Citi GPS

VOL 2

FINANCING A GREENER PLANET

Bridging the Gap between Green Investments and Investors

Citi GPS: Global Perspectives & Solutions

February 2021

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FINANCING A GREENER PLANET – VOL II

Bridging the Gap between Green Investment & Investors

Kathleen Boyle, CFA
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Do we really care about climate change? In 2019, Amnesty International asked 18-25-year olds to name the five major issues facing the world. The most commonly cited issue was climate change. Although young people tend to be more concerned with climate change than older generations, there has been an increase in awareness across all age groups. In the U.S., when asked if dealing with climate change should be a top priority for government, 52% agreed in 2019, up from just 30% in 2009. In Europe, a Kantar survey found 60% of respondents think climate change is one of the most serious problems facing the world, up from 43% in 2017.

Okay, we do care about it, now what's the plan? The Paris Agreement. Signed in 2015, the agreement brought 196 parties together with the same goal — to limit global warming to below 2 degrees Celsius (2°C), compared to pre-industrial levels. Despite a few wobbly moments, it looks like everyone is back onboard to live up to their greenhouse gas reduction commitments.

Overall, momentum for climate action was increasing before the world was hit by COVID-19. Despite the financial hardships brought about by the pandemic, government focus on climate action is actually accelerating with stronger climate policies and net zero emissions targets being put in place. This increased focus on climate is occurring in parallel with a rise in corporate and individual focus. The combination, we believe, puts us at a tipping point on climate action.

In order to decarbonize the world, a whole portfolio of mitigation needs to be developed and implemented across the highest carbon-emitting sectors. Although the pace of innovation has accelerated and investment has increased, the investment gap between what's being spent currently and what needs to be spent is huge— as much as $3-$5+ trillion per year.

Capital is needed to fund the technologies required help markets evolve towards decarbonization. Advancements in battery technology, the hydrogen economy, carbon capture and storage, electrification, and efficiency require investment to become reality. Carbon management (i.e., carbon dioxide removal) and carbon pricing will help to align investment and economic activity with climate goals.

Public sector spending is crucial to funding climate action together with private investment. Luckily, green momentum in the investor community has led to an explosion in assets under management incorporating ESG considerations. At over $30 trillion, the challenge is putting these assets to work. Developing a clear green framework will help deploy ESG assets where they are most needed.

Financial innovation is the key to matching capital supply and demand. Instruments including project finance, green, social, and sustainability (GSS) bonds, SPACs, 'efficiency as a service', green securitization, and used to close the gap.

Given the scale of the issue, we've published *Financing a Greener Planet* in two volumes. Volume I focuses on the three factors which indicate we are at a tipping point on climate action — policy and regulation, innovation, and green momentum in the investor community. Volume II is dedicated to the financial options available to close the massive climate investment gap.

Let's invest in what we care about.

Where There's a Will, There's a Way

CLIMATE FINANCE SPENDING NEEDS TO GROW BY AS MUCH AS 10X

We have reached the green tipping point where global climate policy activity is accelerating alongside renewed green commitments from businesses, investors, and consumers. But there is a substantial gap between the $3 – $5+ trillion level of annual green investment needed to meet the 1.5°C climate by 2050 and the nearly $600 billion of total climate finance invested in 2017/2018.

Annual Climate Finance Spend (2017-18) vs. Green Investment Needed to Meet Climate Goals:

Source: Climate Policy Initiative and GFMI

- **$37bn** Government
- **$216bn** Development Finance Institutions
- **$88bn** Commercial Financial Institutions
- **$183bn** Corporate Actions
- **$55bn** Households

Annual Spend $579 billion **vs.** $122 trillion Investment Needed

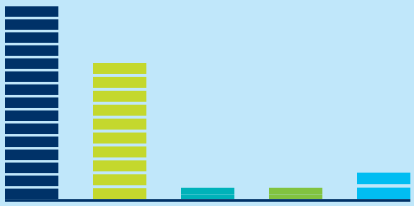
- **$94.6tn** Electrification and Renewables
- **$12.1tn** Efficiency and Circularity
- **$15.0tn** Alternative Technologies

GREEN MOMENTUM IN THE INVESTOR COMMUNITY CONTINUES TO BE STRONG DESPITE, OR POSSIBLY ENHANCED BY, THE COVID-19 PANDEMIC

Interest around Environmental, Social and Governance (ESG) investment started taking off in 2018 with ESG assets under management hitting $30 trillion. Momentum continues to expand with asset managers bringing a range of new methodologies to the investment process to meet increasing demand.

ESG Assets Under Management by Class (2018)

Source: Citi Business Advisory Services



Public Equity	51%
Fixed Income	36%
Private Equity/Venture Capital	3%
Real Estate	3%
Other	7%

Current ESG Investing Approaches

Source: Citi Business Advisory Services

Negative Screening	39%
ESG Integration	35%
Stewardship and Corporate Engagement	20%
Other	6%

New approaches to ESG investing

1. **Data:** Expansion of ESG data set to identify E, S, and G risks
2. **Linkages:** Improved linkages of capital allocation to ESG risks and goals
3. **Investment Universe:** Creating more materially relevant investment universes
4. **KPIs:** Development of KPI's the measure non-financial returns over time

A PORTFOLIO OF MITIGATION IS NEEDED FOR DECARBONIZATION TO TRANSFORM THE GLOBAL ECONOMY

Decarbonizing the world requires nothing short of a great transformation of the global economy, with no single silver bullet, but instead a whole portfolio of mitigation.

Carbon pricing
Carbon taxes, carbon emissions trading systems, carbon credits

Renewables
Solar, wind, battery storage

Carbon Dioxide Mitigation Solutions
Carbon dioxide removal and carbon capture and storage

Hydrogen
Green, blue and grey

Transportation
Road, aviation, shipping

Metals
Primary and secondary metals

Agriculture
Acreage, food waste, sustainable and smart ag

GREEN FINANCE IS THE MATCHMAKER BETWEEN THE 'WANT' AND THE 'NEED'

Financing is important as many green technologies require large upfront capital costs versus low to zero (and even negative) marginal costs. Creative financing options help match the trillions of dollars of demand for capital for green projects with the rising investor demand for green projects.

$1 trillion
Size of Sustainable Debt Capital Markets

53%
Social and Sustainability bond offerings as % of all Sustainable bond issuance in 2020

76%
Percent of $3.8 trillion U.S. municipals market likely to be ESG-aligned

$450 billion
Value of corporate or sovereign bonds with a 'green' label denominated in $, €, or £

33%
Share of utility sector in 2019-20 green bond issuance

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Executive Summary

Climate change is a defining challenge of our time. Record temperatures and increasingly extreme and frequent droughts, floods, wildfires, and storms bear clear testimony to global warming. Indeed, even with accelerating action today, some climate change is locked-in for the near future due to past greenhouse gas (GHG) emissions. Climate action will require extensive climate mitigation, but also climate adaptation. Climate mitigation to achieve the Paris Agreement goals — remaining within 1.5 degrees Celsius (1.5°C) from pre-industrial levels — requires staying within a carbon budget of ~420-580 $GtCO_2e$. This means today's GHG emissions of ~53 $GtCO_2e$ on net need to be cut in half by the 2030s, and reach net zero by mid-century. Net negative emissions would further help as part of ongoing climate restoration.

The world is still battling COVID-19, though the accelerated development of effective vaccines means an end is in sight in 2021. Behavioral changes post-COVID-19 are forecast to be aggressive, but as they likely fall short with regard to sustained emissions reductions, strong climate policy is still needed. A strong economic case can also be made for a green recovery coming out of the pandemic.

Momentum for climate action was already underway before COVID-19, but is now accelerating and reaching a tipping point. Governments are putting net zero emissions targets and stronger climate policies in place for mid-century, notably the EU and China. The U.S. has to rejoined the Paris Agreement in 2021. International climate diplomacy to engage emerging markets (EMs) is important — without a shift in trajectory, EMs are expected to see rapid growth in fossil fuel consumption. Corporations and investors are also joining the 'net zero club', while individuals are embracing climate considerations in lifestyles and consumption. Meanwhile, the oil and gas sector is also adapting to the wider energy transition.

