CURRENT STATUS OF GREEN FINANCE DEVELOPMENT IN GERMANY AND PROSPECTS FOR SINO-GERMAN GREEN FINANCE COOPERATION

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With countries around the world increasingly prioritizing climate change mitigation and sustainable development, the development of green finance is gaining momentum. Our institute is releasing a series of viewpoint articles on global green finance development, aiming to introduce the development of green finance in major economies worldwide to relevant stakeholders in China. The articles summarize the experiences and insights from various countries' green finance development and explore the prospects for cooperation between China and the examined countries in the field of green finance. This article is the eleventh in the series, focusing on the current status of green finance development in Germany and analyzing the prospects for Sino-German green finance cooperation.

Background

The Federal Republic of Germany (hereinafter – Germany) , is located in central Europe and is composed of 16 federal states. It has a land area of 357,582 square kilometers, making it the fourth largest country in the European Union (hereinafter – the EU) [1]. Additionally, with a population of 83.19 million, Germany is considered to be the most populous country in the EU [2].

In terms of the economy, in 2021 Germany has become the world's third-largest exporter and the third-largest importer of goods [3]. According to the International Monetary Fund's data for nominal GDP rankings, Germany is the fourth-largest economy globally [4].

Time	Name	Brief description
2007-2008	The comprehensive climate and energy plan	The guiding principles are energy supply security, economic efficiency, and environmental protection.
2008-2011	German Strategy for Adaptation to Climate Change	Has established a framework for adapting to the impacts of climate change, laying the foundation for cooperation among federal states and other stakeholders. The strategy aims to assess climate change risks, identify potential actions, determine appropriate goals, and implement alternative options for adaptation measures.
2014	Climate Protection Action Plan 2020	Includes several components such as the National Action Plan on Energy Efficiency (NAPE), climate-friendly building and housing strategies, measures for the transportation sector, and more. These initiatives were aimed to reduce carbon dioxide equivalents by 62 to 78 million metric tons by the year 2020.
2016	Climate Action Plan 2050	Aims to achieve the country's climate goals in sectors such as energy, building and environment, transportation, industry, commerce, agriculture, and forestry, in accordance with the Paris Agreement.
2019	2030 Climate Action Plan	Aims to achieve climate goals through a comprehensive set of measures, including innovation, funding, legal standards and requirements, as well as greenhouse gas pricing and emissions trading systems.
2019 2021	Federal Climate Change Act and its regulatory revisions	Ensures the achievement of national and European objectives, and sets the goal of carbon neutrality by 2045.

Table 1. German main climate policy regulations Source: International Institute of Green Finance (IIGF)

Germany is well-known for its industrial sector. Industries such as automotive and mechanical engineering, chemicals, and electrical engineering are considered as its backbone. Other manufacturing sectors, including food, textiles and apparel, steel processing, mining, precision instruments, optics, and aerospace also play a significant role [5].

Germany has a highly export-oriented industrial base, with over half of the products from its main industrial sectors being sold abroad. It is known globally for its numerous specialized small and medium-sized enterprises operating in various niche areas [6].

As for the mitigation of climate change, Germany actively addresses the challenge of climate change by incorporating climate goals from international agreements such as the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the Paris Agreement into its long-term strategic planning for national economic and social development.

It progressively formulates and improves relevant laws and regulations on climate change, issues related policy measures and action plans, and actively promotes carbon dioxide reduction and energy transition using its financial and technological advantages. Germany has provided rich experiences in advancing global climate governance.

According to the revised Federal Climate Change Act in 2021, Germany's updated climate policy goals include a gradual reduction in greenhouse gas emissions. By 2030, greenhouse gas emissions are expected to decrease by at least 65% compared to 1990 levels, by 2040 a reduction of at least 88% compared to 1990 levels is expected with a goal of achieving carbon neutrality by 2045 [7].

Table 1 summarizes the main climate policy regulations in Germany.

The “Comprehensive Climate and Energy Plan” and the “Climate Protection Action Plan 2020”are aimed to promote Germany's goal of reducing greenhouse gas emissions by 40% compared to 1990 levels by the year 2020.

According to a report by the German think tank Agora Energiewende, Germany has surpassed this target, with a total emission reduction of 42.3% in 2020, equivalent to a reduction of 80 million metric tons of greenhouse gases compared to 1990 levels [8]. However, the achievement of this target is closely intertwined with the COVID-19 pandemic impact on economy. The German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection acknowledges that its policies can only achieve a 37.5% emission reduction [9].

Introduced in 2016 by Germany “Climate Action Plan 2050” outlines the specific steps and targets for achieving climate neutrality by 2050 complying with the provisions of the Paris Agreement. It established the fundamental principles for Germany's long-term strategy in climate protection and provided a roadmap for emission reduction goals and methods in sectors such as energy, buildings and environment, transportation, and industry. The Plan includes conducting a Nationally Determined Contributions (NDCs) inventory every five years and undertakes monitoring and updating strategies as necessary.

