

Chapter 9 World Openness in Digital and Green Fields

In recent years, the world's fields of openness have been expanding, forming digital, green and other “new tracks”, which become key forces in restructuring global factors and resources, reshaping global economic structure and changing global competition pattern. These “new tracks” are formed in the era of globalization and have innate attributes of openness. For example, the digital domain requires free flow of data across borders, which promotes and leads openness. Climate change, carbon emissions and other global issues require all countries to strengthen cooperation and jointly deal on the premise of openness. Therefore, digital and green are both closely related to openness, and the continuous promotion of digital and green openness will benefit more countries and people in the world.

I. Booming Development of Global Digital Openness

With the development and commercial application of big data, cloud computing, internet of things, artificial intelligence and other technologies in recent years, the empowering role of digital technology has been further intensified, and its penetration into all industries of the national economy has accelerated, which promote the transformation of the economy to the digital, networked and intelligent directions. The scale and scope of digital economy have greatly expanded, covering a wealth of products, services, business models and industrial forms supported by digital technology and with data as an important factor of production. This paper aims to analyze the current status of global digital openness from the four aspects of infrastructure, rules and standards, digital trade, and cross-border flow of data.

1. Infrastructure “hard connectivity”: Rapid development, but the gap is clear

As a new concept, there is no unified definition of “digital infrastructure” so far, but it can be roughly divided into three parts: 1), the communication network infrastructure represented by 5G, Internet of things, industrial Internet and satellite Internet; 2), new technological infrastructure represented by artificial intelligence, cloud computing and blockchain; 3), computing infrastructure represented by general computing center, supercomputing center, intelligent computing center and edge data center.

From the perspective of global Internet transmission capacity, global Internet bandwidth, average Internet traffic and peak Internet traffic have all showed a rapid increasing trend from 2017 to 2021 (see Table 9.1). In terms of intra-continental transmission capacity, Europe, Asia and North America rank the top three in the world in intra-continental Internet bandwidth, with Latin America, the Middle East and Africa lagging far behind (see Table 9.2). In terms of transmission capacity between continents, a distribution structure has been formed with America, Europe and Asia as the first tier, Latin America and the Middle East as the second tier, and Africa and Oceania as the third tier (see Fig. 9.1). There are 7 core hub cities in Europe, 2 in Asia and 1 in North America.

Table 9.1 Global Internet transmission capacity indicators in 2017-2021

	2017	2018	2019	2020	2021
Peak traffic	89	125	161	263	347
Average traffic	25	50	73	134	179
Bandwidth	285	362	453	609	786

Unit: Tbps

Source: The author’s compilation based on the materials published by TeleGeography^①.

Table 9.2 Global Internet bandwidth and CAGR

	bandwidth (Tbps)	CAGR in 2017-2021 (%)
Europe	503	27
Asia	192	37

① <https://global-internet-map-2022.telegeography.com/>

	bandwidth (Tbps)	CAGR in 2017-2021 (%)
North America	163	23
Latin America	91	26
Middle East	57	33
Africa	27	45

Source: The author's compilation based on the materials published by TeleGeography^①.

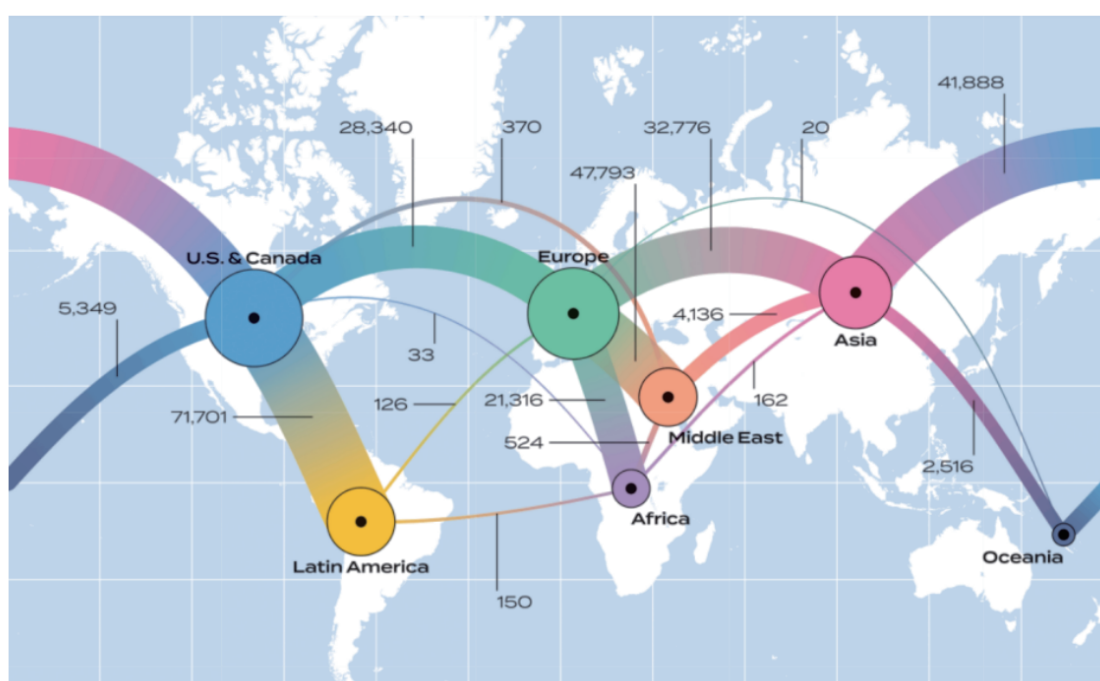


Fig. 9.1 Global intercontinental Internet bandwidth distribution

Source: The author's work based on the materials published by TeleGeography^②.

In the new technology infrastructure, the technical characteristics of artificial intelligence and blockchain are relatively prominent, while the open characteristics of cloud computing remain relatively prominent. In view of this, this section mainly analyzes the connectivity of global cloud computing infrastructure. In terms of global public cloud infrastructure, the number of cloud regions continues to increase, with an average of 15 new cloud regions launched every year^③. As of 2021, Asia and Europe have the highest density of public cloud infrastructure, accounting for 66% of

① <https://global-internet-map-2022.telegeography.com/>.

② *ibid.*

③ *ibid.*

existing facilities globally, while North America accounts for approximately 23.5% of existing facilities, and South America, Oceania, and Africa together account for 10.3%.^①

Table 9.3 Number of Public Cloud Regions in the Continents in 2021

	Number of cloud regions
Asia	42
Europe	28
North America	25
South America	5
Oceania	4
Africa	2
Total	106

Source: The author's compilation based on the materials published by TeleGeography^②.

Computing infrastructure includes general computing center, intelligent computing center, supercomputing center and edge data center, etc. At present, there is no statistical data covering above data centers in the world. Considering servers are the core infrastructure for building data centers, the increase of global servers can reflect the development trend of global data centers to a certain extent. In 2021, the total number of new servers in the world remained stable, and the growth of the total size of data centers slowed down. North America, Asia-Pacific, and Western Europe accounted for more than 90% of the new servers in 2021, and Asia-Pacific in particular, has become an important pole of global growth.