Decarbonizing the world requires nothing short of a great transformation of the global economy, with no single silver bullet, but instead a whole portfolio of mitigation. Decarbonization needs to take place in the power, transportation, industrial, agriculture, and building sectors. Decarbonization in power is now moving at a brisk pace, and is foundational for clean electrification. Road transportation decarbonization is picking up via electric vehicles (EVs), but trucking may require a more mature hydrogen economy. Aviation and shipping require very high energy density and batteries are not there yet. Instead, renewable and synthetic fuels represent the nearer-term decarbonization pathway for aviation, while decarbonization of shipping could be achieved through utilizing hydrogen and ammonia as the hydrogen economy matures; Liquefied natural gas (LNG) could be a bridge fuel. Heavy industries (chemicals, cement, steel, etc.) require a combination of efficiency, scrap use, electrification, hydrogen, and carbon capture and storage to decarbonize. Agricultural GHG emissions come less from carbon dioxide (CO_2) and more from methane and NOx, so major decarbonization could come from process changes, but more specifically alternative proteins. Buildings are decarbonizing through efficiency, electrification, and distributed solar and battery. Metals are an enabling material for most decarbonization technologies, but also need to decarbonize as a sector itself. Overall, efficiency and adopting ‘circular economic thinking’ need to be applied across the board.

Carbon management, including negative emissions technologies, needs to be part of the decarbonization portfolio. This includes carbon dioxide removal (CDR) via carbon capture and storage (CCS). CCS is crucial for decarbonizing concentrated GHG emissions from industrial and power sectors, and can help produce 'blue hydrogen', a low-carbon source of hydrogen to kick-start a hydrogen economy. However, CDR also includes a wide range of natural and engineered solutions for removing CO_2 from the atmosphere. This already happens in agriculture, forestry, and land use (AFOLU). Engineered solutions include CCS but also direct air capture (DAC) to process atmospheric air and remove CO_2. Hybrid solutions also exist including enhanced soil carbon sequestration through cultivating plants that store much more carbon for longer in their root systems, which can be meaningful for the global net carbon balance. Bioenergy with CCS (BECCS) and DAC are among the technologies that can provide net negative emissions, by removing CO_2 from the atmosphere, and storing it in underground geologic formations, essentially permanently. Carbon management is a sector that critically needs a carbon price to be economic, and thus investable.

There is a massive investment gap that must be closed to meet climate goals, perhaps as much as $3-5+ trillion per year. Public sector investment is crucial, but boosting private investment is critical too. Policy innovation as well as financial innovation are needed to boost private financing for green investments. Financing is particularly important as many green technologies require large upfront capital costs versus low to zero (and even negative) marginal costs. This may in fact be the first time there are both trillions of dollars of demand for capital for green projects, as well as investor demand for green projects. There is a growing pipeline of green projects that require investment, and a growing line of investors looking to invest in broadly ESG-aligned opportunities.

Policymakers need to provide a stable, enabling policy environment, with clear long-term targets providing policy certainty. This includes a clear green framework, carbon prices and other fiscal measures, infrastructure investment that supports renewables and EVs and a hydrogen economy, and overall decarbonization technology research, development, and deployment (RD&D).

A clear green framework is essential for green finance to truly flow, and to avoid 'greenwashing'. While this has been a sticking point, the world is now at a critical point of convergence and maturation. Once the green framework matures, this can dramatically catalyze private green investment, not unlike the way earlier financial frameworks and accounting standards became part of mainstream finance. A clear green framework involves taxonomies of climate-aligned activities, and exists currently in the EU Taxonomy. Included are climate-related disclosures for companies and financial institutions, notably the TCFD (Task Force on Climate-Related Financial Disclosures) recommendations. Carbon accounting and sustainability accounting principles for green financial instruments need further development. Broad and credible data and metrics for legal and regulatory compliance, as well as decision-making by investors, businesses, policymakers, and consumers need further development.

Carbon prices are absolutely crucial to (1) accelerate decarbonization, (2) as part of a suite of climate policies, and (3) to provide clear economic signals to align investment and economic activity with climate goals. Putting a price on carbon internalizes the externalities of climate change, and better aligns economic decisions with climate goals. The good news is that carbon-pricing initiatives are likely to be launched in more jurisdictions, cover more sectors, and push to higher price levels. For some crucial parts of the decarbonization pathway, carbon prices are essential, such as for CCS. For others, they greatly improve the

competitiveness of climate-aligned technologies, thereby accelerating the shift. Carbon prices can provide clear climate benefits, while raising revenues for climate spending, alongside a suite of policy tools supporting environmental justice for vulnerable communities.

Good climate policy, including the above considerations, helps to boost the returns and reduce the risks of green investments and green financing. Further policy innovations can be focused on de-risking specific risks across the green investment landscape. Financial innovation further helps to match capital supply with project demand, and manage risks among economic actors, along the whole pipeline from projects to primary and secondary markets.

This two volume report is divided into and four sections. Here is our roadmap.

Volume I – Catalyzing Private Capital for a Net Zero Emissions World

Section 1. The world is reaching a green tipping point focuses on governments and policymakers. Chapter 1 looks at how global climate policy and regulations are evolving. Chapter 2 looks at the green investment gap and how policies might catalyze private green investment. Chapter 3 looks at post-COVID-19 economic trends. Chapter 4 looks at economic and climate policy trends at a global level and in selected countries and regions.

Section 2. How markets are evolving reviews the economic, policy, and commodities market trends that help or hinder decarbonization efforts. Chapters 5-11 cover carbon pricing initiatives; the power sector including renewables; carbon dioxide removal and carbon capture and storage; the emerging hydrogen economy; sustainable transportation; the metals sector; and sustainable agriculture.

Section 3. Green momentum in the investor community looks at how green and wider environmental, social, and governance (ESG) factors are becoming mainstream in the financial sector. Chapter 12 looks at ESG trends in investment management. Chapter 13 provides a view on sustainable investing from the perspective of Citi Private Bank. Chapter 14 looks at the upcoming convergence and maturation of a green framework for climate-aligned finance, including taxonomies, disclosures, carbon/sustainability accounting, and data availability and transparency. Chapter 15 discusses the challenges of greening the financial system for central banks and financial regulators.

Volume II – Bridging the Gap between Green Investment and Investors

Section 4. Green financing options: from projects to primary and secondary markets draws on the expertise of financial professionals across Citi to cover a large part of the landscape of green finance. **At the project level,** this includes the financing of green projects at the asset level, via project finance (Chapters 1 and 2), venture capital (Chapter 3), and private equity. Efficiency investments can be financed on the basis of a stream of future savings, including the "Efficiency as a Service" model (Chapter 4). Development finance institutions (DFIs), export credit agencies (ECAs), and multilateral institutions help to finance green investments worldwide, including in developing countries (Chapter 5), helping to de-risk EM-related risks, including sovereign, political, and currency risks. Financial institutions and corporates can influence companies along the supply chain to decarbonize as part of reducing Scope 3 emissions (Chapter 6). **At the primary and secondary market levels:** green, social, and sustainability bonds are growing quickly, with KPI-linked bonds providing performance measures rather than use of proceeds criteria (Chapter 7).

Municipal bonds are typically climate-friendly even if they are not yet labelled as 'green' (Chapter 8) and are important for sustainable cities and infrastructure. On the equities side, Special Purpose Acquisition Corporations (SPACs) have been seeing a surge in interest in 2020, and provide an alternative path to traditional IPOs for private companies looking to go public, and suit high growth companies (Chapter 9). Overall, the green pipeline from private financing to public fixed income markets continues to grow along with investor demand and facilitative policies (Chapter 10), including in emerging markets (Chapter 11). Meanwhile, green securitization remains in its infancy and should continue to grow, and as a sector is important in pooling, re-bundling, and recycling capital such that many smaller, fragmented green investments can reach the scale to meet large institutional investors' needs (Chapter 12).

Introduction: Public and Private Climate Finance in Context

In this report, we take a deeper dive into various parts of the landscape of climate finance, starting from the project level, then moving to primary markets, and then secondary markets. A high-level schematic is shown in Figure 1 to provide context — this section covers some, but not all, of the picture.

