

Introduction to Green Finance: Concepts and Principles. International Frameworks

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Outline

Introduction: Green Finance \subset Sustainable Finance

Evolution of Green Finance

Principles of Green Finance

Major Instruments

International Frameworks

Climate Reporting and Platforms

Rating Agencies in Green Finance

Regional Comparisons: Europe, Asia, and the US

Case Studies from few countries

Fintech and Green Finance

Challenges in Green Finance

Future trends and recommendations



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Green Finance \subset Sustainable Finance

Green Finance and **Sustainable Finance** are closely related concepts, but they are not identical.

Green Finance

- ▶ Focus: environmental objectives
- ▶ Scope: renewable energy, pollution control, climate projects
- ▶ Instruments: uses green bonds, green loans
- ▶ Subset of sustainable finance

Sustainable Finance

- ▶ Focus: ESG (Environmental, Social, Governance)
- ▶ Scope: green finance + social projects + governance
- ▶ Instruments: SDGs, social bonds, ESG investing
- ▶ A holistic approach to finance and impact

All green finance is sustainable finance, but not all sustainable finance is green.

Green Finance \subset Sustainable Finance

- ▶ **Sustainable Finance** is recognized as being the most inclusive term, encompassing social, environmental and economic aspects.
- ▶ **Green finance** refers to any financial instruments whose proceeds are used for environmentally sustainable projects and initiatives, environmental products and policies under the single goal of promoting a green economic transformation toward low-carbon, sustainable and inclusive pathways. This is a tool to increase financial flows from public and private sectors into sustainable development priorities while managing environmental risks and seeking both a return on investment and environmental benefits.

Green Finance \subset Sustainable Finance

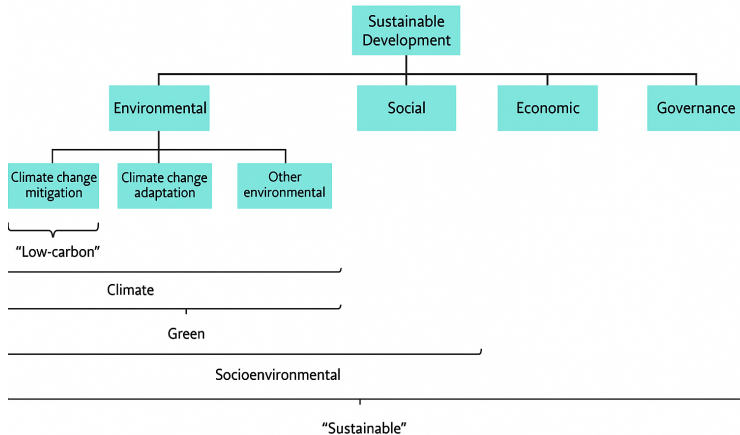


Figure: A simplified scheme for understanding broad terms on sustainable finance¹

¹Source: Definitions and Concepts: Background Note, UNEP, 2016

Why Green Finance Matters

Addresses climate-related financial risks

- ▶ Climate change poses systemic risks to economies, ecosystems, and financial systems
- ▶ Green finance channels capital to projects that mitigate climate change (e.g., renewable energy, energy efficiency) and adapt to its effects

Aligns economic growth with environmental goals

- ▶ Financing the low-carbon transition requires huge investments, and green finance bridges the gap
- ▶ Enables innovation in clean tech, sustainable transport, and circular economy models



Why Green Finance Matters

Supports international commitments (Paris Agreement, UN SDGs, Green Deal)

- ▶ The Paris Agreement (2015) explicitly calls for aligning financial flows with a pathway toward low-carbon, climate-resilient development
- ▶ UN estimates an annual financing gap of around \$4 trillion to achieve the Sustainable Development Goals (SDGs)
- ▶ EU Green Deal and climate neutrality targets

Mobilizes private and public capital, as public funds alone are insufficient

- ▶ Green finance channels private capital toward projects that reduce greenhouse gas emissions, build resilience to climate impacts, and protect ecosystems .
- ▶ By leveraging capital markets and banks, green finance helps fill the investment gap for clean energy, sustainable infrastructure, and other green initiatives.



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Historical Origins (1970s–2000s)

1970s–1980s: Environmental awareness, Brundtland Report

- ▶ The roots of green finance trace back to the broader environmental movement of the 1970s. This period saw rising awareness of environmental issues (e.g. the first Earth Day in 1970) and the creation of environmental regulatory bodies (such as the U.S. EPA in 1970).
- ▶ In 1987, the Brundtland Commission's report "Our Common Future" introduced the concept of sustainable development, emphasizing that economic development must integrate environmental sustainability. This laid conceptual groundwork by recognizing the interconnectedness of economic and environmental goals.
- ▶ By the late 1980s, the idea that financial markets could be leveraged to promote sustainability began to take shape – for example, pioneering investors started considering environmental criteria and "socially responsible investing" practices, although such efforts were nascent.