The main goal of the Plan is to achieve a 55% reduction in Germany's total emissions compared to 1990 levels by 2030[10]. The "Climate Action Plan 2030," which was issued three years later, particularly outlines sector-specific and cross-sector measures to achieve the defined climate goals through a comprehensive set of measures, including innovation, funding, legal standards and requirements, as well as greenhouse gas pricing[11]. This action plan introduces a national carbon pricing mechanism, covering sectors such as transportation and heating that are not currently included in the European Union Emissions Trading System. It specifies a carbon price of 25 euros per ton of CO2 starting from 2021, with gradual increases in subsequent years[12]. Following the approval of this plan, Germany enacted the " Federal Climate Change Act” in 2019, and revised it in 2021, with the aim of ensuring Germany achieves its national climate protection targets, European targets, while supporting the country in achieving carbon neutrality.

Green finance related policies

Currently, Germany's green finance-related policies primarily include the "German Sustainable Finance Strategy" and various policies targeting products related to green finance. The "German Sustainable Finance Strategy" is a strategic approach set by the German government to achieve a global leadership position in sustainable finance. It focuses on financial market policies and financial regulation, outlining Germany's overall direction in supporting the development of green finance. This includes strengthening regional and international cooperation and communication, reducing information asymmetry, enhancing risk management related to climate risks for entities and the financial sector, promoting the sustainable transformation of government financial institutions, setting sustainable benchmarks in capital markets, and promoting knowledge sharing and institutional capacity building.

As for the green financial products, the German government has introduced specific policies regarding green bonds and green insurance. The "Green Bond Framework" and the "Environmental Equity Act" have been enacted for green bonds and green insurance, respectively. The Federal Financial Supervisory Authority's "Guidance on Dealing with Sustainable Risks" and the EU’s "Corporate Sustainability Reporting Directive" regulate environmental disclosure guidelines.

On February 25, 2019, the State Secretaries’ Committee for Sustainable Development in Germany authorized the German government to develop Germany's Sustainable Finance Strategy with the aim of promoting Germany as a leading sustainable finance center[13]. The German government understands sustainable finance as follows:

- Financial market participants from both the public and private sectors should consider sustainability-related issues when making any decision[14].
- The concept of "sustainability" in sustainable finance encompasses not only climate and environmental protection but also economic and social factors, such as the integration of

environmental, social, and governance (ESG) investment principles.

- As for the "financial" aspect of sustainable finance, the focus is placed on the sustainability of financial market policies.

From the perspective of the German government, relevant policy measures include the regulation and supervision of financial markets, such as banking, insurance, pension funds, securities, asset management, and stock markets, as well as dispute resolution and investor protection within the scope of capital market regulation[15]. At the same time it also emphasizes the role of the German government in collaboration with development banks and guarantee institutions as financial market participants, such as investors or bond issuers in capital markets.

On June 6, 2019 the German government established the Sustainable Finance Committe. The council consists of members and observers from the financial sector, real economy, academia, and civil society, bringing together expertise from various fields of endeavor. One of the Council's key responsibilities includes the development of a sustainable finance strategy for the German government, while providing recommendations and fostering important dialogues among relevant stakeholders to advance sustainability-related issues at the German and European levels[16].

In response to an initiative by the German Federal Ministry of Finance, the German Ministry for the Environment, and the German Ministry for Economic Affairs and Energy, the German government released the "Sustainable Finance Strategy" in May 2021. The Strategy outlines five objectives, eight action areas, and 26 specific measures (Table 2, Figure 1) in order to promote sustainable finance in Germany[16].

From particular action areas, Germany continues to drive sustainable finance development at the global and European levels. During its presidency of the G7 summit in 2022, Germany prioritized sustainable finance, aiming to "ensure economic and financial stability, resilience to future crises, and shape the transformation process in the context of digitization and climate neutrality."

Simultaneously, Germany seeks to promote sustainable finance through global dialogues, development cooperation, and collaboration with multilateral development banks. At the European Union level, Germany advances the EU sustainable finance agenda by optimizing the EU taxonomy for sustainable activities and strengthening corporate social responsibility to drive sustainable finance development.

In order to improve environmental information transparency, Germany's sustainable finance strategy includes measures to enhance non-financial corporate reporting. It proposes the establishment of a "traffic light" system for investment products, providing investors with concise information on how to assess and incorporate sustainability factors. The strategy aims to improve the accessibility of corporate environmental information, assisting investors in evaluating and utilizing a company's sustainability information. The strategy also emphasizes strengthening the regulatory responsibilities of the Federal Financial Supervisory Authority (BaFin) in the field of sustainable finance.

Objective 1	Promote sustainable finance at the European and international levels	Action 1	Strengthening sustainable finance at global and European levels
Objective 2	Seize opportunities, leverage finance to support economic transformation, and consolidate the impact of sustainable development.	Action 2	Enhancing transparency
Objective 3	Proactively enhance risk management capabilities in the financial industry to ensure market stability.	Action 3	Strengthening risk management and supervision
Objective 4	Promote Germany as a sustainable finance center and foster the accumulation of expertise.	Action 4	Improving and implementing impact assessment methodologies.
Objective 5	Establish the German government as a role model for sustainable finance within the financial system.	Action 5	Financial support for sustainable transformation
		Action 6	The role of the German government in capital markets.
		Action 7	Strengthening institutional capacity to create and share knowledge
		Action 8	Establishing efficient organizational structures to implement the sustainable finance strategy.