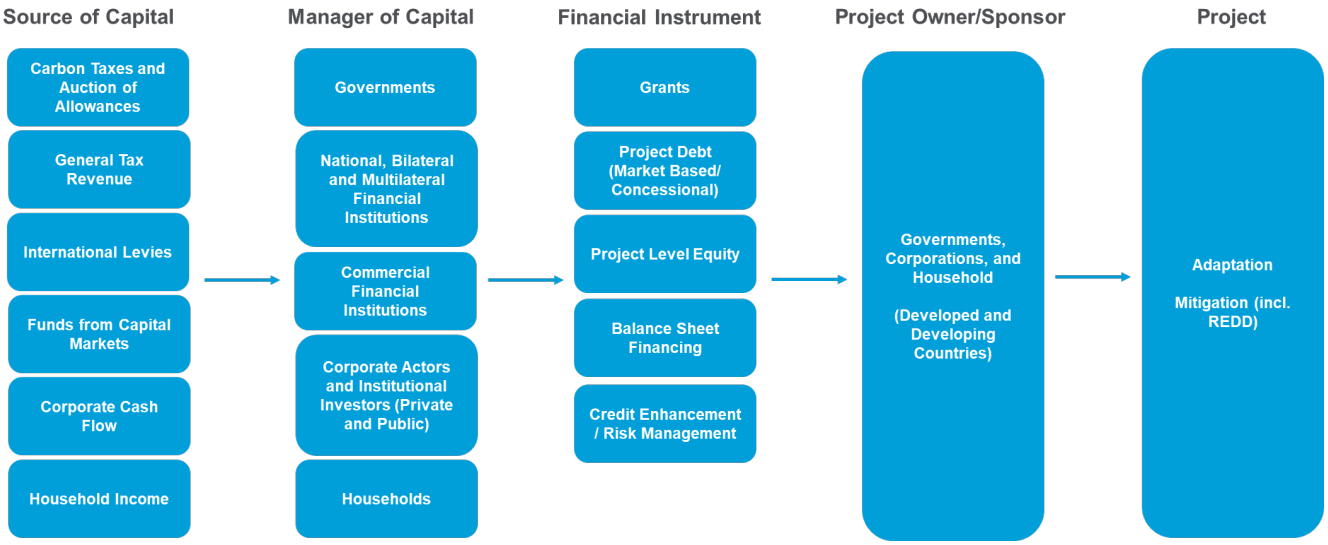
At the project/company/asset level, we look at project finance and infrastructure finance in Chapters 1 and 2, with discussions of financing for emerging project types beyond renewables, including efficiency, hydrogen, and carbon capture and storage (CCS). We look at Efficiency as a Service (EaaS) models for financing pools of efficiency investments in buildings in Chapter 4, with green interventions in supply chain finance discussed in Chapter 6. Green venture capital in early stage companies is discussed in Chapter 3, with an eye on impact investing and dual bottom lines.

We touch on public sector climate finance in Chapter 5, where the Citi Export Agency Finance (EAF) team discusses climate finance alongside export credit agencies (ECAs), development finance institutions (DFIs), and multilateral institutions.

At the primary market level, we look at the massive growth in green bonds and KPI-linked bonds in Chapter 7, and the rise of SPACs in Chapter 9. U.S. municipal bonds and their green credentials are discussed in Chapter 8.

Considering the pipeline of capital through to secondary markets, the growing investor demand for green fixed income, and some of the key obstacles, is discussed in Chapter 10, with a deeper focus on green bonds in emerging markets in Chapter 11. The pooling, rebundling, and recycling of capital is touched on in Chapter 12 on green securitization, in terms of mortgages and loans for green buildings and vehicles.

Figure 1. Framing the Landscape of Public and Private Climate Finance



Source: UN IPCC 2018

1. Financing Green Projects: Current Practices and Recent Trends

Renewable Energy Investment: Continued Growth and Innovation in Financing

Alternative Energy Finance, BCMA

Marshal Salant

Pierre Steenblik

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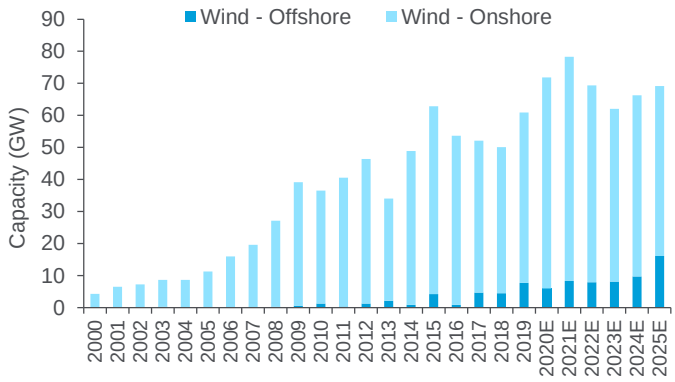
2019 marked another year of strong performance for the renewable energy industry after the success seen in 2018. In 2019, renewable energy accounted for more than three-quarters of all new global power generation capacity at approximately 199.1 gigawatts (GW). Growth in renewables continues to be driven primarily by wind and solar, with 60.9 GW of new wind capacity additions and 118.4 GW of new solar capacity additions in 2019.

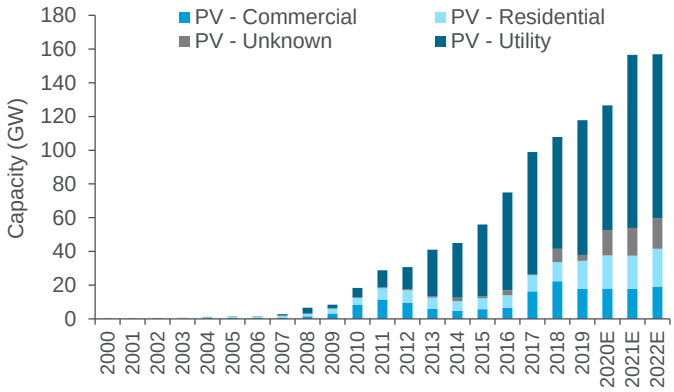
Despite the COVID-19 pandemic, Bloomberg New Energy Finance (BNEF) projects we achieved strong year-over-year growth in renewables for 2020. Cumulative installed capacity for wind is expected to have grown by 71.8 GW in 2020, representing a ~18% increase from 2019; solar over the same period is expected to have grown by 127.5 GW, representing a ~8% increase. Looking ahead, renewable energy is expected to experience strong growth in the next decade and should remain the largest segment of new global power generation investment, accounting for over 71% of projected investments in new capacity from 2021 to 2030.

Figure 2. Global Wind Annual Capacity Additions



Source: BNEF

Figure 3. Global Solar Annual Capacity Additions



Source: BNEF

The renewable energy financing landscape has continued to evolve over the last few years and strongly underpins growth in the sector. Financial innovation and investor comfort in the technologies have led to reduced financing costs and more efficient financing structures. As a result, wind and solar are now competitive with other forms of generation in many parts of the world and can compete on a level playing field without subsidies. Additionally, technologies like offshore wind and energy storage are expected to achieve scale, attract investors, and experience the same explosive growth as onshore wind and solar in the short to medium term. Renewable energy is growing out of its teenage years and is on the verge of full maturity. Clean, renewable, 'alternative energy' has become mainstream.

It is important to remember that financing costs are particularly important to the lifetime economics of renewable energy projects. The lifetime economics of fossil fuel generation projects are critically dependent on the cost and price volatility of the fuel burned in these projects to produce electricity (e.g., the price of coal or natural gas).

But renewable energy project economics are not critically dependent on 'fuel' source costs because the projects don't pay for sunlight or wind. **Instead, the lifetime economics of renewable energy projects are more dependent on the upfront costs to needed build the project and the financing cost.** Lowering construction and financing costs is a key objective of the renewable energy industry. Let's take some time to summarize some of the recent trends in the clean energy markets.

A Maturing Financing Model: Recent Innovations in Renewable Energy Finance

For utility-scale projects, a growing number of sponsors are bundling large wind projects into portfolios for financing and asset sell-down purposes. This practice has become popular due to the increased scale and diversification it provides investors. **Portfolio financings enable sponsors to reduce average transaction costs per project by spreading legal, consulting, and advisory costs across more projects.** These portfolios have proven to be popular with large institutional investors, who see their entrance into the market as opportunities for them to deploy significant capital quickly. This in turn has enabled sponsors and developers to sell down their positions and allows them to recycle capital into new projects. Citi closed its first wind portfolio tax equity financing in December 2018, and has since closed three additional wind portfolio tax equity financing transactions.

The second trend within utility-scale financing involves a growing number of repowering and retrofitting of old projects to take advantage of improved technologies and larger and better wind turbines. There are also financing benefits. For example, in the case of utility-scale wind, an eligible repowered project could claim an additional 10 years of production tax credits. Developers are increasingly looking towards repowering as a way to reuse existing infrastructure, including land rights and transmission connections, while still being able to claim additional tax credits before they sunset. According to BNEF, wind repowerings are expected to involve as many as 30% of U.S. wind farms by the end of 2020.

For the distributed generation and residential solar sector, solar third-party ownership ('TPO') and loan and lease securitizations have become increasingly popular financing tools. In the U.S. market, there are three primary ways for a residential homeowner to finance a solar system: (1) ownership, purchased with cash; (2) ownership, financed with a solar loan; and (3) a power purchase agreement (PPA) or lease agreement with the solar developer (third-party ownership or 'TPO'). In the residential solar market, the solar loan option has grown in popularity in recent years and is expected to be a strong performer for U.S. residential solar capacity additions in 2020.