① <https://www.cloudinfrastructuremap.com/#/service/cloud-regions>.

② <https://www.cloudinfrastructuremap.com/#/service/cloud-regions>.

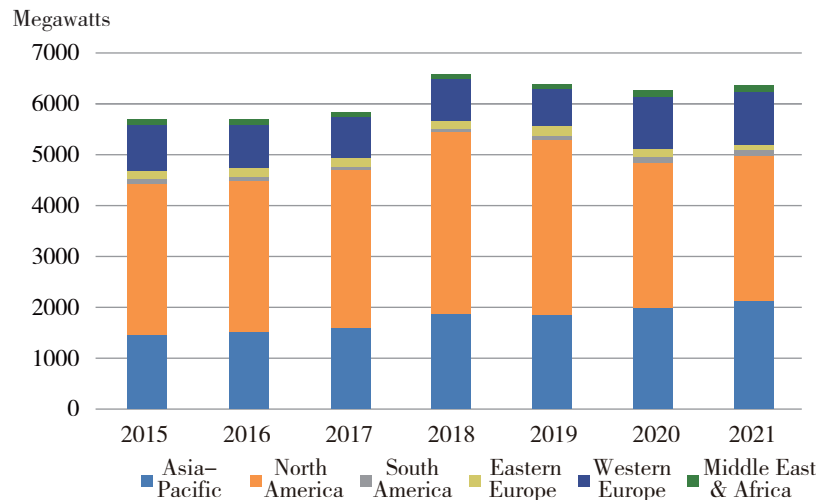


Fig. 9.2 Global annual server additions

Sources: White Paper on Data Center (2022), China Academy of Information and Communication Technology.^①

Countries, especially data powers, have made positive progress in rapidly promoting the construction of their data infrastructure and data connectivity. However, after economic globalization encountered serious setbacks, infrastructure “hard connectivity” among various economies has been increasingly strictly regulated due to various factors.

At present, digital technology has become the core field of great power competition. Major economies have all formulated digital technology development strategies to promote the development of digital technologies mainly represented by 3D printing, blockchain and 5G technology. In the field of 3D printing, the United Nations Digital Economy Report 2019 shows that the US, China, Japan, Germany and the UK account for 70% of the total number of 3D printing enterprises in the world^②, while the rest of the economies only account for 30%. In the field of blockchain technology, the number of patent applications in China accounts for about 50% of the total number of global applications, and the US accounts for more than 25%. In the 5G domain, North America and China are expected to have a 5G penetration rate of more than 45% by 2025, while the Middle East, North Africa and sub-Saharan Africa are all expected

① http://www.caict.ac.cn/kxyj/qwfb/bps/202204/t20220422_400391.htm.

② The United Nations, Digital Economy Report 2019. <https://unctad.org/webflyer/digital-economy-report-2019>.

to have a 5G penetration rate of less than 10%; In the field of artificial intelligence, China, the US and Japan combined accounted for 78% of all patents applied for in 2019. It can be seen that digital technology has been advancing by leaps and bounds, but digital divide is deepening.

2. Rules and standards “soft connectivity”: gradual improvement but with respective emphasis

The “soft connectivity” of digital openness is mainly manifested in the level of rules and standards, which is specifically reflected in digital economic and trade rules in the free trade agreements or digital trade agreements concluded between countries. Before 1994, there were almost no issues related to digital trade in the WTO framework. However, with the vigorous development of digital trade, digital technology and digital economy, the game between major economies around digital economic and trade rules have become increasingly fierce. After experiencing the four stages of absence, germination, formation and development, global digital economic and trade rules have formed a relatively complete rule system.

a. Four major characteristics of global digital economic and trade rules

Digital economic and trade rules have gradually formed their characteristics in the process of evolution. (1), ever-expanding scope of coverage. The regulatory targets started from producers, and gradually extended to consumers, governments and such emerging business forms as Internet platforms. The areas of rules adjustment started with digital trade facilitation and gradually expanded to areas such as data development and flow, and digital governance. The Digital Economy Partnership Agreement (DEPA), for example, extends from digital trade to digital economy and it also introduces digital governance arrangements such as the regulatory framework for digital economy and digital competition policy. (2), taking into account balance in the process of rules advancing toward a high level. The US-Mexico-Canada Agreement (USMCA) once pushed digital trade liberalization and cross-border information transfer liberalization to extremes, but very soon the subsequent US-Japan Digital Trade Agreement (UJDTA) negotiations retreated from aforementioned extreme trade liberalization provisions. (3), increasingly strengthened mandatory rules. The increase of mandatory clauses is the result of increased interest consensus of the parties, which is also helpful to improve the FTA utilization rate. (4),

transforming from single substantive rules to integrated development of substantive rules and procedural rules. The continuous improvement of procedural rules has greatly improved the FTA utilization rate.

Box 9-1 Digital Economy Partnership Agreement (DEPA)

The Digital Economy Partnership Agreement (DEPA) is a digital trade agreement initiated by Singapore, Chile and New Zealand and signed online on June 12, 2020.

The pact consists of 16 thematic modules, involving initial terms and general definitions, business and trade facilitation, digital products treatment and related problems, data, the broad trust environment, business and consumer trust, digital identity, emerging trends and technology, innovation and digital economy, cooperation of small and medium-sized enterprises, digital convergence, transparency, joint committees and liaison, dispute settlement, exceptions and final terms, etc.

The features are as follows.

(1) The DEPA deeply draws on the essence of the Comprehensive and Progressive Trans-Pacific Partnership Agreement (CPTPP), the US-Mexico-Canada Agreement (USMCA) and the US-Japan Digital Trade Agreement (UJDTA).

(2) The DEPA is open and inclusive and has a considerable development prospect.

(3) The scope of the DEPA has been further expanded from digital trade to digital economy. Based on the focus of previous high-level agreements on digital trade, the DEPA takes into consideration digital technology arrangements, including artificial intelligence and fintech arrangements, proposes digital governance arrangements, such as digital economy regulatory framework, digital competition policy and digital convergence, and further strengthens extensive cooperation among the Parties in digital economy, making it the broadest digital trade agreement that has ever been signed in the world.

(4) It deletes some provisions on the protection of intellectual property rights in the digital sector and gives special attention to digital start-ups and small and medium-sized enterprises.

(5) Procedural rules have been further consolidated and the implementation of the agreement has been greatly enhanced.

b. Main contents of global digital economic and trade rules

Digital economic and trade rules currently form three main sections, mainly

involving digital trade facilitation, data development and flow, and digital governance. The digital trade facilitation section aims to reduce tariff barriers and promote digital trade facilitation in order to promote the development of global digital trade. The data development and flow section aims to solve two problems: one is how to maximize the promoting effect of digital elements through data development and utilization, and the other is how to maximize free flow of data across borders without infringing on personal privacy, impairing data sovereignty and national security. The digital governance section focuses on how to solve various social problems arising in the process of the development and openness of digital economy through international coordination and regulatory consistency. It includes information governance, intellectual property protection, Internet platform governance, technology governance, industrial governance, security precaution and dispute settlement, etc. The main contents are shown in the following table.