Historical Origins (1970s–2000s)

Global Frameworks Emerge (1990s)

- ▶ In 1990s, the sustainable finance became more institutionalized worldwide
- ▶ In 1992, at the Rio Earth Summit, the first financial sector coalition for sustainability was launched – the UNEP Finance Initiative – engaging banks and investors to incorporate environmental considerations
- ▶ The Kyoto Protocol was adopted in 1997 (effective 2005), introducing market mechanisms like the Clean Development Mechanism (CDM) which allowed the creation of carbon credits and trading – effectively a new financial asset class to fund emissions-reducing projects.
- ▶ During the 1990s, some banks and insurers also began developing environmental policies (e.g. the Equator Principles) and a few niche investment funds targeted environmental sectors.



Historical Origins (1970s–2000s)

The 2000s marked significant growth and innovation in green finance

- ▶ Carbon markets expanded – the EU launched its Emissions Trading System in 2005 as a major cap-and trade program spurred by Kyoto.
- ▶ In 2007–2008, the world's first green bonds were issued, pioneering the idea of labeled bonds for climate-friendly projects. The European Investment Bank (EIB) issued a “Climate Awareness Bond” in 2007, and the World Bank followed with its first green bond in 2008 .
- ▶ These early green bonds proved the concept that investors were willing to accept proceeds being earmarked for environmental projects.
- ▶ Also in this period, ESG investing gained traction: the UN-supported Principles for Responsible Investment launched in 2006, initially with 63 investment firms as signatories, growing to thousands in the next decade.
- ▶ By the late 2000s, mainstream investors were beginning to integrate ESG criteria.

Acceleration after 2015

Paris Agreement (2015)

- ▶ This Agreement gave a powerful impetus – 196 countries committed to nationally determined contributions and to making financial flows consistent with climate objectives

UN SDGs (2015)

- ▶ The UN 2030 Agenda and Sustainable Development Goals (SDGs) underscored the need for huge investments in sustainability

Acceleration after 2015

Task Force on Climate-related Financial Disclosures (TCFD)

- ▶ In 2017, the TCFD released its recommendations, pushing companies and financial institutions to disclose climate risks and opportunities – a major step toward transparency
- ▶ Concepts like “climate risk” (physical and transition risks) became mainstream in finance, with central banks and regulators (Network for Greening the Financial System, 2017) acknowledging climate change as a source of financial risk

Green finance activity surged: annual global green bond issuance, for instance, has grown exponentially since 2015 (the year of Paris); cumulative green bond issuance jumped from roughly \$500 billion in 2018 outstanding to nearly \$2.9 trillion by 2024 . Beyond bonds, many new financial instruments emerged.

Recent Developments (2020s)

EU Taxonomy: Green finance is becoming embedded in financial regulation and strategy

- ▶ The European Union, through its 2019 **Green Deal** and 2018–2020 **Sustainable Finance Action Plan**, implemented the EU Taxonomy (a detailed classification of sustainable economic activities) in 2020 to combat greenwashing and guide investors .
- ▶ Many jurisdictions (EU, UK, New Zealand, China, etc.) were making climate disclosures mandatory for large firms, often aligned with TCFD.
- ▶ There was also growth in new instruments like sustainability-linked bonds (SLBs) – broadening the green finance toolbox.

Recent Developments (2020s)

- ▶ The **green bond** market continues to break records (over \$0.5 trillion issued in 2023 alone), and sovereign green bonds are now issued by over 40 countries.
- ▶ Green finance has expanded to themes beyond climate: for example, **blue bonds** for ocean conservation and nature-positive finance for biodiversity are emerging.
- ▶ Financial institutions are increasingly setting **net-zero targets** for their portfolios (e.g. through the Glasgow Financial Alliance for Net Zero launched in 2021).

In summary, in just a decade green finance has evolved from a niche to a central component of global finance, reflecting recognition that mobilizing private capital is essential to address environmental challenges.

Green Finance: Current Market Overview

Global Green Bond Market

- ▶ Market capitalization: \$2.9 trillion (almost $6\times$ growth since 2018)
- ▶ Annual issuance (2024): \$700 billion
- ▶ Green bonds = 60% of sustainable bond issuance

Sustainable Debt Instruments

- ▶ Sustainable debt issuance (Q3 2024): \$323 billion
- ▶ Emerging markets reached \$1 trillion in GSSS (Green, Social, Sustainability, and Sustainability-Linked) bond issuance

Green Finance: Current Market Overview

Regional Insights

- ▶ Europe: France issued over €70 billion in sovereign green bonds (Q1 2024)
- ▶ Non-financial corporates: 28% of total EU green bond volumes
- ▶ USA: Green bond issuance declined to \$24.4 billion by May 2025 (from \$43.3B in 2024), partly due to "greenhushing"

Green Finance: Current Market Overview

Sustainable Finance Market Growth

- ▶ Projected 2034: \$35.7 trillion (CAGR 19.8%)
- ▶ Alternate forecast: \$6.3 trillion (2024) → \$27.9 trillion (2033, CAGR 17%)
- ▶ Green finance market alone: \$5.07 trillion → \$23.99 trillion (2032, CAGR 21.45%)



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Core Principles of Green Finance

Additionality

Green finance should ideally support projects that would not otherwise happen without green funding. The idea is to provide additional environmental benefit, rather than just rebadging business-as-usual projects. For example, proceeds from a green bond should finance new or expanded green projects, not simply refinance existing assets without improvements.