Securitizations for pools of renewable assets have also increased in popularity over the past few years. In a securitization, a solar company pools together receivables (typically leases, PPAs, or loans) and borrows against them. By doing so, it converts future payment streams into cash in the present to pay for current installations. Companies securitize assets for many reasons, including to achieve a lower cost of capital and to access a wider investor base. Citi will commonly provide shorter-term warehouse financing to aggregate a diverse pool of leases, PPAs, or loans, with the intent to securitize these assets in the capital markets once a critical mass has been reached.

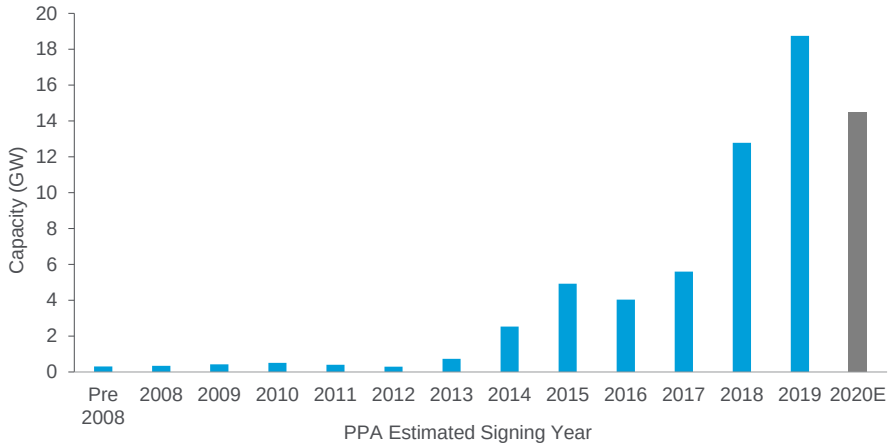
Diversified pools of loans can now also be sold to sophisticated institutional investors to raise capital for developers and specialty finance companies as an alternative to an ABS financing (asset-backed security financing). See additional commentary on green securitizations in Chapter 12.

Corporate Involvement on the Rise and the Influx of Institutional Capital

Corporate involvement in the renewable energy space has dramatically increased in recent years. Many corporations have publicly announced ambitious sustainability targets, including carbon neutrality and sourcing 100% of their power from clean energy projects. **To achieve their targets, corporates are signing up for power purchase agreements (PPAs), hedges, and other forms of offtake agreements with renewable energy projects.**

According to BNEF, corporations bought 18.7 GW of renewable energy in 2019 through PPAs, up more than 45% from the previous year. The majority of this purchasing occurred in the U.S., but also underpinning the strong uptrend is a surge in corporate sustainability commitments around the world. Technology companies were the biggest buyers in the corporate PPA market, led by Google and its commitment to purchase over 2.7 GW of clean power. Some of the other large buyers were Facebook and its deals for a combined 1.1 GW of power, followed by Amazon and Microsoft with contracts for 900 MW and 800 MW, respectively. Corporate PPA volumes for 2020 are projected to have decreased due to the COVID-19 pandemic, with firms hesitant to make large commitments and expenditures amid business uncertainty.

Figure 4. Global Corporate Renewable Energy PPA Volumes



Note: 2020 estimates projected as of October 2020.
Source: BNEF

By contracting with renewable energy projects, corporates increase the demand for renewable energy capacity additions and enable more projects to get long-term financing. This is particularly true in the U.S., as lenders and tax equity providers generally require a significant portion of the project's cash flows to be contracted (typically under a PPA or commodity hedge) to provide long-term financing.

Increased Investor Focus on Green Assets

In addition to high corporate demand, the renewables sector is seeing several new sources of capital, including global infrastructure funds acquiring pipelines of renewable assets; global oil and gas companies seeking to improve their environmental footprints; and institutional investors with ESG investing objectives aiming to improve their ESG scores and take advantage of the expiring tax credits. In 2019, U.S. investment into renewables totaled $55.5 billion of which the vast majority flowed to onshore wind, solar, and other power generation projects. With a growing body of research correlating climate-resilient assets to financial performance, ESG and impact investing is galvanizing investors to finance low-carbon technologies.

The influx of institutional capital is occurring simultaneously with record levels of global demand for investments in the green space. The challenge lies in matching an unprecedented amount of dry finance powder with a diverse set of investment opportunities. Innovations in financing structures such as asset-backed securitizations form the instruments through which investors can deploy a significant amount of capital into the sector. Rating agencies also fulfill an important role, educating investors and sending market signals by issuing credit ratings and methodologies for rating renewable technologies. For example, rating agencies have historically developed methodologies for wind and solar to achieve an investment grade credit rating on project bonds, unlocking huge pools of debt investors and contributing to the meteoric growth in these technologies. On the other hand, technologies such as biomass, biodiesel and fuel cells have been relatively starved for capital. This is because rating agencies typically rate renewable energy projects employing proven technology with substantial commercial operating experience. Ratable projects also typically benefit from long-term power purchase agreements with investment-grade counterparties, which substantially mitigate price risk. Newer technologies may face unstable production and unpredictable costs among other indicators, making it difficult to procure long-term PPAs.

Offshore Wind

The offshore wind industry is in its nascent phase in the U.S., but has seen notable acceleration in recent years. The current offshore wind pipeline in the U.S. has grown to more than 25 GW, with more than 21 GW with exclusive site control. Several projects have already secured offtake agreements with local utilities.

As of today, the U.S. offshore wind industry is much smaller than its European or Asian counterparts, with the only project in operation being the 30 MW Block Island Wind Farm, which Citi provided financing for. Nonetheless, developers see great potential in the U.S. offshore wind industry, notably on the northeastern seaboard. Offshore wind is an attractive commercial opportunity due to its higher wind resource (compared to onshore wind) and its ability to provide significant renewable energy capacity to high-population coastal load centers. The merger & acquisition (M&A) landscape in U.S. offshore wind was very active in 2019, including several joint ventures being formed between developers. Many of the developers looking to bring these projects to completion are large European companies with prior offshore wind experience in Europe and Asia.

The investment and development pipeline for near-term projects is significant. 6.1 GW of offshore wind capacity was added to the mix in 2019, representing a 35.5% increase over the previous year, during which 4.5 GW of capacity were installed. BNEF predicts that as much as 69 GW of offshore wind capacity could be installed globally by 2024. Future North American offshore wind may someday include five markets including the Atlantic Coast, Gulf coast, Pacific coast, Great Lakes, and other areas (Alaska, Hawaii, Puerto Rico, and the Virgin Islands).

Rapid cost declines are projected to propel offshore wind from a niche technology to a serious contender in the market. A number of factors have contributed to rapid cost declines.

- **Larger turbines:** Just like in onshore wind, larger turbines need fewer foundations, less cabling, and fewer parts to install and maintain. Fewer turbines make for better park layouts with respect to wind direction and ground conditions and significantly reduce operation and maintenance cost, which is a per-turbine rather than per-megawatt expense
- **Project scale:** Economies of scale start to materialize in parks larger than 300 MW. Savings come from using existing port infrastructure, a detailed knowledge of ground conditions, and other factors
- **Growing supply chain and developer experience:** Developers are beginning to streamline projects as they get more experience – more efficient installation practices, optimized marine logistics, and a clearer understanding of supply chain's abilities and offerings
- **Competitive auctions:** Developers in the most active offshore wind markets – including Europe, Taiwan and the US – now compete on price in order to secure contracts. This trend is expected to continue as governments seek to reduce contract prices, future liabilities, and the cost to consumers
- **Policy design and project scope:** Governments are starting to take a larger, active role in the project scope of their countries' domestic offshore wind markets

Floating wind technology, or wind turbines on floating foundations, will unlock new offshore wind markets and enlarge existing ones. Conventional, seabed-fixed turbines are capped to depths of 50-60 meters, whereas floating turbines could sit in waters over 1,000 meters deep. Floating wind turbines will also typically sit further from shore than bottom-fixed ones. For now, the floating sector is still in its infancy, with only a few prototype projects online. This technology could be crucial to the development of the Pacific coast offshore wind market.

Offshore wind holds much promise for the future. However, developers still need to overcome certain obstacles, including: the need for huge amounts of capital to construct multi-billion dollar projects (including tax equity), the need for more infrastructure to support construction and transmission, and the lack of certain equipment (such as 'jack-up boats') dedicated to the North American offshore wind market.