Table 2. Objectives and action areas of the German Sustainable Finance Strategy

It supports both the real economy and the financial industry in enhancing their capabilities to manage physical climate risks. Furthermore, the strategy focuses on continuous development of ESG impact assessment and evaluation methodologies to enhance ESG impact evaluations. In terms of financing sustainable transformation, the German government's financing instruments play a crucial role by providing comprehensive financing options that incorporate sustainability factors.

To drive the sustainable transformation of government financial institutions, specific measures include:

- Advancing the transformation of KfW (Kreditanstalt für Wiederaufbau) into a development bank oriented towards sustainability and carbon neutrality. This involves systematically investing in restructuring opportunities presented during the transformation process, particularly providing more funding for transformative technologies.
- Integrating sustainability factors and ESG standards into investment decisions of the German "Future Fund" (Zukunftsfonds). The government supports innovative companies in the environmental and social sectors to access additional funding from the Future Fund and its financing partners.
- Considering sustainability factors explicitly in export financing and federal credit guarantees provided by the German government.

To support the sustainable development of capital markets, Germany is issuing

No.	Measure	Time horizon
	Strengthen sustainable finance at the global and European level	
1	Sustainable finance – an important topic during the German G7 Presidency 2022	Short-term
2	Promoting global dialogue	Medium-term
3	Strengthening sustainable finance in development cooperation	Medium-term
4	Strengthening sustainable finance within multilateral development banks	Short-term
5	Advancing the European sustainable finance agenda	Short and medium-term
6	Ongoing development of the EU taxonomy	Short and medium-term
7	Strengthening corporate social responsibility	Short-term
	Improving transparency	
8	Strengthening non-financial corporate reporting	Medium-term
9	"Traffic light" for investment products	Medium-term
10	Improving access to sustainability-related corporate information	Short to medium-term
	Strengthening risk management and supervision	
11	Improved supervision by strengthening BaFin	Short-term
12	Supporting the real and financial sector to improve risk management in relation to physical climate risks	Medium to long-term
	Improving and implementing impact assessment methods	
13	Ongoing development of ESG impact assessment and evaluation methods	Short-term
	Financing transformation	
14	Continuing the development of KfW into a transformation bank	Short to medium-term
15	Taking account of sustainability in the German Future Fund	Short-term
16	Taking sustainability explicitly into account in foreign trade financing	Short-term
17	Taking sustainability explicitly into account in the case of Federal Guarantees	Short-term
	The German government in capital markets	
18	Establishing a green Bund yield curve	Short-term
19	Improving sustainability and transparency in the German government's capital investments	Short-term
	Strengthening institutions, generating and sharing knowledge	
20	Ensuring competent advice through the integration of sustainability aspects into expert competency exams, training courses and a broad advanced training portfolio	Short-term
21	Better informing investors	Medium-term
22	Strengthening basic research and knowledge transfer	Medium-term
23	Strengthening the dialogue with the *Länder* and local authorities	Short-term
24	Developing indicators to better measure and analyse Germany's development as a sustainable finance centre	Medium-term
	Creating efficient structures for implementing the Sustainable Finance Strategy	
25	Interministerial Sustainable Finance Working Group	Short-term
26	Perspectives for the Sustainable Finance Committee (SFC)	Short-term

Figure 1 Particular measures to implement Germany's green finance strategy

green sovereign bonds with the aim of building a green bond yield curve and becoming a benchmark in the Euro green bond market. This effort enhances transparency in green bond pricing and strengthens the development of the green finance market. In terms of knowledge generation and sharing, the strategy emphasizes better informing investors and strengthening foundational research and knowledge sharing. It also promotes dialogue with state and local authorities. Furthermore, to ensure necessary advice and objective feedback, the strategy integrates sustainable development content into expert competence tests, training courses, and extensive advanced training. Indicators will be developed to measure and analyze the development of sustainable finance in Germany. Lastly, from an organizational perspective, the strategy establishes a cross-departmental coordination working group and a sustainable finance committee to ensure institutional support for sustainable finance.

In addition to the comprehensive and strategic German Sustainable Finance Strategy, the German government and related institutions have implemented relevant policies in the areas of green bonds, green insurance, and environmental information disclosure.

As for the green bonds, the German government, as a market participant, directly engages in the capital market by issuing Green German Federal Securities as benchmarks for green bonds, thus contributing to further advancing the development of the sustainable finance instrument market.

Germany plans to issue more green bonds with different maturities in the future and establish a green bond yield curve to serve as a benchmark for the green euro capital market. The "Green Bond Framework" was released by the German government on August 24, 2020, with the aim of leveraging the bond market to support the achievement of economic and social sustainability goals [17].