Core Principles of Green Finance

Transparency & Disclosure

High transparency is crucial to prevent “greenwashing” (or, “greenhushing”). Issuers and borrowers should clearly disclose how funds are used and what environmental impact is achieved. Standards like the Green Bond Principles (by ICMA) emphasize reporting on use of proceeds and environmental impact. Likewise, TCFD-aligned disclosure of climate risks is about transparency for investors. As green finance grows, regulators are mandating more disclosure.

Core Principles of Green Finance

Do No Significant Harm

This principle, embedded in the EU Taxonomy, holds that an activity counted as “green” should not significantly harm other environmental objectives. In other words, a project’s overall sustainability must be considered – for example, a bioenergy project should not cause deforestation or harm biodiversity.

Core Principles of Green Finance

Science-based Criteria

Defining “green” should be based on scientific metrics and benchmarks (e.g., an energy project must have emissions below a threshold). Many taxonomies and standards use scientific inputs. For instance, climate bonds certification uses emissions thresholds per sector. This principle ensures environmental integrity of green finance, aligning investments with pathways like net-zero by 2050.

Core Principles of Green Finance

Risk Mitigation and Opportunity

On one hand, the principle of precautionary risk management means recognizing climate change as a financial risk (physical asset damage, regulatory changes, etc.) and incorporating it into risk assessments.

On the other hand, there is the principle of value creation – that investing in sustainable solutions can generate long-term returns and new market opportunities.

Many green finance principles (like “polluter pays” in policy, or internal carbon pricing in corporations) aim to correct market failures by pricing in environmental externalities, thereby shifting finance toward greener outcomes.

Core Principles of Green Finance

In summary, green finance operates on principles of accountability (clear reporting and avoidance of false green claims), impact (achieving real environmental benefits), and alignment (with scientific climate targets and sustainability goals). These principles are operationalized through various standards and frameworks internationally.



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Major Instruments

Green Bonds

Green bond is a fixed-income debt instrument whose proceeds are allocated for environmentally beneficial projects. Examples of eligible uses include renewable energy installations, energy-efficient buildings, clean transportation, sustainable water management, and climate adaptation infrastructure. Green bonds are issued by a range of entities: sovereign governments, development banks, municipalities, and corporations. Investors are often willing to buy green bonds even at similar or slightly lower yields than conventional bonds, a phenomenon known as the “greenium” (a price premium for green bonds). Green bonds adhere to standards such as the Green Bond Principles (GBP) developed by the International Capital Market Association – which outline four core components: use of proceeds for green projects, project evaluation and selection process, management of proceeds, and reporting on project impact.

Major Instruments

Green Loans and Green Credit

Green loans are similar to green bonds: the funds are dedicated to qualifying green projects, but are structured as loans. For instance, a bank might extend a green loan to finance a wind farm or an energy-efficient real estate development. Many banks have developed “green loan frameworks” or adopted the Green Loan Principles (from Loan Market Association) to define eligible projects and reporting requirements, mirroring bond standards. Beyond specific loans, banks are integrating environmental criteria into their overall lending portfolios, a practice known as green credit policy. For example, China’s Green Credit Guidelines (first issued in 2012) guided banks to increase lending to green sectors and restrict loans to highly polluting industries.

Major Instruments

ESG and Sustainable Investing

ESG investing – the practice of incorporating environmental, social, and governance criteria into investment decisions, particularly in equity and portfolio management. These investment strategies take several forms: negative screening (excluding industries like coal, tobacco), positive screening or thematic funds (selecting companies with strong environmental performance), ESG integration (alongside financial analysis), and impact investing (targeting specific social/environmental outcomes). Key instruments here include mutual funds and ETFs that track sustainability indices (like low-carbon indexes), green equity indexes (e.g., MSCI Climate Leaders index). Impact funds may take equity stakes in green startups (like electric mobility, sustainable agriculture).

Major Instruments

Carbon Pricing and Markets

Carbon pricing mechanisms, including carbon taxes and emissions trading systems (ETS), are economic instruments that directly price the externality (pollution without paying for damage) of greenhouse gas emissions. In a cap-and-trade system (ETS), a government sets a cap on total emissions and issues allowances (right to emit 1 ton of CO₂); companies can trade these permits, and a market price for carbon emerges. Companies that emit less can sell unused allowances. Carbon credits can also be generated via offset projects and sold to companies seeking to compensate emissions. From a green finance perspective, carbon markets have enabled new financial assets (carbon allowances, offset credits) that banks and funds trade, and carbon revenues/taxes create funding pools for climate projects.

Major Instruments

Sustainability-Linked Bonds (SLBs) / Loans (SLLs)

They tie the cost of capital (interest rate or coupon) to the borrower's achievement of predefined sustainability performance targets. For example, a company might issue a bond that will incur a higher coupon (penalty) if its greenhouse gas emissions are not reduced by, say, 30% by 2025, as per the bond terms. If it meets the target, it pays a lower interest rate. This mechanism incentivizes the issuer to improve sustainability performance across the entire firm, not just for a single project.

Major Instruments

Other Instruments and Mechanisms

Green securitization has emerged, e.g., bundling solar leases or energy efficient mortgages into asset-backed securities to free up bank balance sheets for more green lending.

Green insurance products (such as insurance for renewable energy projects or resilience bonds for disaster risk) help manage risks and encourage investment. Green crowd-funding platforms and community finance (e.g., community solar bonds) allow citizen investors to participate.
etc.