Energy Storage

Storage is seen as a necessary addition to the electric grid in order to enable a higher penetration of renewable energy. Energy storage is a broad term that encompasses many different technologies, including flow batteries, lead-carbon, sodium-sulfur, and compressed-air energy storage, to name a few. Storage has many potential benefits to the electric grid by smoothing out the intermittency in production of renewable energy and reducing load stress on the transmission grid.

BNEF projects total energy storage build to increase significantly, reaching a cumulative power capacity of 1,293 GW by 2050. Around 57% of that capacity, or 658 GW, is derived from utility-scale batteries, which shift energy to help with the integration of renewables, as well as providing peaking services. The remaining 495 GW are derived from small-scale batteries, which households and businesses install alongside behind-the-meter photovoltaic (PV) systems. In the future, many residential rooftop PV solar power systems will include battery storage to provide solar power after sunset. Some of this capacity is also used for peak-load management in the commercial and industrial sector.

Despite the wide range of options available, the market has so far converged around lithium-ion technology. No other storage technology benefits to the same extent from the ramp-up in research and development, and manufacturing capacity of lithium-ion for electric vehicles has helped to drive down costs. According to BNEF, the price of lithium-ion battery packs fell 85% from 2010 to 2018 with a current weighted average price of approximately $176/kWh.

Today, most lithium-ion battery storage projects are built alongside renewable or fossil fuel technologies as hybrid projects. The U.S. Energy Information Administration (EIA) reported that by the end of 2019, approximately 125 hybrids had been installed, representing 13.4 GW of generating capacity and 0.9 GW of storage capacity. Battery storage projects produce a blend of value streams, including energy arbitrage, capacity, and other ancillary services. These value streams can be quantified and converted to a fixed PPA price, given a set of operating assumptions. Battery storage projects may also be eligible for tax credits depending on guidelines surrounding the proportion of time through which a battery is charged by a renewable resource. Long-term contracted revenues and tax incentives allow battery storage projects to procure debt and tax equity financing similar to that of wind and solar.

For developers and financiers, operational considerations for battery storage projects can be complex and have a significant impact on project economics. For example, batteries lose storage capacity, or the amount of energy that can be withdrawn from a fully charged state, through a process called degradation. A battery with degraded storage capacity may be limited in its ability to provide capacity firming and other ancillary services. Degradation rates may change based on how the battery is operated and require close monitoring of certain operational parameters. Another consideration for developers and financiers relates to how battery capacity is replenished over time, as augmentations require either additional upfront or ongoing investment into the project.

From a bankability perspective, another key consideration for energy storage projects is the credit quality of the servicer counterparty backstopping the project's performance risks over time. Especially for an emerging technology such as battery-storage, lenders and investors will scrutinize a project's performance risk over time (including degradation and cycle count) to a high degree and projects that use high quality operations and maintenance (O&M) / augmentation service providers with an established track record and strong credit quality can help give comfort to lenders.

Looking ahead, a significant proportion of battery storage systems are projected to be built alongside solar. The Lawrence Berkeley National Laboratory found in a 2020 study that 27.7% of all solar projects proposed for interconnection to the U.S. grid in 2019 were hybrid battery storage projects, compared to 4.8% for wind. Batteries provide significant benefits to solar generation, particularly for firming up capacity. California's 'duck curve' is an ideal example, as solar energy floods the grid during the day but provides insufficient capacity at night.

The largest disadvantage of lithium-ion batteries is their inability to provide long-duration energy storage, with storage durations generally limited to 4-8 hours. While this can help smooth daily fluctuations in renewable energy generation, they do not yet have the capacity to meet long-duration storage needs, such as during events that take out generation for days or weeks. Technological innovation producing long-duration energy storage may improve the economics for both hybrid and stand-alone storage projects going forward.

Investors are keenly trying to get exposure to energy storage, as they see it as a critical piece in a low-carbon energy system. Wind or solar projects can be paired with storage to either provide capacity and ancillary services to grids or utilities, or to arbitrage energy markets. Utilities and municipalities are also looking to battery and other forms of energy storage as a substitute for new gas peaker plants, and as a more cost-effective way of reducing local congestion on grids than large-scale and costly transmission projects.

Beyond Net-Zero: Negative Emissions and New Sustainability Solutions

Renewable energy has made significant strides in the past decade. Progress towards a sustainable energy mix is both meaningful and well documented. However, most policy experts and climate scientists believe that high levels of renewable penetration alone (including grid enabling technologies such as energy storage) will not be enough to meet the most aggressive climate goals. As a result, many are turning to new forms of sustainability solutions, with carbon capture, energy efficiency, and hydrogen topping the list. These solutions would complement a transition to a carbon-free power grid, and help to decarbonize hard to abate sectors, including heavy industry, air transport, and other sectors where electrification is not a viable alternative.

Carbon Capture and Storage

Carbon capture and storage, also called carbon capture and sequestration, or 'CCS', is a process that involves capturing carbon dioxide from point sources or the ambient air and sequestering it in a location where it will not be released into the atmosphere. The most common storage sites include underground geological reservoirs or other organic materials. This section will focus on carbon capture and storage, distinct from carbon capture and utilization, or 'CCU', which will be discussed in the following section.

Broadly speaking there are two types of carbon capture technology. 'Point source' refers to capturing CO_2 where it is originated, often from waste streams produced by power generation or other industrial processes. 'Direct air capture' removes CO2 directly from the ambient air. While carbon capture technology as a whole has not reached scale and widespread deployment, the vast majority of carbon capture technology deployed today is captured as point source, while direct air technology is only deployed in a handful of locations.

A power plant equipped with point source carbon capture technology could reduce its CO_2 emissions by approximately 80-90% compared to a plant without the technology. Existing thermal generation may be able to extend its useful life and keep pace with increasingly stringent environmental regulations by retrofitting with carbon capture technology. Similarly, new thermal generation may consider incorporating the technology during initial construction.

Direct air capture technology has yet to be proven out, as costs can be severely prohibiting. Fans that are about half the size of a tennis court pull ambient air into containers, where a chemical process filters and processes the air into a transportable carbon dioxide solution. Because CO_2 concentrations are much higher at the source of production compared to the ambient air, point source carbon capture tends to be more efficient than direct air capture.

Many natural solutions also exist to sequester carbon directly from the air, primarily in the forestry and agricultural sectors. These include in forestry the sustainable management of tropical forests, temperate forests, and afforestation; in agriculture, silvopasture and regenerative agriculture. These solutions rely on the natural absorption of carbon from forest ecosystems and plant material to offset current emissions and draw down accumulated emissions from prior years. This absorption and sequestration potential has historically been hindered due to deforestation and depletion of biodiversity, and scaling up these natural solutions could materially reduce accumulated CO_2 levels in the atmosphere.

While the methods for sequestering carbon from the atmosphere may differ, the end goal is the same. Almost every model used by the Intergovernmental Panel on Climate Change (IPCC) shows that simply reaching 'net neutral' emissions is insufficient for the planet to avoid an adverse climate scenario. As global carbon emissions continue to rise and hundreds of gigatons of emissions are on the way from fossil fuels, CCS will have to play a critical offsetting role by burying gigatons of CO_2 and creating so-called 'negative emissions'.

The U.S. in particular is primed to reduce its carbon footprint by using CCS methods. The power sector alone accounts for approximately 28% of the country's GHG emissions. Though renewable energy and other low-carbon sources are projected to grow significantly in the coming decades, about half of all generation capacity is still likely to come from unabated fossil fuel power. Gas fleets are young and growing, and retiring nuclear, which provides more than 60% of carbon-free power, will probably be replaced only by partially zero-carbon resources. Retrofitting CCS technology onto fossil fuel generation is one potential way of reducing the power sector's carbon footprint, at least in the interim as baseload fossil fuel generation compensates for higher renewables penetration.

The second major opportunity for CCS lies in its applications for the U.S. industrial sector, which accounts for approximately 22% of total emissions. Cement and steel production are large CO_2 emitters, as well as natural gas processing, and synthetic fuel production. CCS attached to chemical production facilities could be another place for CCS growth.

Carbon Capture and Utilization

Though it's not commonly thought about, carbon dioxide is a commodity with some value. It is used, both directly and as a feedstock, by a range of industries including cement and concrete, fertilizers, beverages, and many others. Using captured CO_2 in these processes would either recycle or even sequester carbon in long-lasting materials and building products.

The advantages of CCU are two-fold. First, it could reduce CO_2 emissions, in part by sequestering some carbon permanently in durable products and in part by substituting for carbon-intensive processes, thus avoiding emissions that would have otherwise occurred. Nevertheless, CCU will likely not reduce enough CO_2 to avoid the need for CCS (e.g., burying carbon). The tonnage of CO_2 humanity emits is simply far greater than the tonnage of carbon-based products it consumes. In most cases, CCU will be best analogized to carbon recycling — where CO_2 emissions are effectively deferred into the future. For example, CO_2 may be captured from the air and converted into a synthetic fuel. Once the fuel is burned, CO_2 is released back into the atmosphere.

