “artificial intelligence + robots.” In this field, the top five cities (clusters) in terms of strength of technological innovation commercialization are Pittsburgh, Tokyo-Yokohama, Guangdong-Hong Kong-Macau Greater Bay Area , San Francisco-San Jose, and Boston MA. In the top 20 list, Asian cities account for 8 seats (4 are Chinese cities), and US cities account for 5 seats.

From the ranking results, the United States has leading strength in intelligent robots. Benefiting from deep technical accumulation and a mature innovative ecosystem, Pittsburgh's innovative achievements in the intelligent robot industry are ranked first in the world. Companies in Silicon Valley that specialize in developing intelligent chips contribute to the strong innovation competitiveness in the San Francisco-San Jose area.

The Tokyo-Yokohama also performs well in the innovation of humanoid robot technology. As the world's largest producer of industrial robots, Japan has accumulated a lot of industry-related experience and laid a solid foundation for the technological development of humanoid intelligent robots.

The majority of China's intelligent robot industry clusters are located in coastal regions. In recent years, many intelligent robot companies have chosen to settle in Guangdong-Hong Kong-Macau Greater Bay Area, with products that include not only humanoid robots but also intelligent travel tools and self-driving vehicles. Hanson Robotics, the company that created the world's first humanoid robot Sophia with human citizenship, is in the Greater Bay Area of Guangdong-Hong Kong-Macau.

 Metaverse

Rank	City/ Metropolitan Area	Rank	City/ Metropolitan Area
1	San Francisco-San Jose	11	Washington DC-Baltimore
2	Seattle-Tacoma-Bellevue	12	London-Oxford-Cambridge
3	Guangdong-Hong Kong-Macao Greater Bay Area	13	Berlin MA
4	Beijing	14	Paris MA
5	New York MA	15	Tokyo-Yokohama
6	Los Angeles MA	16	Zurich
7	Hangzhou	17	Amsterdam MA
8	San Diego MA	18	Geneva
9	Singapore	19	Tel Aviv
10	Shanghai	20	Stockholm

The United States is dominant in this industry, which has already become a focus of attention. The top five cities (clusters) are San Francisco-San Jose, Seattle-Tacoma-Bellevue, Guangdong-Hong Kong-Macau Greater Bay Area, Beijing, and New York MA. In the top 20 city list, the US cities take 6 seats, Chinese cities take 4 seats, and Swiss cities take 2 seats.

The global major economies have begun to prepare for entering the metaverse industry, at present, the main channels for user penetration are mainly entertainment and games. The San Francisco Bay Area and Seattle metropolitan area, which are known for large information technology companies, lead the metaverse industry in technological innovation. Cities such as the Guangdong-Hong Kong-Macau Greater Bay Area, Beijing, and Hangzhou in China also have many outstanding information technology companies that are constantly injecting vitality into the metaverse industry.

In comparison, Europe has relatively few technology companies involved in metaverse technology innovation. In addition to China, cities in Asia that have made some achievements in metaverse industry innovation are mainly concentrated in Japan, Singapore and other countries with developed financial industries. Singapore have relatively relaxed financial technology regulatory policies and a good active venture capital ecological environment, creating good development conditions for technological innovation in the metaverse industry.

 Advanced Communication

Rank	City/ Metropolitan Area	Rank	City/ Metropolitan Area
1	San Francisco-San Jose	11	Berlin MA
2	Beijing	12	London-Oxford-Cambridge
3	Guangdong-Hong Kong-Macao Greater Bay Area	13	Singapore
4	San Diego MA	14	Paris MA
5	Seattle-Tacoma-Bellevue	15	Los Angeles MA
6	Seoul MA	16	Helsinki
7	Tokyo-Yokohama	17	Kyoto-Osaka-Kobe
8	Dallas-Fort Worth	18	Houston MA
9	Stockholm	19	Hefei
10	Suzhou-Wuxi-Changzhou	20	Tel Aviv

At present, the commercialization of 5G in various regions of the world is gradually being implemented, major economies around the world start to compete in the 6G field. The top five cities (clusters) in advanced communications industry are San Francisco-San Jose, Beijing, Guangdong-Hong Kong-Macau Greater Bay Area, San Diego MA, and Seattle-Tacoma-Bellevue.

Advanced communication technology is the cornerstone industry for future industrial development, the network communication is the technology that provides underlying support for artificial intelligence, the Internet of Things, blockchain and even metaverse. Major economies such as the United States, China, South Korea, Japan, the European Union, have released 6G technology development plans.

 Biotechnology

Rank	City/ Metropolitan Area	Rank	City/ Metropolitan Area
1	Boston MA	11	Tel Aviv
2	Geneva	12	Amsterdam MA
3	San Francisco-San Jose	13	Beijing
4	London-Oxford-Cambridge	14	Stockholm
5	Munich-Stuttgart	15	Berlin MA
6	San Diego MA	16	Copenhagen
7	Tokyo-Yokohama	17	Seattle-Tacoma-Bellevue
8	Zurich	18	Toronto-Burnaby
9	Washington DC-Baltimore	19	Singapore
10	New York MA	20	Kyoto-Osaka-Kobe

The top five in this biotechnology industry are Boston MA, Geneva, San Francisco-San Jose, London-Oxford-Cambridge, and Munich-Stuttgart. In the top 20 list, European cities occupy 8 seats, Asian cities occupy 5 seats, and US cities occupy 5 seats. From the ranking results, the technological innovation of the biotechnology industry is dominated by the United States and European countries, Asian regions are clearly weaker in this field.