Table 9.4 Main contents of global digital economic and trade rules

Main sections	Main contents	CPTPP	USMCA	UJDTA	EPA	RCEP	DEPA
Digital trade facilitation	Tariff-free for electronic transmissions	√	√	√	√	√	√
	Non-discrimination of digital products	√	√	√	×	×	√
	Domestic electronic transaction regulatory framework	√	√	√	√	√	√
	Electronic authentication and electronic signature	√	√	√	√	√	√
	Paperless trading	√	√	×	×	√	√
	Logistics, electronic invoices, express delivery	×	×	×	×	×	√
Digital development and flow	Data development	×	×	×	×	×	√
	Government data openness	×	√	√	×	×	√
	Network openness, access and use	√	√	√	√	×	√
	Electronic transfer of information across borders	√	√	√	√	√	√
	Location of computing facilities (non-localization of data storage)	√	√	√	×	√	√

(Continued)

Main sections	Main contents		CPTPP	USMCA	UJDTA	EPA	RCEP	DEPA
Digital governance	Information governance	Online consumer protection	√	√	√	√	√	√
		Personal information protection	√	√	√	√	√	√
		Unsolicited commercial electronic information	√	√	√	√	√	√
		Digital identity	×	×	×	×	×	√
	Intellectual property protection	Source code (algorithm) protection	√	√	√	√	×	×
		Protection of information and communication technology products with encryption technology	×	×	√	×	×	√
	Internet platform governance	Internet platform intellectual property exemption	×	√	√	×	×	×
		Internet interconnectivity cost sharing	√	×	×	×	×	×
	Technology governance	Innovation and digital economy	×	×	×	×	×	√
		Emerging trends and technologies	×	×	×	×	×	√
		Digital inclusion	×	×	×	×	×	√
	Industry governance	Regulatory framework for digital economy	×	×	×	×	×	√
		Digital competition policy coordination	×	×	×	×	×	√
	Security precaution	Network security	√	√	√	×	√	√
		Exception clauses	×	×	√	×	×	√
	Cooperation and dispute settlement	SMEs cooperation	×	×	×	×	√	√
		Joint committees and liaisons	×	×	×	×	√	√
		Transparency	×	×	×	×	√	√
		Disputes settlement	√	×	×	×	√	√

Source: The author's conclusions based on the texts of free trade agreements and digital trade agreements.

c. Comparison of global digital economic and trade rules

Different countries have different emphasis on digital economic and trade rules,

but there is still a basis for cooperation in many aspects. At present, a diversified digital trade rules pattern represented by the United States, Europe and Asia-Pacific has been formed, with the driving force in Asia-Pacific being mainly led by Singapore and China. The similarities and differences of different regions are as follows:

Difference remains relatively little in digital trade liberalization and facilitation In terms of rules and positions, there is little difference, and the emphases in the future can be put on trade facilitation to promote the development of digital trade. For example, some of China's domestic trade facilitation measures have been very successful, but most of them have not yet been elevated to the international level, and there is great room for such kind of development in the future.

Differences remain relatively large in data sharing and flow Domestic data sharing is a policy area that all countries are pushing forward, but the stances on free flow of data across borders remain quite divergent. The US and Singapore advocate full development and free flow of data, with the US focusing on free flow, while Singapore focusing on full development. The EU and China remain more aligned and relatively cautious, believing regulatory and security challenges posed by free flow of data should be taken into full consideration.

Digital governance is a key area for future advancement The US attaches great importance to intellectual property rights protection and the development of Internet platforms, reflecting a development-oriented nature. Europe has high requirements in the area of information governance mainly represented by personal information protection, but its rules and concepts in applying digital technology such as digital identity to promote development lag behind, with the emphasis placed on regulating the development of Internet platforms and digital monopoly industry. Singapore and other DEPA parties has a perfect digital governance rule system and plays a leading role especially in industrial governance and technological governance. China attaches greater importance to the balance between development and governance, and there will be more room for cooperation with the US in information governance, Internet platform governance and industrial governance. In the area of intellectual property rights, the economic and trade propositions of China, Europe and Singapore are more similar. Meanwhile, China and Singapore have been relatively active in cooperation and dispute settlement.

3. Digital trade: Coverage is expanding, but varies widely from country to country

As a new thing, the definition and measurement of digital trade are dynamically adjusted as its scope continues to expand. At present, some representative institutions like the UNCTAD, OECD, WTO, IMF, CAICT, and USITC have different interpretations and statistics on it, but the analysis of cross-border e-commerce and digital service trade as two most important variables can better outline the map of global digital trade openness.

With the strong support of digital technology, cross-border e-commerce platforms have risen rapidly and cross-border e-commerce has entered a period of rapid growth. Global retail e-commerce sales exceeded \$4.9 trillion in 2021, up 14% from 2020. From 2015 to 2021, global retail e-commerce sales grew at an average annual rate of 17%.

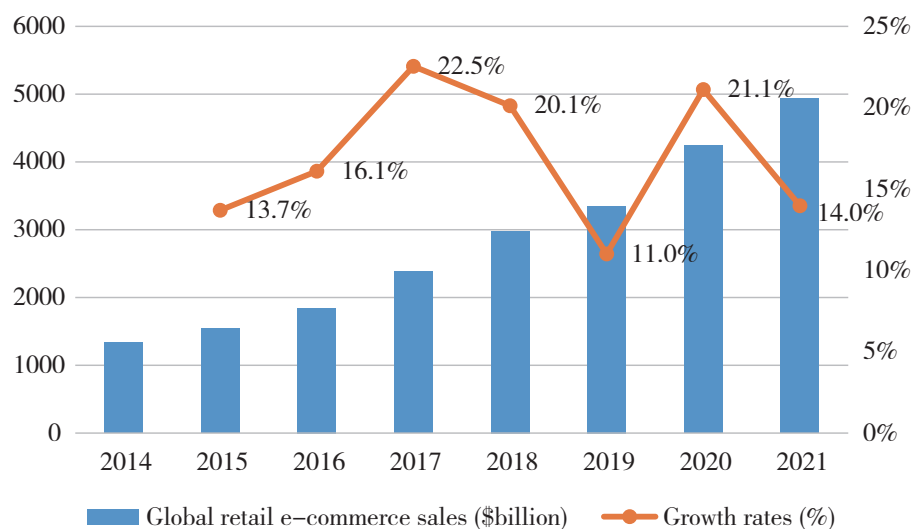


Fig. 9.3 Global retail e-commerce sales and growth rates in 2014-2021

Source: Statista. <https://www.statista.com/statistics/379046/worldwide-retail-e-commerce-sales/>

In terms of country, data from China's Bureau of Statistics shows that China's online retail sales reached 13.1 trillion yuan (RMB) in 2021, the largest in the world and far ahead of other countries. China's customs data showed that the import and export volume of China's cross-border e-commerce in 2021 was 1.92 trillion yuan.