The second advantage of CCU technology is that demand for CO_2 driven by CCU could provide an early market pull for carbon capture as a whole, helping to get the technology scaled up and its costs pushed down. As was the case with wind and solar, once the economics are more reasonable, power producers, industrial companies, and corporates looking to offset their emissions will be much more likely to adopt carbon capture technology.

The most common use of carbon dioxide today is for enhanced oil recovery, where CO_2 is injected into oil-bearing reservoirs to enhance oil recovery rates. Increasing oil production this way is a standard, mature, and routine global operation. CO_2 can also be permanently sequestered in geological formations in concert with enhanced oil recovery, though this has not yet become the standard. CO_2 can also be used (directly) to carbonate beverages or transformed, via a wide variety of chemical processes, into materials or feedstocks. These may include concrete, liquid fuels, fertilizer, baking soda, and other materials. Of the various categories of CCU, only construction materials can claim to sequester CO_2 semi-permanently. For example, CO_2 can be chemically bonded within concrete, which can last up to a century.

Energy Efficiency

Energy efficiency is not one technology; it is a bucket including any technology, building technique, market incentive structure, or other process through which energy and electricity demand is reduced for the same amount of output. This bucket includes load shifting (reducing peak electricity demand), improving building insulation and lighting, more efficient home appliances, more efficient HVAC systems, and more efficient vehicles. Energy efficiency is one of the most effective ways to mitigate emissions by reducing the amount of fossil fuels (and therefore emissions) needed to power the global economy.

The energy efficiency/home improvement consumer lending space has experienced significant growth in the past decade. Energy efficiency/home improvement products include loans and retail installment contracts to finance the installation of eligible home improvements, with the primary use of proceeds being improvements that reduce the homeowner's energy usage. An eligible improvement may include improvements to a building's heating, ventilation, and air conditioning (HVAC), doors, windows, roofing, electric systems, water heaters, and other innovative technologies.

These products form a critical piece of home infrastructure, provide essential services to customers (e.g., hot water, heating, cooling, etc.) and generally improve savings for the customer. Energy efficiency finance products are particularly relevant to the 'MUSH' market, including municipal and state government-owned buildings, universities and colleges, schools, and hospitals. These buildings are often old, drafty and would benefit the most from energy efficiency-related improvements.

Citi is a leader in energy efficiency/home improvement financing. Similar to financing for the distributed generation and residential solar sector, Citi can provide aggregation facilities in the form of a warehouse to collect a diverse pool of energy efficiency/home improvement leases or loans and subsequently access the capital markets through an asset-backed securitization. Rating agencies have developed methodologies for rating these term issuances, utilizing analysis of the underlying collateral pool and historical performance of static pool data (e.g., losses and delinquencies) among other factors.

Corporations are also increasingly looking for energy efficiency solutions to reduce their energy consumption. A wide range of financings including certain off balance sheet structures are being utilized to facilitate corporate energy efficiency projects. New structures are being developed and utilized in the structured finance markets to help corporations reduce energy consumption.

Hydrogen

As renewable energy becomes commonplace, and as carbon capture gears up to meet growing demand from corporate sustainability goals and demands from the industrial sector, many other promising solutions are still only at very early stages. These technologies could have material impacts on decarbonizing the global economy, but require innovations in public policy support and financing structures to unlock capital and promote widespread adoption. Hydrogen is one of those technologies.

Hydrogen, and the use of the hydrogen molecule in energy and industrial applications, has significant potential in a decarbonized world. Most notably, hydrogen provides a path to decarbonization for the hardest sectors, including heavy transport, heavy industry, and long-term energy storage. Hydrogen can be produced either through electrolysis using clean energy (green hydrogen) or using natural gas or coal (gray or brown hydrogen), potentially outfitted with CCS (blue hydrogen). Once produced, hydrogen can be stored for long periods of time and combusted for energy production or for use as a heat catalyst in industrial processes (steel, cement, etc.). Furthermore, the only byproducts of hydrogen combustion are water and oxygen, resulting in a zero-emission power source if originally produced through electrolysis with renewable energy.

So far, the major hurdle has been the high cost of green hydrogen as compared to gray hydrogen. With the right policy support and with new announcements from corporates to kick-start demand, costs could fall rapidly as scale is reached. Water can also be a scarce resource for certain regions in the world, posing a supply challenge for the production of green hydrogen. Electrolysis of seawater is a potential solution that could provide a new boost for hydrogen as an energy source.

Scaling the Next Wave of Sustainable Solutions

Once again, the experience and life cycle of wind and solar reveal a lot about what is needed on the policy and financing front to help scale new sustainable solutions. In many cases, the positive benefit from these solutions (reduction in GHG emissions) is spread across society, and currently does not have a direct monetary incentive. Various policy methods would help to change this and unlock a treasure trove of capital looking for sustainable investments, including CCUS, energy efficiency, and hydrogen.

Required Policy Support

Policymakers have multiple policy options to choose from in promoting clean energy and sustainable solutions. Many economists point first and foremost to a carbon price, where the negative externalities of emissions are priced in and that cost is forced to be borne by polluters. Other policy options include mandates, standards, tax incentives, public financing support, and changes to utility processes. Each of these options entails certain pros and cons, and can be more or less efficient in reaching climate goals depending on the situation.

Alongside state policy, federal tax incentives have been the primary policy driver for the growth of wind, solar, and other renewables during the past decade. These incentives include the tax credits, such as the investment tax credit (ITC) and the production tax credit (PTC), as well as tax benefits due to accelerated depreciation. The tax credits are only effective if value can be derived from them by some entity.

Given that most project owners do not have enough tax liability to monetize the tax credits, and carrying forward tax credits will result in a significant loss in project economics, project owners rely on partnering with tax equity investors. Given the economic downturn due to COVID-19, there are significant concerns within the renewable energy industry that the supply of tax equity will decrease due to cuts in corporate profits and reductions in taxes owed by tax equity providers. Several developers, particularly small developers, may be unable to procure tax equity financing for their renewable energy projects.

One way to capture the full value of the tax credits without having to carry forward value or share value with the tax equity market is to make the credits refundable, either through a direct payment, a cash grant or as a refundable tax credit. Refundability is not a new idea. In 2009, Congress enacted a provision under Section 1603 of the American Recovery and Reinvestment Act whereby energy projects could receive a 30 percent cash grant from the Department of Treasury instead of the PTC or the ITC. Refundability would enable more developers to utilize the tax benefits themselves so they would not require tax equity from third party tax equity investors. It would also increase the number of tax equity investors and increase the pool of tax equity dollars that can be invested by making it easier for the tax equity investor to monetize the tax benefits. Refundability, along with an extension of the tax credits and their expansion to energy storage, CCUS, and other renewable technologies is crucial for the continued growth in the renewables industry.

Among other policy options, a carbon price is seen as the most efficient and the most flexible in incentivizing sustainable practices. This tool would materially shift the economics of clean technologies that either avoid emissions (and don't pay the carbon price) or reduce emissions (and could earn revenues from doing so).

This would most notably apply to CCUS and energy efficiency, as these would directly help reduce costs for producers and consumers, and would incentivize more efficient uses of energy or deployment of clean alternatives. With a carbon price, electricity (from fossil fuels) and energy costs would rise; the avoided cost of energy efficiency would therefore rise in unison. A carbon price would also help the production of green hydrogen for use in hard to abate sectors that require industrial process heat, but where hydrogen produced from electricity is not yet cost-competitive.

Mandates and standards, while not as cost-efficient as a carbon price, can have a material impact in promoting sustainable solutions. They can be particularly effective in sectors in which it is harder to calculate project specific emissions (agriculture, buildings), and where promoting or requiring more sustainable practices early on (such as building codes) can have a large impact on what investments are made. This is most notable for energy efficiency solutions, where standards for buildings, home appliances, and vehicles can materially shift how companies in those sectors design their products. This can also be a strong driver for hydrogen, by requiring that natural gas be blended with green hydrogen so as to stimulate demand for the clean fuel. Lastly, mandates have been extremely effective in the power generation space by creating forced and visible demand for clean sources of energy; this is leading to a surge in renewable energy deployment, and arguably has the potential to do the same with CCUS.