Boston, San Francisco-San Jose, London-Oxford-Cambridge, San Diego are ranked 1st, 3rd, 4th, and 6th respectively. The biotechnology industry clusters in these cities are all backed by world-renowned universities and research institutions with biotechnology academic capabilities, and have incubated hundreds of biomedicine and technology start-ups, forming a good biotechnology innovation ecosystem. The Asian cities (clusters) that made the list are Tokyo-Yokohama, Tel Aviv, Beijing, Singapore, Kyoto-Osaka-Kobe, ranked 7th, 11th, 13th, 19th, and 20th respectively. Japan is leading the way in the Asian region, with many well-established biopharmaceutical enterprises

Topic 3.2

GFI Ranking by Industry: The Stars of the Future - Top 20 Enterprises





















Quantum Information

Enterprise		Enterprise	
1	IBM 	11	PsiQuantum 
2	Quantinuum 	12	Pasqal 
3	Google 	13	SEEQC 
4	QuantumCTek 	14	IQM 
5	Rigetti 	15	Origin Quantum 
6	IonQ 	16	QuantWare 
7	Xanadu 	17	ORCA Computing 
8	D-wave 	18	Quandela 
9	CIQTEK 	19	ColdQuanta 
10	Arqit 	20	NQCG 

 Green Energy

Enterprise		Enterprise	
1	Siemens AG-REG 	11	First Solar INC 
2	TOYOTA MOTOR 	12	GCL-Poly Energy 
3	Schneider Electric 	13	Samsung SDI Co. 
4	Panasonic Co. 	14	Doosan Enerbility 
5	Longi Solar 	15	China Longyuan 
6	Vestas Wind Syst 	16	Green Plains 
7	Tesla 	17	BYD Co., Ltd 
8	Ballard 	18	Kyocera Corp 
9	Xinjiang GoldWind 	19	CATL Co. 
10	Sharp 	20	Hinabattery 




 AI Robot

Enterprise		Enterprise	
1	Boston Dynamics 	11	Engineered Arts 
2	Hanson Robotics 	12	Macco Robotics 
3	Raytheon 	13	Agility Robotics 
4	DJI 	14	TOYOTA Robotics 
5	Pal-Robotics 	15	Pormobot 
6	Tesla 	16	Segway-Ninebot 
7	Softbank Robotics 	17	Stryker 
8	Intuitive 	18	Halodi Robotics 
9	Shadow Robot 	19	Apptronik 
10	Beyond Imagination 	20	UBTech Robotics 

 Metaverse

Enterprise		Enterprise	
1	Tencent Holdings 	11	Magic Leap, Inc. 
2	NVIDIA Corporation 	12	Appinventiv 
3	Meta (Facebook, Inc.) 	13	Suffescom 
4	ByteDance 	14	Oyelabs 
5	Roblox Corporation 	15	INORU 
6	Microsoft Corporation 	16	SemiDot Infotech 
7	Globant 	17	PixelPlex 
8	Alibaba Cloud 	18	LeewayHertz 
9	Queppelin 	19	Sparx IT Solutions 
10	Netease, Inc. 	20	SoluLab 

 Advanced Communication

Enterprise		Enterprise		
1	Samsung		11 Qualcomm	
2	Ericsson		12 T-Mobile	
3	Nokia		13 Verizon	
4	NTT Docomo		14 Vodafone	
5	Huawei		15 NEC	
6	LG		16 Intel	
7	ZTE		17 China Satellite Network Grc	
8	HughesNet		18 Orange	
9	Starlink		19 Softbank	
10	Viasat		20 China Telecom	

 Biotechnology

Enterprise			Enterprise		
1	Novo Nordisk		11	Cotinga Pharmaceuticals	
2	Thermo Fisher Scientific		12	Schdinger	
3	Amgen		13	Relay Therapeutics	
4	Regeneron		14	Roivant Sciences	
5	Amyris		15	Genecis	
6	Precigen		16	Cysbio	
7	Apeel Sciences		17	Kinnva	
8	ElevateBio		18	Codexis	
9	Twist BioScience		19	National Resilience	
10	Ginkgo Bioworks		20	Erasca	

What's the driving
force for the
development of
future industries?

What are the
possible threats to
the development of
future industries?

Chapter 4

Summary

Summary

Globally, the development of “future industries” is showing a good trend, and major economies around the world are actively participating in innovation and creation in these fields of cutting-edge technology. At present, the global pandemic is still serious, and the impact of COVID-19 on the economy and society will take longer to recover. In addition, issues such as climate change, geopolitical conflicts, and energy shortages also bring more uncertainty to human development. The various disruptive technologies that are gradually being implemented in practical applications are not only the driving force for the development of “future industries,” but also an important support for social and economic development in the post-Covid 19 era.

Overall, future industrial development will not deviate from the direction of intelligence, sustainable development, and life sciences. The technological innovation of frontier technologies can play a decisive role in the competitiveness of a country, and governments will continue to introduce relevant policies to promote the development of their own “future industries” . The international competitive landscape is complex, and we should be wary of the threats posed by “protectionism” and “unilateralism” to technological innovation factors such as technology, talent, and finance.

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