This framework provides detailed provisions on the selection of green projects, the use and management of raised funds, information disclosure, external evaluation and certification for German sovereign green bonds [18]. Under the German "Green Bond Framework," qualified use of proceeds is categorized into five main areas: transportation; international cooperation; innovation, research, and awareness-raising; energy and industry; and agriculture, forestry, soil, and biodiversity conservation [19].

In the area of green insurance, Germany primarily implements environmental pollution liability through mandatory liability insurance and financial guarantees or assurances. The German government's Act on Environmental Liability, first enacted in 1990 and updated in 2017, stipulates that owners of facilities with significant environmental liability risks must fulfill certain pre-cautionary obligations, including entering into liability insurance contracts with insurance companies or obtaining financial guarantees or assurances from state, federal authorities, or financial institutions. In case of non-compliance, the competent authorities can partially or completely prohibit the operation of such facilities, and facility owners may also face imprisonment or fines. [20]

In the aspect of environmental information disclosure, Germany strives to enhance transparency regarding sustainable-related investments and corporate environmental risks. The German government plans to strengthen non-financial information disclosure for established large companies and groups in the following ways:

1. Expand the obligation of non-financial reporting to include all entities classified as large entities in accounting, limited partnership companies, parent companies of large groups, and all listed companies regulated by stock exchanges in the European Union.
2. Non-financial reports must be included in the (consolidated) management report and presented as a separate section.
3. Non-financial information disclosure should encompass the environmental impact on the company's sustainability to a certain extent or the company's activities' impact on sustainability-related aspects, i.e., a dual-substantiality approach [21].

Furthermore, regarding transparency requirements at the EU level, Germany strives to align domestic policies on environmental information disclosure, such as the Non-Financial Reporting Directive, with EU-level regulations on sustainable corporate governance. Germany will advocate for the development of requirements that integrate existing and new regulations to avoid duplicative or conflicting reporting demands on companies. The German government will also oversee other EU reporting requirements, such as the Eco-Management and Audit Schem (EMAS) and regulations in the sustainable finance field, and review the sustainable corporate governance initiative proposed by the European Commission. Based on these approaches, Germany aims to drive the development of unified global standards for sustainable development reporting based on EU standards. It seeks to cover all aspects of sustainable development through a dual-substantiality approach and promote the development of non-financial reporting, making Europe a "driver" in the global landscape of environmental information disclosure. [22]

The German green finance market

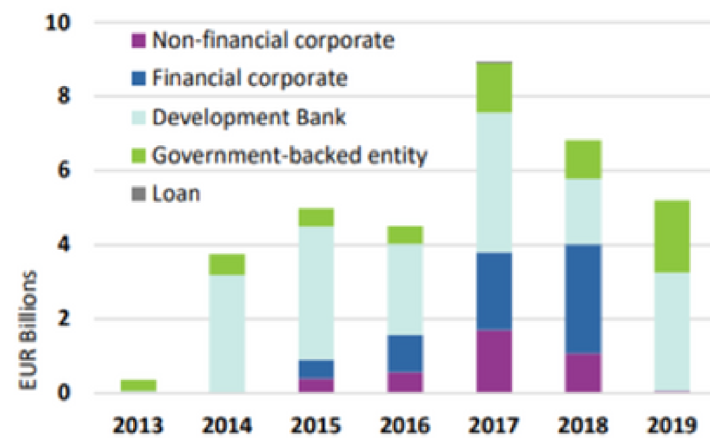
The green finance market in Germany is dynamic, with many innovative applications of green financial instruments and promising performance in the market. The following part will introduce the latest developments in the German green finance market from the perspectives of green bonds, green loans, green funds, green insurance, and the carbon market.

Green bonds

The green bond market in Germany is quite dynamic. In 2021, a total of 33 issuers issued 232 green bonds, with a total issuance volume of approximately $67.1 billion, representing a year-on-year growth of 158%.

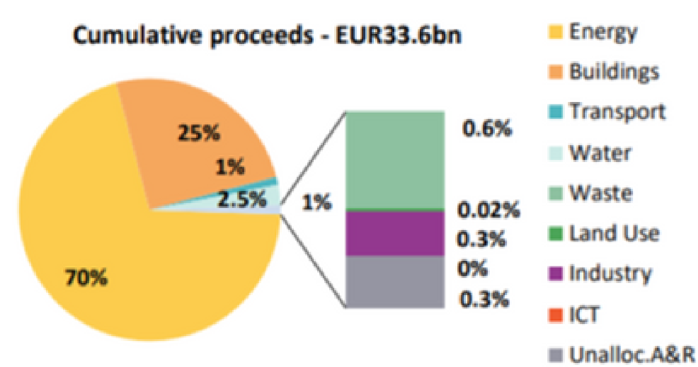
In the same year, Germany surpassed France in green bond issuance, becoming the third-largest green bond issuer globally and the largest in Europe [23]. According to the Climate Bonds Initiative, as of the end of June 2022, Germany has cumulatively issued $93.3 billion in green bonds [24]. In terms of issuers, according to the Climate Bonds Initiative's report on the German green bond market in 2018, financial institutions accounted for 43% of the issuance volume in 2018 (see Figure 2), and an additional 25% of the volume came from KfW, Germany's largest green bond issuer. By May 2019, KfW had issued €3 billion in green bonds [25].