Major Instruments

In conclusion, the toolkit of green finance is diverse and growing, enabling capital flows at different scales and for different needs – from large institutional bond financing down to small community-level projects. These instruments work towards the sustainability development goal , mainly focusing on environment: reorienting financial flows toward sustainable, low-carbon, and climate-resilient development.



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International Frameworks

EU Green Taxonomy for sustainable activities (“green taxonomy”) (2020)

The EU Taxonomy is essentially a detailed classification system defining what counts as an environmentally sustainable economic activity . It covers six environmental objectives: (1) climate change mitigation, (2) climate adaptation, (3) sustainable use and protection of water, (4) circular economy transition, (5) pollution prevention and control, and (6) biodiversity and ecosystem protection. The Taxonomy provides technical screening criteria for many economic sectors – for example, it specifies threshold emissions (g CO₂/kWh) for power generation to qualify as climate-mitigating. It underpins other EU regulations: large companies must disclose the proportion of their activities that meet Taxonomy criteria (under the Non-Financial Reporting Directive/CSRD), and financial products claiming sustainability must report Taxonomy alignment (under SFDR).

International Frameworks

TCFD: Task Force on Climate-related Financial Disclosures (2017)

TCFD structured climate disclosure into four thematic areas: Governance, Strategy, Risk Management, and Metrics & Targets, with 11 recommended disclosures outlined. A key innovation was scenario analysis: encouraging firms to assess how their business would fare under different climate scenarios (including a 2°C or lower scenario). TCFD's goal is to make climate risk information clear, comparable, and useful for investors, thereby helping markets price climate-related risks and avoid sudden shocks. Its influence on green finance is profound: it shifts climate change into the realm of core financial reporting, which in turn drives corporate behavior and informs investors.

International Frameworks

Paris Climate Agreement (2015)

It was the first time a climate treaty included a broad finance alignment goal, sending a strong signal to both public and private sectors. Article 2.1(c) states the goal of “Making finance flows consistent with a pathway toward low greenhouse gas emissions and climate-resilient development.” Paris framework fostered many initiatives within Green Finance. The Paris goals (holding warming well below 2°C , aiming for 1.5°C) effectively define the scale of green finance needed (e.g. how many per year should be invested in clean energy and infrastructure to meet these goals). In essence, Paris provides the global policy context in which green finance operates – it is the reason many financial institutions cite for their net-zero pledges (aligning portfolios with 1.5°C), and it has spurred governments to introduce sustainable finance roadmaps.

International Frameworks

UN Sustainable Development Goals (SDGs) (2015)

The 17 SDGs provide a holistic framework for sustainable development, encompassing poverty, health, education, equality, and environmental goals (e.g. SDG 13 focuses on Climate Action, SDG 7 on Clean Energy, etc.). This has driven the rise of “SDG-aligned investing” – many investors and banks map their green/social finance activities to specific SDGs. Multilateral bodies and development banks have aligned their strategies with SDGs, channeling funds accordingly. the SDGs have been less prescriptive than the EU Taxonomy or TCFD, but they are influential in shaping the narrative and ambition of sustainable finance: finance is not an end in itself, but a means to achieve these people-planet prosperity goals by 2030.

International Frameworks

Other International Initiatives and Standards

- ▶ **UN Finance Initiative (UN FI), 1992:** It has developed key voluntary principles, such as the Principles for Responsible Banking (PRB) and the Principles for Sustainable Insurance (PSI). It also convenes projects on metrics (like developing methodologies for banks to set science-based targets in lending portfolios).
- ▶ **UN Principles for Responsible Investment (PRI), 2006:** it has grown to over 5,000 signatory investment institutions. Signatories commit to six principles, including incorporating ESG into analysis and ownership, seeking appropriate disclosure, and reporting on their activities. The PRI network has facilitated a mainstreaming of ESG investing globally.



International Frameworks

Other International Initiatives and Standards (continued)

- ▶ **Equator Principles, 2003:** these are a set of voluntary guidelines for banks to manage environmental and social risk in project finance. Projects are categorized by risk, and high-risk projects require environmental impact assessments, action plans, and monitoring. This effectively ensures large infrastructure or resource projects meet certain environmental standards before banks lend, thus steering project finance toward more sustainable outcomes or mitigation measures.
- ▶ **Climate Bonds Initiative (CBI) and Green Bond Standards:** CBI developed the Climate Bond Certification Scheme – a set of sector-specific criteria to certify bonds as “Climate Bonds.” It’s more granular and restrictive in some ways than ICMA’s Green Bond Principles. Many issuers seek CBI certification to signal robustness. ICMA’s Green Bond Principles are another important industry standard that has been widely adopted for transparency and reporting in labelled bond markets.



International Frameworks

Other International Initiatives and Standards (continued)

- ▶ **International Platform on Sustainable Finance (IPSF)**: launched by the EU along with e.g. China, India, and others, IPSF is a forum for officials to align approaches on taxonomy, disclosures, standards. It produced the EU-China Common Ground Taxonomy (2021) that maps the overlap between EU and Chinese taxonomies, helping investors navigate differences and move toward global compatibility of sustainable finance standards.
- ▶ **Network for Greening the Financial System (NGFS)**: an alliance of over 100 central banks and supervisors formed in 2017. NGFS shares best practices on incorporating climate risks into financial supervision, conducting climate stress tests, and encouraging green finance. It has issued guides on scenario analysis and climate risk management for central banks. NGFS's existence shows the normalization of climate considerations in core financial stability mandates.