From 2010 to 2020, global trade in digital services increased from \$1.87 trillion to \$3.16 trillion, accounting for 63.6% of total global service exports.

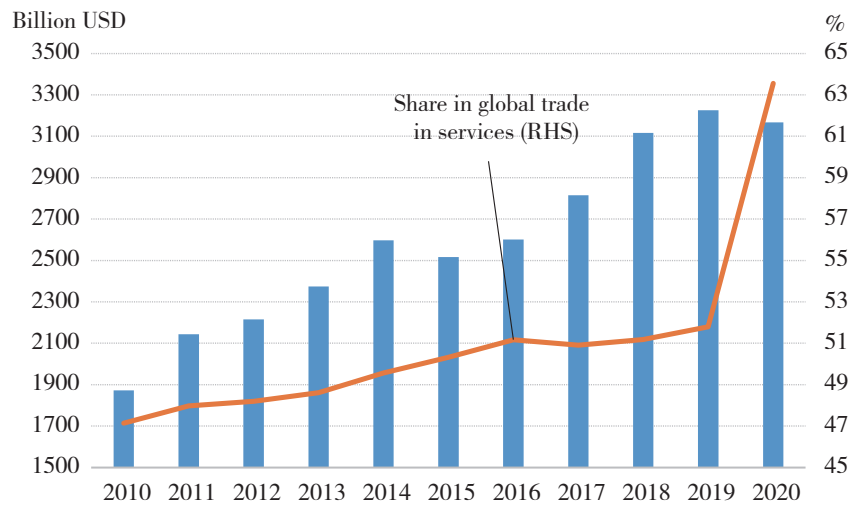


Fig. 9.4 Global trade in digital services and its proportion in global total trade in services, 2010-2020
Source: UNCTAD Database^①.

From the perspective of growth rate, global digital service trade generally maintained a rapid growth trend, with an average growth rate of 5.6% from 2010 to 2020, compared with 1.04% and 2.16% average growth rate of trade in goods and trade in services during the same period. The COVID-19 pandemic had a big impact on global trade in 2020, but the growth rate of digital services trade only decreased by 1.78% year-on-year, which was far lower than that of services trade (down 21.7% year-on-year) and goods trade (down 7.7% year-on-year).

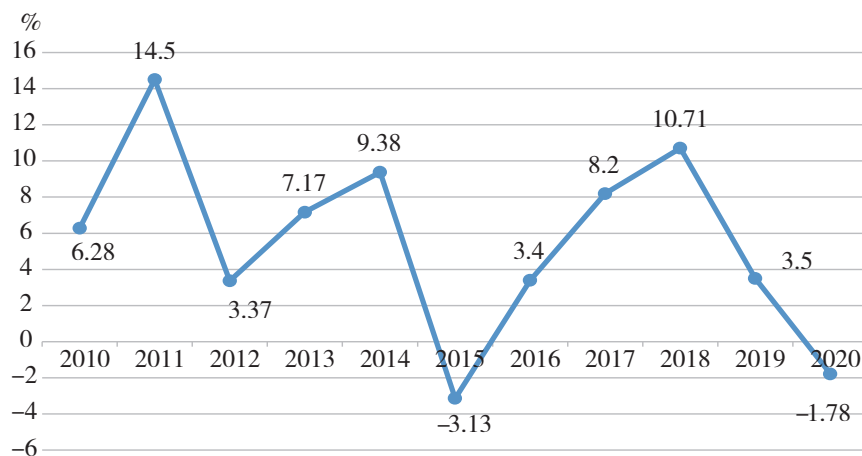


Fig. 9.5 Growth rate of global trade in digital services, 2010-2020

Source: UNCTAD Database.

^① <https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=158358>

From a specific country perspective, the top 10 countries in terms of import and export of digital services trade are concentrated in North America, Western Europe and Asia-Pacific. Differences vary greatly in size from country to country, but the US, with its huge advantage in digital trade, has long remained the leader.

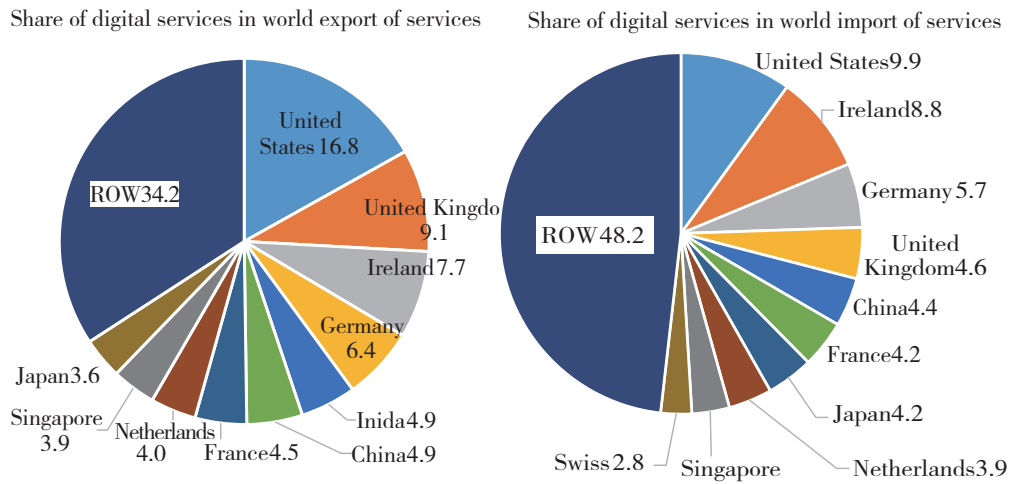


Fig. 9.6 Top 10 economies by share of digital services trade, 2020

Source: UNCTAD Database^①.

4. Free flow of data across borders: important factor of production, but not to a high degree of value

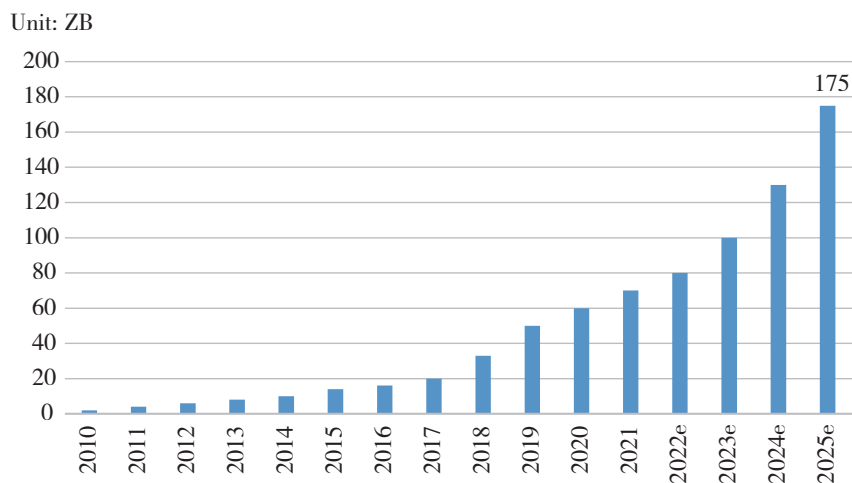


Fig. 9.7 Global data volumes, 2010-2025

Source: Data Age 2025^②, IDC.