If we look at the industry distribution of green bond issuances in Germany since 2019, we can see that the clean energy sector dominates, accounting for 70% of the total proceeds raised, while low-carbon buildings represent the second-largest sector, accounting for 25% (Figure 3). In addition to these characteristics, almost all green bond issuances in Germany undergo external evaluation and certification: 86% of transactions have second party opinions (SPO), 12% have Climate Bonds Standard certification, and 1% have green bond ratings [26].



Note: All green bond data as at 31 May 2019, unless otherwise stated.

Figure 2. Green bond issuers in Germany



Note: As much as possible, CBI tries to assign adaptation and resilience allocations to sectors. "Unalloc.A&R" could not be allocated to a sector.

Figure 3. Sectoral distribution of green bond related projects in Germany in 2019
Source: Germany: Green Finance State of the Market - 2019 Update

As for the green bond innovation, on September 2, 2020, one week after the release of Germany's Green Bond Policy: "Green Bond Framework," Germany issued its inaugural Green German Federal Security.The bond was jointly underwritten by financial institutions such as Barclays Bank, Deutsche Bank, and J.P. Morgan.

It had a zero-coupon rate, raised €6.5 billion, had a maturity of 10 years, and was issued using a "twin-bond" structure. This structure contrasted the Green German Federal Security with Germany's conventional sovereign bonds, giving both bonds the same characteristics and features, such as the same maturity, coupon rate, interest payment dates, and maturity dates.

The issuance of "twin-bonds" was introduced in order to create high liquidity and attract more international investors. By linking the green bond with a conventional federal bond, investors purchasing the green bond have the option to convert it into a regular government bond at any time, securing liquidity. The German Finance Agency can conduct open market operations to provide liquidity, ensuring that yields remain within a reasonable range while also helping to establish a pricing benchmark for green bonds.

According to the issuance results, Germany's inaugural green sovereign bond received approximately €33 billion in oversubscription from global investors, indicating a strong market response. The issuance price was set at 104.717, with a yield to maturity of -0.463%. According to the German government's plan, green sovereign bonds with maturities of 2 years, 5 years, 7 years, 15 years, and 30 years will be gradually issued. With the improvement of the maturity structure, the German government aims to establish a risk-free yield curve for green bonds, providing a trading reference and pricing benchmark for the Euro-denominated green bond market [27]. The German Agency for International Cooperation (GIZ) provided technical consultation to the German Federal Ministry of Finance regarding the issuance of Germany's inaugural green sovereign bond.

Green loans

In the field of green loans, the federal government, federal states, and the European Union have numerous plans and initiatives to support and facilitate implementation of green projects and provide financing for pioneering environmental initiatives. In 2018, the entire German SME sector received around €10 billion in support for environmental projects from KfW, the German Development Bank [28]. One notable example is KfW IPEX Bank, which provides green loans for financing projects that contribute positively to environmental protection, climate action, and resource conservation [29]. In 2020, the German government provided approximately €16.7 billion (compared to €21 billion in 2019) in export credit guarantees for new business. The volume of transactions in the renewable energy sector was around €1.1 billion (compared to €1 billion in 2019), with a significant portion (around €1 billion) allocated to the wind energy industry. In the same year, the German government provided approximately €900 million (compared to €3.3 billion in 2019) in investment guarantees for new projects. In the renewable energy sector, the transaction volume was approximately €56 million in 2020 (compared to €47 million in 2019), primarily focused on wind energy and hydropower [30].

Green funds

In terms of green funds, Germany is not the leading country compared to the rest of Europe.

In 2017, Germany accounted for only 9% of the green fund market in Europe. The three countries that outperformed Germany were Switzerland, France, and the United Kingdom, with market shares of 33%, 21%, and 20% respectively [31]. In comparison with Austria and Switzerland, Germany's growth rate in sustainable fund assets remains relatively low, maintaining a relatively slow growth pace.

As the largest economy in Europe, Germany accounted for only 9% of the green fund market in the region in 2017, while the market shares of the United Kingdom and France were twice as high. According to the 2021 Novethic European SRI Market Report, the sustainable fund market in Europe reached €243 billion, with Germany accounting for only €7 billion. The 2020 annual report by the Forum Nachhaltige Geldanlagen (FNG), a financial industry association, found that Germany's interest in sustainable investment has significantly rebounded, growing by 23% in 2019 to reach €270 billion. However, this still only represented 5.4% of the country's fund market that year [32].