International Frameworks

To sum up, all these frameworks and initiatives collectively are shaping a cohesive global sustainable finance architecture.

There is momentum toward convergence – for example, the new ISSB standards (global baseline for sustainability reporting) incorporate TCFD and are being considered by many countries, potentially reducing fragmentation. However, divergence still exists (e.g., US vs EU approaches, or multiple taxonomies globally), which we will compare in the next section.

Nonetheless, international frameworks have significantly advanced clarity and ambition: they set common languages and benchmarks (what is green, how to disclose risk, what targets to aim for), which in turn accelerate green finance flows by increasing investor confidence and comparability.



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Financial & Regulatory

- ▶ **CDP**. Global climate disclosure database with data from thousands of companies, cities, and regions. Key Data: Corporate emissions, water risk, supply chain disclosures <https://www.cdp.net>
- ▶ **GHG Protocol Tools**. Standardized tools for measuring scope 1, 2, 3 emissions. Key Data: Carbon accounting across value chains <https://ghgprotocol.org/calculation-tools>
- ▶ **PCAF**. Financed emissions accounting methodology and dataset. Key Data: Portfolio-level carbon disclosure by financial institutions <https://carbonaccountingfinancials.com>
- ▶ **SBTi**. Sets and validates science-based climate targets for companies. Key Data: Benchmarking companies' climate ambitions and pathways <https://sciencebasedtargets.org>
- ▶ **Climate Bonds Initiative** Certified green bond database and market analytics. Key Data: Green bond issuance, taxonomy-based use of proceeds <https://www.climatebonds.net>

Financial & Regulatory

- ▶ **CEU Taxonomy Compass**. Interactive portal of environmentally sustainable activities. Key Data: Technical screening criteria, sector classification <https://ec.europa.eu/sustainable-finance-taxonomy>
- ▶ **CSFDR/ESAs Joint Portal**. Centralized templates and guidance for fund-level sustainability disclosures. Key Data: Pre-contractual and periodic SFDR templates <https://www.esma.europa.eu>
- ▶ **CEFRAG**. Hosts EU sustainability reporting standards and support docs. Key Data: ESRS standards for CSRD compliance <https://www.efrag.org>
- ▶ **European Single Access Point**. Central EU hub for corporate sustainability and financial disclosures. Key Data: Cross-EU ESG and green finance data [https://www.european-financial-data-space.com/European_Single_Access_Point_\(ESAP\).html](https://www.european-financial-data-space.com/European_Single_Access_Point_(ESAP).html)

Scientific, Scenario & Risk

- ▶ **CIEA Global energy and emissions scenarios.** Key Data: Transition risk modeling, investment strateg: <https://iea.org>
- ▶ **CNGFS Climate Scenarios.** Central bank-led climate scenarios database. Key Data: Climate stress testing by financial institutions <https://ngfs.net>
- ▶ **CCMIP6 Climate Models.** IPCC-supported climate models for research. Key Data: Temperature, sea level, physical risks <https://esgf-node.llnl.gov>

Scientific, Scenario & Risk

- ▶ **OECD Environment Statistics.** Policy-linked environmental and green finance data <https://data.oecd.org/environment.htm>
- ▶ **IMF Climate Change Indicators Dashboard.** Macroeconomic-climate risk linkage indicators <https://climatedata.imf.org>
- ▶ **UNEP FI.** Research on ESG integration by financial institutions <https://www.unepfi.org>



Company-Level Environmental Data Sources

- ▶ Emissions (Scope 1, 2, 3)
- ▶ Water usage and discharge
- ▶ Climate targets, risks, and strategy
- ▶ Source: Voluntary reports, regulatory filings, data aggregators

Company-Level Environmental Data Sources

- ▶ **CDP (Carbon Disclosure Project)**
 - ▶ Scope 1-3 GHGs, water, forests
 - ▶ Used for ESG investing, TCFD alignment
 - ▶ cdp.net
- ▶ **GHG Protocol**
 - ▶ Corporate carbon accounting standard
 - ▶ Framework for Scopes 1–3
 - ▶ ghgprotocol.org
- ▶ **PCAF**
 - ▶ Financed emissions (banks, investors)
 - ▶ carbonaccountingfinancials.com

Company-Level Environmental Data Sources

- ▶ **Bloomberg ESG / Refinitiv / MSCI**
 - ▶ Commercial ESG datasets
 - ▶ Emissions, water, waste, intensity metrics
- ▶ **SEC Climate Disclosures (USA)**
 - ▶ U.S. public company filings (10-K, 20-F)
 - ▶ [sec.gov/edgar](https://www.sec.gov/edgar)
- ▶ **EU CSRD / NFRD**
 - ▶ GHG, water, taxonomy alignment
 - ▶ Future access via ESAP portal

Company-Level Environmental Data Sources

- ▶ Corporate Sustainability Reports
 - ▶ GRI, SASB, TCFD aligned
 - ▶ Direct from company websites
- ▶ Climetrics (ISS ESG + CDP)
 - ▶ Climate fund ratings based on company data
 - ▶ climetrics-rating.org