① https://unctad.org/system/files/official-document/tn_unctad_ict4d19_en.pdf.

② <https://www.sgpjbg.com/baogao/62098.html>.

Global data volume has shown exponential growth, and according to the IDC^① forecast, it will reach 175ZB by 2025. Data has jumped to become the most promising production factor. Fig. 9.7 gives a comprehensive picture of the scale of global data. The world big data centers are concentrated in the US, China and Japan, with the US accounting for 39%, China 10% and Japan 6% in 2021^②. The revenue of the global data center market has been steadily growing, reaching \$67.93 billion in 2021 and is projected to reach \$74.65 billion in 2022 (see Fig. 9.8).

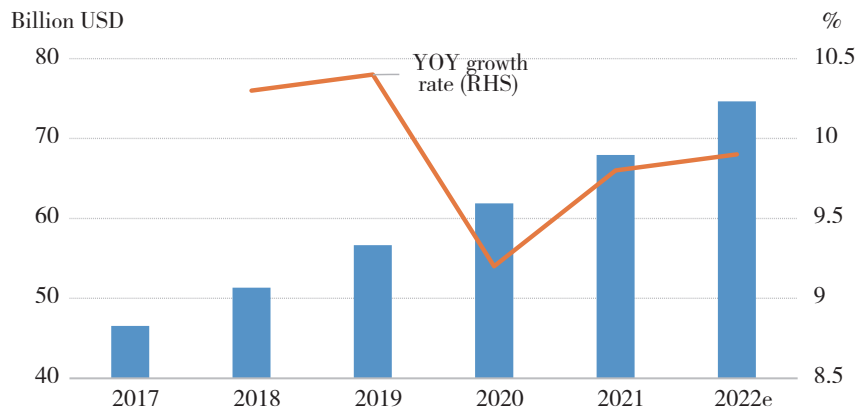


Fig. 9.8 Market revenues and growth rates of Global data center, 2017-2022

Source: White Paper on Data Center 2022^③, CAICT.

There seems to be a positive correlation between the rapid growth of global data volume and the steady rise of data center market revenues, but the growth rate of data center market revenues is far lower than that of global data volume, which actually reflects a problem that cannot be ignored, that is, data value is not high. As a factor of production, data has not acquired a value commensurate with its volume and growth trend. There are two main reasons for this. First, in most countries, there is no mature experience to follow in the relevant practices of valuing data. Rules for data empowerment and trading are still being explored in most economies and consensus

① IDC, whose full name is International Data Corporation, is a wholly-owned subsidiary of International Data Group, which is headquartered in the US. The company is a professional provider of marketing consulting, consultancy and event services for information technology, telecommunication and consumer technology sectors. Its website often publishes market information, forecasts and opinion articles by senior analysts on hot topics in the industries.

② <http://dc.infosws.cn/20210901/50596.html>.

③ http://www.caict.ac.cn/kxyj/qwfb/bps/202204/t20220422_400391.htm.

is yet to be reached at the international level. Second, based on personal privacy, data sovereignty, national security and other considerations, many countries have carried out supervision to varying degrees on cross-border data transmission, which restricts the play of data value.

II. Broad Prospects of Global green Openness

Green economy is a new model that pursues efficiency, harmony and sustainability and supports sustainable economic and social development with less and cleaner energy consumption. It is the redefinition and shaping of the whole economic development paradigm, which not only enjoys broad prospects and extensive cooperation opportunities, but also faces numerous challenges.

1. Global consensus on green economic transformation

In the wake of the 2008 global financial crisis, “green stimulus” packages became a policy choice for many countries to improve economic resilience. At the United Nations Conference on Sustainable Development (Rio+20) in June 2012, participating countries agreed to make green economy a priority area for achieving sustainable development. Subsequently, most developed and developing countries put green development high on government agenda when designing and implementing national sustainable development strategies. Especially with the global signing of the Paris Agreement on Climate Change in 2015, achieving carbon neutrality has become an important part of green economic strategies of all countries.

EU

Green transition features prominently in a range of EU medium- and long-term programs and strategies, including *Europe 2020 Strategy*, *7th Environment Action Programme*, *EU Framework Programme and Sectoral Policies*. At the end of 2019, the EU adopted the *European Green Deal*, which aims to set the EU on the path to green transition that will eventually lead to its carbon neutrality by 2050 (Table 9.5). In 2022, the EU further proposed the *REPowerEU* plan, emphasizing the need to accelerate the pace of green transition, rapidly reduce dependence on Russia for oil and gas, and improve the resilience of the EU energy system.

Table 9.5 Strategic deployment of green economy in the EU

Main programs	Main contents
The European Green Deal	<p>A package of policies includes:</p> <ul style="list-style-type: none"> Achieving climate neutrality by 2050; The “fit for 55” package to translate Green Deal ambitions into law; The Climate Change Adaptation Strategy to help restore Europe’s biodiversity; EU Biodiversity Strategy 2030; A Farm to Fork Strategy to promote sustainable development of the EU food system; A European industrial strategy to lead the transition of European industry to climate neutrality; The Circular Economy Action Plan to decouple economic growth from resource use; A clean, affordable, and secure energy plan; The sustainable and intelligent transport initiatives to accelerate the deployment of clean energy and technologies; The sustainable finance initiative to mobilize private capital to invest in green industries and develop financial standards for green bonds and others; The Just Transition Mechanism to provide financial and technical support to regions most affected by the low-carbon transition with a total budget of 17.5 billion euros.

Source: EU official website documents.

US

During the Donald Trump administration, the budget was considerably slashed in the field of environmental protection, resulting in relatively weak development of green economy in the US, but a lot of investments have been made in renewable energy, electric vehicles, energy efficiency, hydrogen energy and other fields at the state level. After taking office in 2021, Joe Biden led the US to re-join the Paris Agreement and signed a number of executive orders to deal with the climate crisis at home and abroad, making climate change once again the strategic focus of green transformation for the US (Table 9.6).