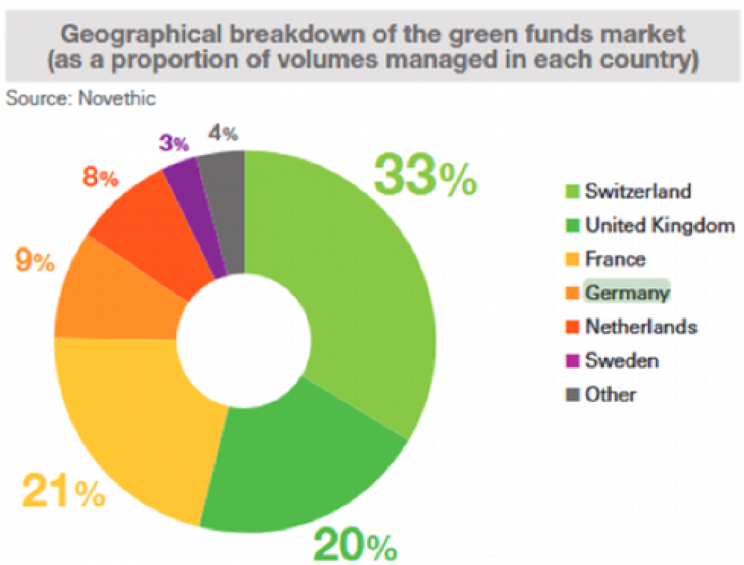


Figure 4. Green Fund shares by geographical location

Green insurance

In the field of green insurance, environmental liability insurance has a long history in Germany. As early as 1965, insurance products were available to provide coverage for personal injury and property damage claims resulting from environmental harm [33].

The green insurance market in Germany offers relatively comprehensive and sophisticated products, including services such as environmental risk analysis, risk transfer measures, and risk and loss prevention. Examples of such products and services include environmental loss insurance provided by HDI [34] and environmental liability insurance offered by VersWiki [35].

In addition, some insurance companies in Germany have committed to achieving climate-neutral investment portfolios by 2050. This includes insuring renewable energy and other clean technology facilities that promote economic transition, as well as offering insurance for natural disaster losses related to extreme weather events and climate risk. According to the German Insurance Association (GDV), German insurance companies are no longer willing to underwrite commercial or industrial risks that hinder sustainable development [36]. Regarding the German insurance industry itself, many insurance companies in Germany have pledged voluntary measures to reduce emissions. For example, by 2025, German insurance companies aim to achieve carbon neutrality in their office buildings and infrastructure.

Carbon market

As for the carbon market sector, in addition to participating in the European Union Emissions Trading System (EU ETS) along with other EU member states [37], Germany has also established a carbon pricing mechanism for the construction and transportation sectors within its own territory.

“The introduction of the National Emissions Trading System (nETS) for the building and road transport sectors, which are not covered by the EU ETS, is considered a complementary measure to the EU ETS and a cornerstone of Germany's "Climate Action Plan 2030" proposed by the government in 2019.

The German Fuel Emissions Trading Act (BEHG) was passed in December 2019 and revised in November 2020 [38]. Germany's domestic fuel carbon market was officially launched in 2021, with an independent registry, and all allowances are issued through auctions. Furthermore, the "Emission Reporting Regulation for 2022" has been introduced, which clarifies the measuring, reporting, and verification (MRV) obligations in the domestic fuel carbon market for the years 2021 and 2022 [39].

According to current regulations, from 2021 to 2025, the allowances within Germany's fuel carbon trading system have a fixed price that increases gradually each year (from 25 euros to 55 euros). In 2026, a price corridor is planned to be introduced, and the price trajectory from 2027 onwards will be reviewed in 2025 [40]. In September 2022, to alleviate energy price pressures, the German government decided to temporarily freeze the planned increase in carbon prices in the domestic fuel carbon market, maintaining it at 25 euros [40].

German's international cooperation in green finance sector

Participation in international mainstream green finance initiatives

In terms of international cooperation in green finance, the German government and official organizations actively seek partnerships with various stakeholders. Germany, as a member country, has joined the International Platform on Sustainable Finance (IPSF) and the Coalition of Finance Ministers for Climate Action (CFCA).

Within Germany's financial and regulatory sectors, the Deutsche Bundesbank, as the central bank, participates in the Network for Greening the Financial System (NGFS), and the Federal Financial Supervisory Authority (BaFin) is involved in both NGFS and the Sustainable Insurance Forum (SIF). As of the end of 2021, a total of 9 German banks have signed the Principles for Responsible Banking (PRB), and 9 insurance and financial companies have signed the Principles for Sustainable Insurance (PSI).

In addition to joining and cooperating with international organizations, the German Federal Ministry of Finance, the Federal Financial Supervisory Authority (BaFin), and the Deutsche Bundesbank (German central bank) aim to strengthen global-level dialogues and seek multi-stakeholder international cooperation in green finance in a more influential manner. For instance, Germany collaborates with the European Union and the United Nations Development Program (UNDP) to support partner countries in developing Integrated National Financing Frameworks (INFF). This international organization cooperation aims to promote sustainable financing and economic development [41].

The German government has prioritized sustainable finance as part of its agenda during its presidency of the G7 in 2022 [42]. Additionally, the German Federal Ministry for Economic Cooperation and Development (BMZ) has provided initial funding for the Latin American Green Bond Fund (LA GREEN) through KfW Development Bank.