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Traditional Credit Rating Agencies

- ▶ **S&P Global Ratings**
 - ▶ ESG Evaluation Scores, Green Bond opinions, Climate Credit Analytics
 - ▶ Trucost environmental database: carbon and natural capital data
- ▶ **Moody's Investors Service**
 - ▶ ESG factors integrated into ratings
 - ▶ Vigeo Eiris (integrated into ESG Solutions) for ESG performance using 330+ factors
- ▶ **Fitch Ratings**
 - ▶ ESG Relevance Scores
 - ▶ Climate scenario analysis (Climate Vulnerability Signal)

Specialized ESG and Climate Rating Providers

- ▶ **MSCI ESG Ratings**
 - ▶ Covers 10,000+ companies, carbon risk, climate VaR
- ▶ **Sustainalytics (Morningstar)**
 - ▶ ESG Risk Ratings, green/social bond SPOs, Taxonomy tools
- ▶ **Emerging and Sector-Specific Rating Initiatives**
 - ▶ Arabesque S-Ray: AI-driven ESG and climate analytics
 - ▶ Refinitiv ESG: ESG data integrated with financial analysis
 - ▶ FTSE Russell: Green Revenues classification



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Europe: regulation-driven

- ▶ Europe's policy environment is characterized by wide-ranging support and requirements for sustainable finance. The EU's 2018 Action Plan on Sustainable Finance and 2019 European Green Deal led to numerous measures the Taxonomy, SFDR, CSRD requiring $\approx 50,000$ companies to report detailed sustainability information, and prudential measures. Across Europe's financial sector there are 20+ ESG-related rules or standards in force
- ▶ European governments have also issued sovereign green bonds (e.g., Germany, Netherlands, Sweden etc., following Poland/France).
- ▶ European Green Bond Standard (EuGBS, 2024) is a voluntary, EU-wide "gold standard" for green bonds designed to boost transparency, credibility, and integrity in the sustainable finance market - Taxonomy alignment

USA: market-led with emerging policy

- ▶ In the absence of federal mandates like a taxonomy, US sustainable finance landscape has been shaped by investors, states, and to some extent litigation.
- ▶ State-level policies drive some green finance: e.g., California's cap-and-trade system creates a carbon market; several states and cities have green banks to leverage private investment
- ▶ On the regulatory side, Securities and Exchange Commission (SEC) in 2022 proposed climate disclosure rules that would require public companies to disclose climate risks, governance, and GHG emissions (yet not launched)
- ▶ Inflation Reduction Act (IRA) is a major US law (2022) that includes \$370+ billion in investments to combat climate change and accelerate the clean energy transition. Provides tax credits for renewables, electric vehicles, energy efficiency, and clean manufacturing. Now facing facing rollbacks and challenges.

China: state-driven green finance boom

- ▶ Implemented a top-down strategy to green its financial system as part of its broader policy goals. Guidelines for establishing a green financial system were issued making China one of the first countries to have a comprehensive roadmap.
- ▶ Green credit has been a centerpiece – world's largest green loan portfolio, green credit policies, green finance pilot zones (e.g. in Zhejiang, Jiangxi, Guangdong provinces)
- ▶ China's green bond issuance grew quickly (with some controversial categories like “clean coal”)
- ▶ Closely tied to industrial policy, with financial support for EVs and renewable energy manufacturing
- ▶ Challenges include ensuring consistent standards and balancing growth with risk

green finance in a developing context, albeit with some differences in standards.



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Poland: World's first sovereign green bond

- ▶ Issued 5-year €750M in 2016
- ▶ The proceeds were allocated to renewable energy, clean transport, afforestation and national parks, and other climate-related projects in Poland
- ▶ The bond was certified under the Climate Bonds Standard and helped Poland finance part of its national environmental policy

France: Largest sovereign green bond and framework

- ▶ €7B 22-year Green OAT (French Treasury bond) in 2017
- ▶ a robust framework was established: an interministerial committee allocates proceeds to eligible green expenditures in the state budget (renewable energy, building energy efficiency, public transport infrastructure, biodiversity, etc.) and an independent council of experts evaluates the environmental impact.
- ▶ France also innovated in impact reporting, publishing detailed annual reports on jobs created, emissions saved, etc., from the green expenditures – setting a high standard for sovereign issuers.
- ▶ France committed to regular issuance and indeed has issued multiple green OATs, totalling over eur30 billion outstanding

Nigeria: First African sovereign green bond

- ▶ The bond was relatively small (\$29 million, 5-year tenor, in 2017) but highly significant symbolically - it was Certified by the Climate Bonds Initiative, meaning it met rigorous standards
- ▶ Proceeds financed solar photovoltaic off-grid projects, reforestation/afforestation programs, and flood defense
- ▶ The case is notable for how a developing country, heavily reliant on oil revenues, signaled a shift towards sustainable finance.
- ▶ Since then, other African countries have initiated green bonds (e.g., Seychelles did a Blue Bond for marine projects; South Africa's cities like Cape Town issued green bonds for water resilience)