Table 9.6 Green Economy Initiatives in the US

Green stimulus programs during the pandemic	<p>The Coronavirus Aid, Relief, and Economic Security Act (CARES) in March 2020 provides more than \$250 million in payroll relief funds to clean energy businesses;</p> <p>The American Rescue Plan in January 2021 plans to earmark \$30 billion for mass transit system;</p> <p>The Infrastructure Investment and Jobs Act signed into a law on November 2021 plans to increase renewable energy grids, electric vehicle charging stations, public transport, clean energy research and development support, and other green infrastructure over the next four years;</p> <p>In June 2021, the Hydrogen Shot program was launched, with \$8 billion allocated to support the construction of regional Hydrogen energy centers and \$1.5 billion to support the research and development demonstration of the Hydrogen energy industry chain.</p>
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“The Long-term Strategy of the United States - Pathways to Net Zero Greenhouse Gas Emissions by 2050” submitted to the UNFCCC in 2021	<p>Power sector targets: achieving 100% clean electricity by 2035;</p> <p>Transportation sector: improving fuel efficiency and emissions standards; supporting the construction of zero-emission vehicles and charging piles; promoting the use of renewable fuels;</p> <p>Construction sector: applying new technology, new materials and new building standards, etc.;</p> <p>Heavy industry sector: supporting low-carbon industrial technology and equipment, and using government procurement to support zero-carbon industrial early stage markets;</p> <p>Other targets include agriculture, forestry and marine protection.</p>
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Source: Compiled according to IEA and United Nations Framework Convention on Climate Change (UNFCCC) official website documents.

Japan

Japan is one of the countries that has vigorously implemented the *Green New Deal*. After the 2008-2009 financial crisis, Japan adopted documents such as *Japan’s Vision and Actions toward Low-Carbon Growth and a Climate-Resilient World* to support green and low-carbon transition. In December 2020, Japan released *Green Growth Strategy Through Achieving Carbon Neutrality in 2050*, which took carbon emission reduction and digital economy as two important engines for economic development in the post-pandemic era, and formulated five policy tools to accelerate the construction of Japan’s green economic policy ecosystem (Table 9.7).

Table 9.7 Five policy tools of Japan’s 2050 Carbon Neutrality and Green Growth Strategy

Policy tools	Main contents
Financial supports	<p>Green Innovation Fund: 2 trillion yen (about 122.7 billion yuan) over 10 years;</p> <p>PPP stimulates private R&D and investment worth 15 trillion yen;</p> <p>Increasing government procurement.</p>
Tax incentives	<p>Enterprises that invest in research and development of new fuel cells, wind power generation, semiconductor and other projects will be exempted from corporate tax by 5% to 10%;</p> <p>Tax incentives to stimulate private investment worth 1.7 trillion yen over 10 years;</p> <p>Encouraging the export of advanced technologies such as offshore wind power generation and hydrogen energy, and increasing the amount of export insurance coverage from 90% to 100%.</p>
Financial policies	<p>Formulating guidelines for transformation financing and establishing a long-term fund discount plan (1 trillion yen in 3 years based on business scale);</p> <p>Attracting global ESG investment.</p>
Regulatory reform	<p>Considering regulatory changes in areas such as hydrogen, offshore wind power, and mobile battery;</p> <p>Discussing carbon boundary adjustment and related policies to ensure a level playing field globally.</p>

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Policy tools	Main contents
International cooperation	Carrying out cooperation on innovation policies with developed and emerging countries, including projects in third countries; Carrying out standardization and rules-making; Providing a variety of decarbonization solutions; A global promotion campaign.

Source: the website of the Ministry of Economy, Trade and Industry Japan.

https://www.meti.go.jp/english/policy/energy_environment/global_warming/ggs2050/index.html.

China

Green and low-carbon are also key words in China's 12th Five-Year Plan (2011-2015) and 13th Five-Year Plan (2016-2020).

During this period, China issued a series of policy documents on controlling greenhouse gas emissions, promoting energy conservation and emissions reduction, and building a green financial system to promote green transformation. After announcing the goal of achieving carbon dioxide peaking before 2030 and achieving carbon neutrality by 2060 in September 2020, China issued the *Guiding Opinions on Accelerating the Establishment and Improvement of the Green and Low-carbon Circular Development Economic System*, the *14th Five-Year Plan (2021-2025)*, *Guidance for Carbon Dioxide Peaking and Carbon Neutrality*, and *Action Plan for Carbon Dioxide Peaking before 2030*, to ensure that carbon emissions peaking and carbon neutrality are achieved (Table 9.8).

Table 9.8 China's work deployment for carbon dioxide peaking and carbon neutrality

Phased goals	Forming an economic system for green, low-carbon and circular development by 2025; Achieving significant progress in comprehensive green transformation and peaking carbon emissions by 2030, and promoting steady decline of carbon emissions; Realizing carbon neutrality by 2060;
Strategic visions	Strengthening the "dual control" of energy consumption intensity and total energy consumption, and build a clean, low-carbon, safe and efficient energy system; Promoting industrial green and low-carbon transformation, vigorously developing green and low-carbon industry; Comprehensively promoting green and low-carbon development of urban and rural construction; Promoting the construction of low-carbon transportation system; Promoting nature-based solutions at a faster pace to maximize the role of agriculture, forestry and marine ecosystems; Promoting comprehensive green transformation of economic and social development and optimizing regional distribution.

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Technological paths	Promoting the progress of energy-saving technology; Upgrading the electrification of the terminal energy sector; Developing technologies for renewable energy and nuclear energy, new energy plus energy storage, hydrogen, natural gas, biofuels, and carbon capture, utilization and absorption; Enhancing carbon sequestration capacity and ecological restoration of the ecosystem.
Capacity building	Raising the level of green and low-carbon development in opening up to the outside world; Improving laws, regulations, standards and statistical monitoring systems; Improving investment, green finance, fiscal and tax pricing policies; Promoting the building of market-based mechanisms.

Source: UNFCCC website, *China's Mid-Century Long-Term Low Greenhouse Gas Emission Development Strategy*, <https://unfccc.int/documents/307765>.

Other countries

Singapore announced its *Green Plan 2030* in February 2021, and South Korea unveiled its \$37 billion *Green New Deal* stimulus plan, and also submitted its *2050 Carbon Neutral Strategy* to UNFCCC Secretariat. India also announced at COP26 that it would become carbon neutral by around 2070. According to the UNFCCC website on May 31, 2022, 194 Parties to the Paris Agreement have submitted their information on Nationally Determined Contributions (NDCs), covering 91.3% of global emissions, of which more than 140 countries have announced or are considering net zero emission targets (Table 9.9).