Tax incentives and public financing support are two policies through which the government helps to de-risk a project, either through reduced financing cost (loan guarantees, etc.) or through providing additional economic value that can be monetized (tax credits). These are particularly effective at promoting investment in large infrastructure projects — such as CCUS and hydrogen — where the initial risk profile is too large for the projected return. A combination of federal green bank, state, and state green bank government policy could help incentivize the growth of clean energy. Under the Biden administration, the federal government may dramatically increase the procurement of renewable energy for federal installations and purposes.

Regulatory Obstacles and 45Q

Section 45Q of the Tax Code provides for tax credits for CCUS to attempt to increase the economic value of such projects; this tax credit has historically been underutilized. CCS is currently deployed in only a handful of locations, but may expand given proper regulatory policy and guidance. The technology is proven and well understood — in 2019, more than 25 million tons of CO_2 from the power and industrial sectors were permanently stored using CCS technology. The main obstacles to widespread adoption are the project costs and the underlying economics. The practice of capturing and storing carbon dioxide by itself yields no economic benefit to the user of the technology. This is because the market does not price in the negative impact on the environment caused by carbon dioxide emissions. If such an externality were to be taken into account through the use of stricter environmental regulations, a carbon price, or other tax-driven incentives, the government could effectively attract further investment in the space.

In February 2020, the IRS released its first stage of guidance on the framework for Section 45Q, in the form of Revenue Procedure 2020-12 and Notice 2020-12. In June 2020, the Treasury Department and the IRS released further regulations on the Section 45Q tax credit.

Investors may claim a tax credit for the capture of "qualified carbon oxide" from industrial facilities — including qualified power plants — that are built by January 2024. The credit can be claimed for 12 years from the date the carbon sequestration equipment is placed in service, and ranges from $10 to $50 per metric ton, depending on what is done with the captured carbon dioxide at the date when the operations begin. The IRS recommends the tax credit investments be structured in the form of a partnership flip — similar to wind project financings based on the production tax credit — and the approval of a six-year safe harbor period, two years more than the equivalent period for wind and solar projects. Additionally, under the new rules for carbon capture, tax equity investors can fund up to half of their investment on a 'pay as you go' basis, as opposed to just a quarter for wind projects. This allows investors to adjust subsequent investments depending on project performance, e.g., how much carbon is captured. The new regulations issued in June 2020 provide several additional clarifications, including how to timely begin construction of a project, how to contract for carbon oxide sequestration, acceptable carbon oxide storage standards, and so on.

The primary issues that would still benefit from further guidance are regarding the qualification for, and recapture of, Section 45Q credits. Nonetheless, the proposed regulations, together with IRS guidance issued earlier in 2020 may be sufficient for the first set of investments to come to fruition this year. Owners of ethanol plants in the Midwest are likely to be the first movers, since the plants are already built and located near geological formations favorable for carbon capture. Oil and gas companies are also likely to move quickly, particularly in the shale oil regions in North Dakota and Texas.

Financing the Solutions of Tomorrow

Strong and reliable policy support can grow demand and enable sustainable solutions to reach scale faster. This would unlock the tremendous amounts of capital looking to be deployed in sustainable investments. The influx of institutional capital in the wind and solar markets, and the significant compression in yields due to that influx, show the pent up demand awaiting more opportunities for investment. Yet many risk adverse investors require a long-term policy strategy and demand outlook prior to making investments. Many investors are also unwilling to take on the risks associated with financing newer technologies, or may require a rate of return that translates to a prohibitively high cost of capital. Newer technologies by definition lack operational history that investors can use to get comfortable with the technology. Additionally, several waves of financing may be required for newer technologies to benefit from learning curves, economies of scale, and lowered costs associated with mature technologies.

So far, CCUS projects are being looked at as project financing structures, notably when paired with a power generation plant or an industrial plant. The CCUS technology could either be included as part of the broader plant financing, or be financed separately with revenue contracts signed with the underlying plants. Both methods, coupled with the 45Q tax credits, would lead to project finance structures being the most efficient. As discussed above, 45Q has so far been a difficult sell for tax equity investors due to the lack of guidance on tax-related matters.

Other types of carbon capture, such as direct air capture or natural solutions, may not be as easy to finance as it may be harder to precisely calculate the amount of CO_2 sequestered. If state or federal government agencies provide a framework for estimating and recompensing the amount of CO_2 sequestered from such projects, then project financing would likely become available.

Hydrogen would also most likely be suited for project financing structures. The high upfront cost of a hydrogen production facility, a hydrogen pipeline, or a fuel cell or combustion facility would likely result in economics not dissimilar from those of natural gas, biofuels, or other commodity outputs from industrial processes. It is likely the hydrogen sector would split into two: hydrogen for power production, and hydrogen for heat in industrial processes. The former would result in similar revenue structures as natural gas: long-term contracts for fuel supply (electricity for electrolysis) and matching long-term offtake contracts or commodity hedges. As such, typical project finance structures such as project bank debt, project bonds, tax equity (if tax credits are available), and others would best match the financial characteristics of hydrogen projects.

Due to the wide range of solutions within the energy efficiency bucket, it is hard to pinpoint one financing structure as a best fit. For residential energy efficiency projects such as home insulation, electric boilers, and smart home systems, the financing structure is already proven out in the form of securitized consumer loans and leases. For larger projects, such as in the case of energy efficiency improvements in commercial buildings, commercial real estate financing may be best suited for on-balance sheet upgrades. One notable innovation for off-balance sheet upgrades has been the Energy Savings Agreement; this contract provides for financing of upfront cost by the developer, who then is repaid over time through part of the savings of the owner. This type of long-term contract with stable revenues may one day open the door for pooling of such contracts to raise securitization financing.

Corporate Involvement and Procurement

Just as corporates helped to drive adoption and deployment of wind and solar technologies, corporates have a large role to play in driving demand for new solutions such as CCS, hydrogen, and energy efficiency. Over the last decade, corporates — notably technology and telecoms companies — were early adopters of renewable technologies and early innovators in signing PPAs that provided clear demand to project developers. The same is starting to happen with CCS, with recent announcements from some corporates looking to go beyond net-neutral on carbon, with promises to sequester CO_2 already in the atmosphere. While the technologies for doing so are not at scale, these announcements with clear timelines provide visibility of demand for developers and solution providers to attract more capital and scale up.

Corporates in hard to decarbonize sectors also have a big part to play in driving forward solutions that could help them meet their own sustainability goals. Airlines are increasingly looking at reliable carbon offset solutions such as forestry solutions. Steel and cement manufacturers are pledging to switch to heat from hydrogen instead of fossil fuels. Oil and gas majors are searching for new, cleaner investment opportunities.

As we are seeing today, corporates can be a powerful force to provide visible demand for sustainable technologies, whether to meet general sustainability goals or to actually reduce the impact of a company's operations. Demand can be magnified if policy incentives provide corporates and investors with opportunities to match sustainability goals with investment opportunities. If credit-worthy corporations will sign contracts to purchase power or synthetic fuel or other output from green projects, the project developers can then obtain financing and raise money to build the projects.

A Pathway Forward

Continued progress in renewable energy expansion and development of new sustainable solutions are reasons to be optimistic about the future of the planet. However, many barriers still remain that limit the ability for investment and financing to bring certain technologies to scale. As demand from voters, consumers, investors, corporates and experts grows for governments to act on the issue of climate change, these governments will be faced with the issue of how to help accelerate the energy transition with the least costs. Many policy options exist, each using different mechanisms that utilize financial incentives and penalties.

These policies would help to provide stable, long-term frameworks around which public and private actors can make investment decisions. This would in turn help to better reflect the value of clean technologies that have reached scale, and de-risk many emerging technologies. With such a framework of policy support in place, these sustainable solutions would be ripe for investment and growth. The recent Biden victory in the U.S. means we should expect to see various new climate-friendly policies and pronouncements emanating from the federal government. Given COVID-19-related state, local, and federal deficit spending, it will be a challenge for governments to pay for all the new renewable energy. The key will be to enact government policies that also promote private sector investment into new and expanded clean energy projects.

2. Trends in Utility-Scale Renewable Energy Project Finance

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From the outset, Citi played a pivotal role in opening up the renewable energy financing market, leading the $1.43 billion non-recourse financing for the 845 MW Caithness Shepherds Flat wind project in 2010. The construction financing for the project priced at 300 basis points (bps) over LIBOR and since then, pricing for non-recourse construction loans for renewables has continued to tighten to margins below 100bps, an impressive decline enabling sponsors to raise debt capital at increasingly competitive terms. The significant reduction in pricing for renewables financing illustrates lenders' increasing comfort with various technologies, offtake profiles, and idiosyncratic risks associated with the industry. This trend is further reinforced as the energy transition to renewables advances, levelized cost of generation continues to decrease, and more technologies become competitive and broadly adopted by consumers, utilities, and commercial and industrial businesses.