China: Huzhou (in Zhejiang) green finance pilot zone

- ▶ This pilot (launched in 2017) is an example of policy experimentation with local criteria: a local green project taxonomy was developed and every bank branch was encouraged to have a “green finance division”
- ▶ Innovated multiple products: green credit risk guarantees, interest subsidies for green loans, a trading platform for environmental rights (like emission rights or water use rights), and even launched a carbon pledging facility (enterprises could pledge carbon emission quotas as collateral for loans)
- ▶ A system of environmental information sharing between government and banks (so banks could access data on companies' environmental compliance) was established.
- ▶ Huzhou's model of linking environmental performance with credit access. For example, companies with good environmental ratings got easier credit approval and sometimes lower rates
- ▶ Success also included public awareness – the city held green finance expos and training to increase participation

Indonesia: Sovereign Green Sukuk

- ▶ Indonesia provides a case of innovation by combining Islamic finance with green objectives : world's first sovereign green sukuk (Islamic bond) at \$1.25 billion over 5 years in 2018 was issued. Sukuk are structured to generate returns without violating Islamic law (no interest; typically asset-linked)
- ▶ Indonesia developed a Green Bond and Framework aligned with ICMA (International Capital Market Association) principles and reviewed by CICERO (Center for International Climate Research) as second-party opinion
- ▶ Proceeds have funded projects in renewable energy (geothermal development, which is big in Indonesia), energy-efficient transportation (railway electrification), sustainable agriculture, waste management, and resilience to climate change

Apple Inc: corporate green strategy - green bond

- ▶ Apple first issued \$1.5 billion in green bonds in 2016, then another \$1 billion in 2017, and \$2.2 billion in 2019, totaling \$4.7 billion – one of the largest corporate green bond issuers
- ▶ It invested in projects across its operations: renewable energy, energy efficiency upgrades in its offices and data centers, research into recycling technologies, and even environmental projects in its supply chain
- ▶ Beyond bonds, Apple engages in supplier clean energy programs, essentially facilitating green finance by getting suppliers to invest in renewables
- ▶ Transparency in impact reporting
- ▶ Many other corporates (e.g., Google, PepsiCo, Verizon, Toyota) followed ,issuing green bonds for EV programs, circular economy projects, etc. The corporate green bond market is now a major component of green finance

Case Studies from few countries

in summary,

- ▶ Each of these cases – spanning government, local, corporate, and emerging market contexts – shows different facets of green finance in action. Common threads include innovation, policy support, and transparency
- ▶ They also show that size isn't everything; a small pilot (Nigeria) can have outsized influence, and a large issuance (France) can set new benchmarks
- ▶ These cases are the examples of concrete outcomes: thousands of solar panels installed, hectares of forest planted, emissions avoided, and importantly, investor confidence built



DIGITAL

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How Fintech supports green finance

- ▶ **Green investment platforms**
 - ▶ Democratize access to ESG and impact investing
 - ▶ Example: robo-advisors offering sustainable portfolios
- ▶ **Carbon credit markets**
 - ▶ Use blockchain for transparent and traceable carbon offsets
 - ▶ Example: KlimaDAO, Toucan Protocol
- ▶ **Sustainable lending**
 - ▶ AI-enhanced credit scoring to finance green SMEs
 - ▶ Digital loan origination with environmental screening

How Fintech supports green finance

- ▶ **Impact measurement and verification**
 - ▶ IoT, satellite, and AI for Monitoring, Reporting, and Verification (MRV)
 - ▶ Improve accountability of green finance outcomes
- ▶ **Climate risk analytics**
 - ▶ Fintech tools model physical and transition risks
 - ▶ Used by insurers, asset managers, regulators
- ▶ **Tokenization of green assets**
 - ▶ Blockchain-based tokens represent shares in green infrastructure
 - ▶ Enable fractional ownership and liquidity

Examples of Fintech & Green Finance

- ▶ **Doconomy (Sweden)**: Offers carbon tracking tools and green banking
- ▶ **Tomorrow Bank (Germany)**: Sustainable mobile banking experience
- ▶ **ClimateTrade (Spain)**: Carbon credit trading on blockchain
- ▶ **Raise Green (USA)**: Crowdfunding platform for local climate projects
- ▶ **Chia Network**: Blockchain-based low-carbon crypto protocol



Summary: Fintech's Role in scaling green finance

To sum up:

- ▶ Enhances transparency, efficiency, and inclusiveness of green finance
- ▶ Empowers retail and institutional green investments
- ▶ Facilitates better risk analysis, compliance, and innovation
- ▶ Crucial for mobilizing capital toward climate solutions at scale



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Greenwashing and integrity

- ▶ Greenwashing is the misleading portrayal of financial products as environmentally friendly. It undermines trust in sustainable finance and is a key challenge as the market grows. Examples:
 - ▶ ESG funds holding high-emission companies
 - ▶ “Green” bonds funding projects with weak climate impact
 - ▶ Firms issuing green instruments while continuing polluting practices
- ▶ Regulatory responses: Taxonomy, SFDR – clearer definitions and fund labeling; SEC ESG task force and proposed ESG disclosure rules
- ▶ Solutions: External reviews (e.g., Climate Bonds Initiative certification); ESG data audits, fund greenness ratings; Harmonized impact reporting (e.g., CO₂ avoided)