LA GREEN, as a major investor in green bond issuances, contributes to building confidence in capital markets and promoting green financial products and investments. Under the mandate of BMZ, the German Agency for International Cooperation (GIZ) supports the development of green finance markets and the promotion of green financial products and investments in countries such as Brazil and Vietnam, working with their respective economic/finance ministries, central banks, and financial institutions. Through the

"Emerging Markets Sustainability Dialogues (EMSD)" project, GIZ facilitates sustainable dialogues among think tanks, public-private sectors, financial institutions, and other stakeholders in emerging economies. The "Emerging Market Sustainable Finance Dialogue" is one of the three pillars of this project.

Under the framework of the Emerging Markets Sustainability Dialogues (EMSD) in sustainable finance, numerous initiatives have been undertaken to align the financial system with the goals of the Paris Agreement's 1.5-degree target and the United Nations Sustainable Development Goals (SDGs).

GIZ collaborates with public and private sector partners from around the world and emerging markets, including financial regulators, banks, institutional investors, stock exchanges, research think tanks, and universities. Through research, development, and piloting of cutting-edge and innovative methodologies and tools, GIZ empowers financial institutions to make sustainable investment decisions. This includes conducting environmental scenario analysis, environmental stress testing, and piloting financial solutions such as "green asset wallets" based on blockchain technology. GIZ, in partnership with the Swedish bank SEB and the United Nations Partnership for Action on Green Economy (PAGE), has also developed an online learning platform for sustainable finance.

Sino-German bilateral cooperation in green finance

As a major European economy, Germany has used its economic advantages and policy experience to take a leading role in promoting global green finance, which is also similar to China’s approach as well. In the future, Germany and China will need to reach consensus on climate change issues and actively promote the establishment of international standards for green finance risk management and disclosure. There is great potential for cooperation in accelerating the development and improvement of the global green finance system.

In terms of specific practical cooperation, China and Germany have carried out numerous green financial cooperation projects. The Ministry of Finance of the People's Republic of China signed loan agreements with KfW Development Bank of Germany on November 18 and November 24, 2020, for the Anhui Huangshan Xin'an River Ecological Protection and Green Development Project, as well as the Luojiang District Zhoujiaba Ecological Wetland Protection and Resource Recycling Project in Deyang City, Sichuan Province. The total investment for the Anhui project is 1.455 billion yuan, including a loan of $100 million from the Asian Development Bank and a promotional loan of €50 million from Germany. The term for the German promotional loan is 15 years, including a 5-year grace period.

The projects mainly include the improvement of urban drainage systems and comprehensive river management, construction of ecological villages, and prevention and control of agricultural surface source pollution. The total investment for the Sichuan project is 445 million yuan, including a promotional loan of €40 million from Germany. The loan term is 15 years, including a 5-year grace period. The main components of the project are the construction of Zhoujiaba No.1 and No.2 sluices, ecological embankments, wetland protection and restoration in Zhoujiaba, upgrading of sewage treatment plants, and the construction of a zero-carbon center demonstration project [42].

In the Shandong Green Development Fund project, the Chinese Ministry of Finance signed a loan agreement with KfW Development Bank of Germany on August 5, 2020. The project was financed through a combination of loans from the Asian Development Bank, German promotional loans, loans from the French Development Agency, and the Green Climate Fund (GCF), with a total scale of 10 billion yuan. The first phase of the project has a scale of 1.7 billion yuan, including a $100 million loan from the Asian Development Bank. The second phase of the project has a scale of 3.3 billion yuan, including a promotional loan of €100 million from Germany. The loan term is 15 years, including a 5-year grace period. The aim of the project is to promote green development in Shandong Province through investments in energy conservation, environmental protection and governance, clean energy, circular economy, and green manufacturing [43].

In addition, Deutsche Börse has engaged in extensive cooperation with Chinese trading and financial institutions. On January 19, 2022, Deutsche Börse announced the signing of a memorandum of understanding with the Guangzhou Futures Exchange (GFEX) in China, establishing a partnership to facilitate and explore international cooperation in the field of green finance. In the future, both parties will collaborate to build a China-Europe mechanism for green financial cooperation, strengthen resource sharing in market research, market promotion, investor education, and explore the possibilities of cooperation in green development products such as carbon emissions trading [44].

On March 2, 2022, Deutsche Börse and Postal Savings Bank of China jointly developed the " STOXX® PSBC China A ESG Index." The index is based on the ESG rating system and database independently developed by the International Institute of Green Finance (IIGF), incorporating international standards. It aims to provide global investors with a more comprehensive and scientific reference for ESG decision-making in investment and financing activities in China, while also facilitating the internationalization of China's capital market [45]. In October 2022, Deutsche Börse included the historical ESG data of the Chinese market provided by the International Institute of Green Finance in its database services, facilitating better evaluation of Chinese companies' ESG activities by international investors [46].

Under the mandate of the German Federal Ministry for Economic Cooperation and Development (BMZ), the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) initiated cooperation with China in the field of green and sustainable finance in 2015. GIZ's global project, the Emerging Markets Sustainability Dialogues (EMSD), aims to support emerging economies within the G20 in building capacity in sustainable finance, sharing knowledge, fostering dialogue among stakeholders, and developing and piloting sustainable solutions. The ultimate goal is to promote sustainable tools and strategies across sectors and regions.