Table 9.9 INDC targets and carbon neutrality commitments of major economies (till May 31, 2022)

Main economies	Summary of latest commitments and goals	Long-term emission strategic commitments
EU	Reducing emissions by at least 55% from the 1990 level by 2030 (the original target was 40%); Raising the share of renewable energy to 45% (the original target was 32%).	Achieving carbon neutrality by 2050
US	Achieving a 26-28% emission reduction from 2005 levels by 2025; Reducing net greenhouse gas emissions by 50-52% from 2005 levels by 2030; Realizing 100% carbon pollution-free electricity by 2035.	Achieving carbon neutrality by 2050
Canada	Reducing carbon emissions by at least 40-45% from 2005 levels by 2030.	Achieving carbon neutrality by 2050
Singapore	Achieving carbon emissions peaking around 2030 and halved from the level by 2050; Realizing clean energy for all vehicles by 2040.	Achieving carbon neutrality as soon as possible after the middle of the century
New Zealand	Reducing greenhouse gas emissions by about 50% by 2030 (the original target was 30%).	Achieving carbon neutrality by 2050

(Continued)

Main economies	Summary of latest commitments and goals	Long-term emission strategic commitments
Japan	Lowering emissions reduction by 46% by 2030 from 2013 levels (the original target was 26%); Raising the share of renewable energy to 36-38% by 2030 (the original target was 22-24%).	Achieving carbon neutrality by 2050
South Korea	Reducing emissions reduction in 2030 by 40% from the 2018 level (the original target was 26.3%).	Achieving carbon neutrality by 2050
China	Peaking carbon emissions by 2030; Increasing the share of non-fossil energy to 25% by 2030 (the original target was 20%); Cutting carbon intensity by more than 65% by 2030 from the 2005 level (the original target was 60-65%).	Achieving carbon neutrality by around 2060
Australia	Reducing emissions by 30-35% by 2030 (the original reduction target was 26-28%).	Achieving carbon neutrality by 2050
India	Lowering carbon intensity by 45% by 2030 from the 2005 level (the original target was 33% to 35% lower); Raising the share of electricity generated from non-fossil sources to 50% (the original target was 40%).	Achieving carbon neutrality by 2070
South Africa	Reducing carbon emissions by 28% by 2030, with a cap of 510 million tonnes of carbon dioxide equivalent in 2025 and 398-440 million tonnes in 2030 (the original cap was 614 million tonnes).	Achieving carbon neutrality by 2050

Source: based on NDCs reports at the UNFCCC official websites submitted by member countries.

Stakeholders

Since 2008, the United Nations Environment Programme, the United Nations Department of Economic and Social Affairs, the United Nations Conference on Trade and Development, and the International Labour Organization have successively launched Green Economy or Green Growth Initiatives. International institutions and organizations such as the World Bank, the OECD, the Partnership for Action on Green Economy, Green Growth Knowledge Platform, Green Economy Alliance, and the Stakeholder Forum are also working to promote green transition on a global scale. The G20 Task Force on Climate-Related Financial Disclosure (TCFD) has issued a series of regulatory guidelines, action plans and regulatory statements related to climate risk governance, among which the TCFD recommendations on climate-related financial disclosures is the most influential climate information disclosure standard in the world.

Banks and asset manager companies representing 40% of global financial assets have pledged to meet the targets of the Paris Agreement. In 2020, the climate finance

by Multilateral Development Banks (MDBs)^① reached \$66 billion, with climate finance accounting for 29% of their total business operations, compared with 19.2% in 2015. As of November 2021, the Glasgow Financial Alliance for Net Zero (GFANZ), convened by the United Nations, had been signed by more than 450 financial firms which together own \$130 trillion in assets. The Principles for Responsible Banking, led by the UNEP Finance Initiative (UNEP FI), has been signed by more than 240 banks representing more than a third of the global banking sector. More and more banks and insurance institutions in the financial market have announced that they will stop providing financing and insurance services for coal power projects.

More and more companies are joining the carbon-neutral campaign. According to the World Bank, as of December 2020, 127 countries, 823 cities, 101 regions and 1,541 companies had committed to decarbonization by mid-century. As the first step towards achieving “Breakthrough 2030”, more than 6,200 members from 110 countries/regions have joined the UN-backed Race to Zero campaign, including major multinational corporations, educational and medical institutions, and others.

2. Positive progress made in green industries and green investment

Backed by ever-growing ambitions and policy actions, investors, businesses and governments are more committed than ever to green and low-carbon transition.

Energy transition has accelerated. Global investment in energy transition totaled a record \$755 billion in 2021, up 6.5% from the previous year^②. Clean energy and electrification accounted for the vast majority of the investment, at \$731 billion. From an individual country perspective, China is the largest energy transition investor, with \$266 billion invested in 2021, followed by the US (\$114 billion). The EU as a whole made an investment of \$154 billion. On top of the \$755 billion, investment in climate technology reached \$165 billion in 2021.

Renewable energy industry has been growing rapidly. The new installed capacity of global renewable energy continued to grow during the pandemic, reaching a record

① Group of Multilateral Development Banks (2021). *Joint Report on Multilateral Development Banks' Climate Finance*. June 30. <https://reliefweb.int/report/world/2020-joint-report-multilateral-development-banks-climate-finance>.

② BloombergNEF (2022). *Energy Transition Investment Trend 2022*. <https://about.bnef.com/energy-transition-investment/>.

280 GW in 2020 and 295 GW in 2021, with China accounting for 46% of global total. The International Energy Agency (IEA) expects that driven by ambitious renewable energy plans in China, India and the EU, the the new installed capacity of global renewable energy will further grow to 320 GW.

Electric vehicles have led transportation industry into a green transition channel. By the end of 2020, the number of electric vehicles in the world had exceeded 10 million, with a year-on-year increase of 43%^①. Among them, 4.5 million were in China, ranking first in the world. The sales of electric vehicles in Europe have also showed a considerable growth, stimulated by the subsidy program for this sector.

The green finance market is on a fast track. By the end of 2021, global cumulative issuance of green bonds had exceeded \$1.8 trillion, continuing a growth trend for ten consecutive years. Europe, China and the US are the most active markets in the world. The investment strategies of most institutional investors around the world are beginning to tilt towards ESG investments. According to the data from Morningstar Direct^②, global ESG fund assets rose to \$2.74 trillion in December 2021, compared with 1.65 trillion at the end of 2020 and \$1.28 trillion at the end of 2019.

III. Trend of Global Digital and Green Openness

Since 2021, the pace of economic globalization has continued to be slowed by the COVID-19 pandemic. Digital and green openness have also been affected as never before. In the short term, the challenges cannot be ignored, but in the long run, openness remains an irreversible trend of the times.

1. Trend of global digital openness: Continue to advance, but difficulties will increase

The development of digital economy is booming, but the openness and difficulty of digital trade, digital infrastructure, free flow of data across borders, and rules and standards vary greatly.

① IEA (2022). *Global Electric Vehicles Outlook 2021*. <https://www.iea.org/reports/global-ev-outlook-2021>.

② Morningstar Direct (2022). *Global Sustainable Fund Flows Report*. <https://www.morningstar.com/lp/global-esg-flows>.

Openness in the field of digital trade is relatively easy. Digital trade liberalization plays an obvious role in promoting a country's economy, and it is the easiest area to reach consensus and realize the highest level of liberalization. In the future, openness in this area is expected to become increasingly wider.

There exist regulations in the field of digital infrastructure. Digital infrastructure connectivity plays a strong supporting role in promoting global digital trade and economic growth. However, since it is usually the carrier of data transmission and storage and digital technology, digital infrastructure is often regulated out of concerns over data leakage and technology spillover.