Lack of data and transparency

- ▶ Reliable and comparable data is essential for green finance—but major gaps remain
- ▶ Key data challenges: many firms (esp. SMEs, emerging markets) don't disclose emissions, resource use, or risks; Lack of standardized methodologies complicates comparisons; Forward-looking data (e.g., scenario analysis) is scarce; Physical climate risk data (e.g., flood, heat) hard to translate into financial terms;
- ▶ Consequences: Impaired risk assessment and pricing; Increased greenwashing risk; Data-poor regions/sectors may be excluded from finance
- ▶ Solutions Underway:
 - ▶ TCFD / ISSB standards for consistent disclosure
 - ▶ EU ESG data register, open-source tools (e.g., OS-Climate)
 - ▶ Satellite data and AI for impact verification
 - ▶ NGFS, central banks developing frameworks for climate risk data

Regulatory divergence and fragmentation

Multiple green finance frameworks exist globally, but lack harmonization

- ▶ Examples of divergence: Different taxonomies (EU, China, ASEAN, UK, Canada, etc.); Varying treatment of technologies (e.g., nuclear, gas, clean coal); Disclosure rules differ (EU prescriptive (SFDR), US more voluntary)
- ▶ Steps toward alignment: EU-China Common Ground Taxonomy (CGT): 80% overlap; ISSB standards – global climate disclosure baseline

Regulatory fragmentation is a transitional challenge—greater global alignment will boost green finance efficiency and investor confidence

Political Resistance and Short-term Fin. Incentive

Political Pushback:

- ▶ Anti-ESG backlash in some U.S. states—penalizing firms that restrict fossil fuel exposure
- ▶ Claims that ESG violates fiduciary duty or introduces bias
- ▶ Fear of policy reversals deters long-term green investment

Short-Termism in Finance:

- ▶ Markets focus on quarterly performance vs. long-term climate returns
- ▶ Green projects (e.g., renewables) often have longer payback periods
- ▶ Transition costs can hurt short-term profits, discouraging action

Addressing these pressures is key to maintaining momentum and ensuring green finance delivers both impact and returns.



Scaling up and emerging market access

Key bottlenecks:

- ▶ Green bond issuance hit \$700B in 2024—but still a small share of global finance
- ▶ Institutional investors cite lack of investable green assets or restrictive mandates
- ▶ Many green projects—especially in developing countries—lack access to finance due to high risk and weak credit

Emerging market challenges:

- ▶ High interest rates, currency risk make green finance costly
- ▶ Most flows concentrated in EU, US, China—Africa and others left behind
- ▶ Capacity gaps in evaluating and managing green finance

Solutions & needs: Transition finance frameworks for “brown” sectors (e.g., steel, cement); Training programs (e.g., Sustainable Banking Network) to build local expertise; Innovative structures, e.g. rate-linked green bonds, performance incentives

Challenges in Green Finance

In summary, these challenges are interrelated:

- ▶ better data and avoiding greenwash will help scale by building trust
- ▶ harmonized regulations will make it easier for global investors to participate
- ▶ countering backlash ensures continuity of policy support
- ▶ creative solutions are needed to bring in new players and markets



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Future trends

- ▶ **Harmonization of standards and global alignment.** We expect a convergence of sustainable finance frameworks. The creation of the ISSB under IFRS; mutual recognition of taxonomies; ISO standard for green investments
- ▶ **Mandatory climate and ESG disclosures everywhere.** Mandatory climate and ESG disclosure is becoming the global norm, driven by frameworks like TCFD; Banks may begin adjusting loan pricing based on ESG risks, making poor environmental performance more costly; Regulators are considering integrating climate risk into prudential supervision, with possible capital adjustments for high-risk assets
- ▶ **Growth of transition finance.** Transition bonds" and sustainability-linked loans are emerging to support high-emitting companies making credible improvements"; The concept of a "just transition" is gaining traction, ensuring climate action considers social impacts like worker retraining; The scope of green finance is expanding to include "brown-to-green" investments

Future trends

- ▶ **Technological innovations.** Fintech is transforming green finance through innovations like blockchain, AI, and digital monitoring. Blockchain enables transparent tracking of green bond proceeds, carbon credits, and renewable energy certificates. Smart contracts can automate sustainability-linked bond adjustments based on verified emissions data. AI and big data tools enhance climate risk analysis, ESG monitoring, and investment decision-making. Digital technologies like satellite monitoring and digital MRV improve transparency and credibility in carbon and green asset markets. Retail fintech apps and crowdfunding platforms are expanding access to green investment opportunities. Regtech tools help financial institutions comply with growing ESG reporting requirements efficiently. Machine learning and natural language processing are critical to managing and verifying large volumes of ESG data

Future trends

- ▶ **Expansion into new thematic areas.** Nature-positive finance is growing, including “blue bonds” for oceans and “rhino bonds” for wildlife conservation. Social and “just transition” bonds aim to support communities affected by the low-carbon shift. EU is considering a Social Taxonomy to guide investments with positive social outcomes.
- ▶ **Public-Private collaboration (blending).** Stronger collaboration between governments, development banks, and private investors is key to scaling green finance. Public finance will increasingly be used to leverage private capital via guarantees, blended finance, and co-investment platforms. Central banks are beginning to integrate climate considerations, such as green lending facilities or greener asset preference

Recommendations and summary



Figure: Key priorities for advancing green finance

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