Under the framework of the EMSD, GIZ, in collaboration with SEB, the Nordic Green Energy Fund, supported the development of the green bond market in China from 2016 to 2019. Their aim was to promote international best practices in terms of environmental standards, market practices, and transparency through the Green Bond Principles (GBP) framework. They also conducted capacity-building activities for the entire ecosystem of the green finance market in China. In 2017, GIZ partnered with the Natural Capital Finance Alliance (NCFA) and nine global banks to carry out a pilot project on environmental scenario analysis. This included a one-year pilot project with the Industrial and Commercial Bank of China (ICBC) to conduct drought stress testing. The project involved developing and testing an analytical framework and tools based on drought scenarios. By utilizing risk modeling, the project aimed to help banks quantify and assess the impact of drought events on their loan portfolios. The ultimate goal was to promote the integration of environmental factors into credit decision-making within financial institutions [47].

The research outcomes were incorporated into the research findings of the Green Finance Study Group at the 2017 G20 Hamburg Summit. In terms of capacity building and knowledge sharing, since 2018, GIZ has been committed to conducting thematic training on ESG investment, green investors, and environmental risk analysis for financial institutions. Starting from 2020, GIZ, the CFA Institute, and the International Institute of Green Finance have collaborated to pilot sustainable finance courses on campuses. Through this project, the concepts, categories, products, and innovative mechanisms of sustainable finance are introduced to students and professionals, aiming to integrate sustainable finance principles into daily work and contribute to the cultivation of professionals in the field [48].

In 2023, under the guidance of the Ministry of Ecology and Environment of China, the Sino-German Cooperation on Climate Change (SGCCC-CP) project implemented by GIZ, in collaboration with the Climate Investment and Finance Association (CIFA), conducted a series of capacity-building activities on climate investment and financing. These activities included introducing relevant products and innovations in climate investment and financing, disclosure of climate and environmental information, as well as methodologies, tools, and practices related to carbon emissions accounting.

Lessons learned and prospects for Sino-German cooperation

In summary, the development of green finance in Germany has been remarkable, with the country achieving a leading position globally through the implementation of a series of policies, innovative application of financial tools, and extensive international cooperation.

Specifically, Germany has established comprehensive and systematic legal policies to address climate issues, with a focus on utilizing green finance as a supporting tool to implement policies and achieve carbon reduction.

Germany has emphasized the combination of international standards and its own national context in legislation related to green finance. The country's representative strategy, the "Sustainable Finance Strategy," actively incorporates common international practices in terms of transparency, risk management, and international exchange, while considering its applicability to the domestic context.

In terms of the performance of the green finance market, Germany primarily supports green projects through the issuance of green bonds, with its green bond issuance ranking among the top globally. Germany has leveraged its position in the European capital market to actively promote green sovereign bonds and use them as a policy experiment to assess the market's attitude towards green projects. The real performance of the market serves as a basis to assist decision-making, refine policies, and make adjustments.

Furthermore, in international financial cooperation, Germany actively participates in international green finance organizations and effectively engages in various green finance collaborations through multilateral initiatives.

Regarding future Sino-German cooperation, in 2019, during the second Sino-German High-Level Financial Dialogue, co-chaired by Liu He, the former Vice Premier of the State Council of China, and Olaf Scholz, the former Vice Chancellor and Minister of Finance of Germany (currently serving as the German Chancellor), both countries agreed to strengthen exchanges and cooperation in the fields of financial technology and green finance [49]. In September 2021, the Lujiazui Financial City Council and the Frankfurt Main Finance Association signed a strategic cooperation memorandum, explicitly stating their intention to promote cooperation in asset management, green finance, and financial technology [50].

Looking ahead to Sino-German cooperation in green finance, both parties can engage in exchanges and collaboration in various areas, including policy formulation and implementation, exchange of innovative green financial products, participation in financial markets, and capacity building in green finance. As green finance involves coordination and cooperation between the financial and environmental sectors, China and Germany can communicate on sustainable finance top-level design and strategic formulation, interdepartmental coordination mechanisms, and cross-sectoral legislation, involving discussions on data sharing, policy assessment, and other aspects. It is suggested that both China and Germany deepen their understanding of each other's financial markets within the framework of the EU-China Common Ground Taxonomy Instruction Report, enhance market access, improve information transparency for investors, and promote the issuance of cross-border sustainable financial products.

Based on the rich experience accumulated by both Germany and China in the green bond market, it is recommended that Germany and China deepen peer-to-peer exchanges, particularly by leveraging Germany's experience in issuing green sovereign bonds. Furthermore, exploring how public institutions in both countries can better demonstrate sustainability in the field of green finance and implement green fiscal policies would be beneficial. Exchanging best practices in green investment and financing by public institutions can also be a focus of collaboration.

China and Germany have accumulated experience in different aspects of green finance development, thus in the future, they can engage in exchange and cooperation regarding the development of the green finance market, broadening channels for talent development and jointly building green finance capabilities.

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