Cooperation and sharing in digital technology are becoming increasingly difficult. Free flow of data across borders is difficult. Cross-border data flow is an inevitable requirement of trade liberalization, but it is closely related to major issues such as personal privacy protection, data sovereignty and national security, so it attracts extensive attention and receives increasingly strict regulation. Digital technology is the core variable of a new round of technological revolution and industrial transformation, and a key force to boost the economy of all countries in the post-pandemic era. However, due to ever-fiercer technological competition and the emergence of value trade, technological cooperation and sharing among non-allied economies are becoming increasingly difficult, and digital technology gap is deepening. This makes digital technology the least open and most easily decoupled area in the digital domain.

Openness space and difficulty coexist in the field of rules and standards.

a. In the field of digital trade liberalization and facilitation, rules are relatively complete and mature, but still need to be adjusted and enriched in the following aspects. First, the definition of digital products, tariffs collection, reduction and exemption, export control and import restrictions, and other rules all need to be extended to the field of digital trade. In particular, the sustainability of duty-free electronic transmission needs to be explored. Second, with the emergence of the new model, 160 sub-sectors in the existing service commitment table are facing expansion, and service trade openness in the future needs negotiations on the expanded service trade commitment table. Third, digital trade facilitation needs to be further improved. The use and mutual recognition of electronic documents (such as bills of lading, certificates of origin, health inspection and quarantine certificates, etc.), promotion of international templates for electronic invoices, and internationalization of electronic

payment systems are all key areas to be promoted.

b. In the area of data development and utilization, rules are becoming more and more perfect, and the space for rules expansion is very big, but the difficulty for this is also big. The difficulties are mainly as follows: first, how to achieve balance between the development of data resources and the protection of personal privacy; second, how to achieve compatibility between security challenges arising from cross-border data flows and different regulatory rules in different countries. The field of data development and utilization can be further subdivided into the following two areas: first, data development and sharing. The construction of rules in the future should be mainly reflected in the areas of data openness, sharing and utilization of individuals, enterprises, industries and governments, data empowerment, asset entry into balance sheets and transaction rules. However, due to the problems of data security, difficulty of empowerment and conflict of interest of data owners, the road to data openness is long. Moreover, as a new production factor, its new characteristics different from traditional factors usually increase the difficulty of data value evaluation and capitalization. As far as cross-border information flow is concerned, it involves cross-border information flow, data localization and offshore data regulation, access and use of the Internet, etc. However, due to huge differences in economic and trade concepts and security concepts of different economies, it is difficult to reach a consensus on cross-border data flow regulation at the international level.

c. In the field of digital governance, only certain agreements such as DEPA , cover part of the digital governance rules. In the future, there will be a lot of room for expansion in digital governance rules and those spillover effects will be great, but they will not pose a big challenge to the domestic system of countries. In view of this, digital governance rules maybe the earliest areas where an agreement can be reached and generate huge welfare effects in the future. They are also important means for a country to empower society and improve the level of digital governance.

2. Prospects of global green openness: Long-term prospects are promising, but short-term challenges should not be ignored

Global green finance and technology cooperation will become more rules-based. The G20 Sustainable Finance Roadmap and the *Common Ground Taxonomy Instruction Report* published at COP26 in 2021 by International Platform on

Sustainable Finance (IPSF) working group co-chaired by China and EU are two important outcomes of global cooperation on green standards, aiming to establish a globally consistent system of sustainable disclosure standards and guide cross-border climate investment and financing activities on a larger scale. The Central Banks and Supervisors Network for Greening the Financial System (NGFS) has been set up by 92 central banks and financial regulators worldwide to promote climate- and environment-related risk management in the financial sector. The Sustainable Banking Network (SBN) consisting of emerging market banking regulators and banking associations was also officially launched in 2019 to advance ESG management and sustainable finance cooperation among financial institutions in emerging markets.

Clean technologies are crucial to the global fight against climate change. In 2015, 24 economies, including the US, Europe and China, launched a global initiative named *Mission Innovation* (MI) at the COP21, aiming to promote scientific and technological investment in clean energy and realize clean energy and technology cooperation on a global scale.

Green Belt and Road Initiative will become an important platform to lead international green cooperation. At present, the “Belt and Road” big data service platform for ecological and environmental protection, the *Belt and Road Green Supply Chain Platform*, the *Green Silk Road Envoy Program*, the *Belt and Road Green Development Coalition* (BRIGC) and other cooperation achievements have been launched, and the *Green Investment Principles* (GIP) for the Belt and Road Initiative have also been signed by many domestic and foreign financial institutions. In May 2022, China issued the “Opinions on Promoting Green Development of the Belt and Road”, which stressed that it will promote green “Belt and Road” construction in specific areas such as green infrastructure, green energy, green industry, green trade cooperation, green finance, green technology and green standards.

The pandemic, geopolitical conflicts and extreme weather events will add uncertainty to international green development and cooperation in the future. At present, the impact of the pandemic has not been completely eliminated, and many countries still focus on fighting the pandemic, supporting vulnerable enterprises and guaranteeing people’s livelihood, which restricts the scale of green investment. Natural Gas and coal markets also remain tight and volatile, with the European energy crisis at the end of 2021 forcing European utilities to switch to heavily-polluting coal sources.

The Ukraine crisis in 2022 has further added uncertainty to Europe's energy supply, which, added by the US being unable to meet Europe's huge natural gas demand in the short term, may cause Europe to burn more coal and build more pipelines and terminals to import fossil fuels from elsewhere in the short term. Supply chains blocked by the pandemic combined with the geopolitical crisis have also increased supply risks for minerals such as lithium, nickel, palladium, aluminum and platinum needed for key clean energy technologies, and continued high prices for raw materials will also increase the cost of kilowatt-hours of solar PV and wind power.

Extreme weather has exposed the volatility and instability of renewable energy, and with an increasing proportion of new energy sources in the future, energy supply will fluctuate more if no major technological breakthroughs are achieved. Therefore, in the process of green transformation, the risks of replacing old energy with new energy should not be underestimated. This is particularly important for big energy consumers such as China and India. The IEA predicts that global energy demand will grow by another 50-60% by 2030, and energy consumption in Asia in particular will grow by about 6% per year (IEA, 2020). In the backdrop of green transformation, large energy consumers such as China and India need to fundamentally change their energy structure, but due to the high carbon lock-in effect caused by coal-based energy structure, continuing energy demands and emissions reduction pressures from industrialization and urbanization, as well as the huge technological and financial gap, these countries will face very prominent transformation challenges.

In general, the development of digital economy and green economy has become the trend of the times, but the development path is closely related to the policies and institutional settings, development level, social structure, resource endowment and specific environmental pressures of each country, and also is vulnerable to the impact of uncertainties such as the pandemics, wars, extreme weather events and geopolitics. From a general perspective, the development of global digital economy and green economy cannot be achieved without the joint participation and open cooperation of all countries.