Despite the effects of COVID-19, the debt markets have remained a reliable home for utility-scale renewable energy project financings. In particular, the bank market demonstrated an ever-growing appetite for greenfield renewable assets. According to project finance league tables tracker IJ Global, there has been 3.5 GW of greenfield renewable energy projects financed in the bank market between mid-March to late October of 2020 in North America alone. These transactions amount to a total of $4.11 billion in debt financing across a wide range of projects in the onshore wind, photovoltaics, and battery-storage space. At the onset of COVID-19, the bank market saw a widening of spreads largely due to increased capital costs for lending, but over time spreads have started to normalize and are now at pre-COVID-19 levels again.

Citi remains a leader in the financing of sustainable energy projects and can provide the full spectrum of financing alternatives to its clients, ranging from arranging bank facilities to structuring/placing capital market solutions (e.g. in the 4(a)(2) private placement market). In March 2020, during unprecedented market uncertainty, Citi successfully priced a private placement to finance John Hancock's minority interest in ExGen Renewable Partners, a 1.4 GW portfolio comprised of 30 wind and solar assets across 13 U.S. states. The transaction priced in early March and notwithstanding the unprecedented market volatility, the issuance was ~1.5x oversubscribed and priced inside of guidance, demonstrating the stability of the private placement market and unwavering appetite for renewable energy credits.

Since March 2020, Citi has closed $1.4 billion of construction bank financings for nearly 1 GW of onshore renewable projects, including Terra-Gen SoCal Wind, sPower Highlander Solar, and SoftBank Energy Juno. These projects have a diverse range of offtakers, including blue chip technology companies, utilities, and even traditional fossil fuel companies. Despite a heightened risk of construction delays and equipment supply delays due to the pandemic, these transactions were able to successfully close and fund on schedule, thus showing that in uncertain conditions, the bank market for renewables remains open.

Sponsors also sought to maximize value to investors and lenders through innovative financing structures. One example of such a financing structure is the Back-leverage Acquisition Financing and Equity Margin Loan structure pioneered by Citi and NextEra Energy Partners (NEP) in conjunction with Blackrock in 2018 and KKR in 2019.

This form of hybrid capital enabled NEP to achieve high-content (non-dilutive) rating agency credit, which entailed a concurrent back-leverage project finance loan for BlackRock and KKR (to acquire a portion of a designated renewable energy portfolio developed by NextEra) and a concurrently closed forward margin share loan. This deal was significant in terms of its innovative structure and the value it provided to NextEra, BlackRock, and KKR, resulting in an accretive solution for NextEra and an attractive investment for BlackRock and KKR. This transaction allowed Blackrock and KKR to acquire 1.4 GW and 1.2 GW of wind and solar assets, respectively.

Apart from renewable energy generation, there has also been an increased demand for built infrastructure with sustainable features. One such example is the Climate Pledge Arena in Seattle, which will act as an entertainment hub for the Pacific Northwest. The arena will be the first zero-net carbon certified arena powered by 100% renewable energy, generate zero waste from operations, and will use reclaimed rainwater to create the ice surface for hockey games. Citi acted as Joint Lead Arranger for the $500 million construction loan for the project.

Looking Beyond Traditional Power Purchase Agreements

When renewable projects were first financed in the early 2010s, debt providers only gave credit to contracted revenues under traditional Power Purchasing Agreements (PPAs) in their debt sizing. In light of an exponentially growing pipeline of new renewables projects and increasing scarcity of 'traditional' bus-bar PPAs with utilities, developers have turned to a combination of various offtake strategies to provide revenue certainty and visibility to support (back leverage) term financing. In particular, contracting with corporate counterparties has become more mainstream and new players such as community choice aggregators (CCAs) showed up to the stage. In addition, power hedging has remained prevalent but sponsors could also decide to leave a portion uncontracted. In line with these dynamics, the debt market commenced to provide credit towards these PPAs with corporate or other counterparties (e.g., CCAs), hedged revenues, and to a certain extent, to uncontracted or merchant cash flow streams. Nowadays it is not uncommon for debt providers to participate in transactions with underlying revenue profiles that have merchant 'tails' after offtake contracts expire or even assets that are partially exposed to merchant risk at the outset.

As many companies across various industries adopt more ambitious ESG goals, a key focus is on their procurement of sustainable energy, which has led to a strong uptick in corporate PPAs. These corporate offtake contracts can take various forms: from traditional physical contracts to more 'synthetic' offtake agreements (e.g., fixed-floating financially-settled swaps based at hub-prices). The complexity and sophistication of these contracts has increased over time. For instance, the market lately has seen corporate PPAs structured as contracts for differences based on a weather-adjusted generation proxy. The latter structure allocates curtailment and availability risk to the generator while still keeping the settlement quantity as close to ‘as-generated’ as possible, as the settlement amount is calculated by a third party calculation agent based on a proxy generation quantity determined using actual measured weather, temperature, and other inputs from the project.

Recently, the market has seen a surge in activity around offtake contracts related to data centers belonging to blue-chip technology companies. As these technology companies continue to offer more services and engage more customers, their ever-expanding network of data centers is likely to only increase. Furthermore, considering how COVID-19 has changed the way people are getting work done with a large portion of people opting to work from home on a permanent basis, the demand for cloud-based enterprise services has never been stronger. As more industries continue to digitize and the internet-of-things becomes more widespread with businesses, technology, and industrial processes generating volumes of data never seen before, the buildout of data centers and by extension high quality renewable assets that supply power for their computing demand is anticipated to increase in parallel. Given the increased shareholder demand for these tech companies to enact ESG policies and carbon neutrality roadmaps (for example, Apple and Google pledging to be carbon neutral by 2030), the number of corporate PPAs with renewable assets is expected to grow tremendously in the coming years.

Offtake contracts with CCAs have become more prevalent in particular for projects in California. CCAs are programs local governments can opt into which enable them to procure power on behalf of their residents, businesses, and municipal accounts from an alternate power supplier (usually a renewable power source), while still receiving transmission and distribution service from their existing utility provider.[1] CCAs, as offtakers, generally have increased counterparty risk as they typically lack an investment grade credit rating (but can be shadow rated or provide additional credit enhancements). The key long-term risks for CCAs are related to mass opt-outs potentially as a result of negative press, fee increases, no mandatory long-term agreement legally binding customers to the CCA, and a lack of cost parity with the competing utilities. However, CCAs provide local governments with a higher degree of autonomy to determine their source of electricity, enabling them to meet their environmental and economic goals while simultaneously encouraging job creation in renewable energy.

Recently, some CCAs have received ratings from rating agencies such as Moody's and this trend is only expected to continue. The ability of CCAs to attain formal ratings represents an important milestone, as it demonstrates that there is a proven rating methodology in place and that an unrated CCA can work towards meeting various criteria in order to obtain an investment grade rating.

In addition to the standard assortment of hedging products, there have been several other hedging structures that have become prevalent in the renewables space, particularly in regions with developed renewables markets such as the Electricity Reliability Council of Texas (ERCOT). One of the newer hedging strategies to enter the market is the swap with extension option, which functions similar to a typical bank hedge but with shorter tenor and a one-time exercise extension collar. This product arose in the ERCOT Independent System Operator (ISO) because of steep backwardation, due to the imbalance between term sellers and term buyers in that market. Project sponsors have traditionally expected forward curve prices will be higher; however, banks have started to rely less on the merchant power price assumptions sponsors use and are less likely to give credit to sponsor-supplied forward curves. Hence, this structure has started to become more prevalent and serves as a way to reconcile sponsors' often optimistic forward curve assumptions with what lenders deem to be a sufficiently visible forward cash flow stream.

[1] https://www.epa.gov/greenpower/community-choice-aggregation.

This strategy also gives sponsors insurance against a depressed forward curve and allows them to not be locked into a lower power price. In this strategy, the project sponsor purchases a put and writes a call. In the event that power prices are within expected levels, the put expires and the call is sold to pay off the premium paid on the put. If power prices are lower than expected, then the put is struck and the project's price is hedged.

In the coming years, more battery-storage related hedging strategies are expected to come to the fore. Developers of battery-storage projects are exploring products that allow them to hedge their revenue streams related to wholesale arbitrage, peak-shaving / energy time shift, or for ancillary services (e.g., by buying an around-the-clock swap on responsive reserve services in ERCOT). This trend is expected to continue as battery technology becomes more widespread and ISOs start creating more demand for ancillary services and as renewable power (which has a higher degree of hourly variability) continues to penetrate the power market.

Contrasting Forecasted P-values to Actual Generation

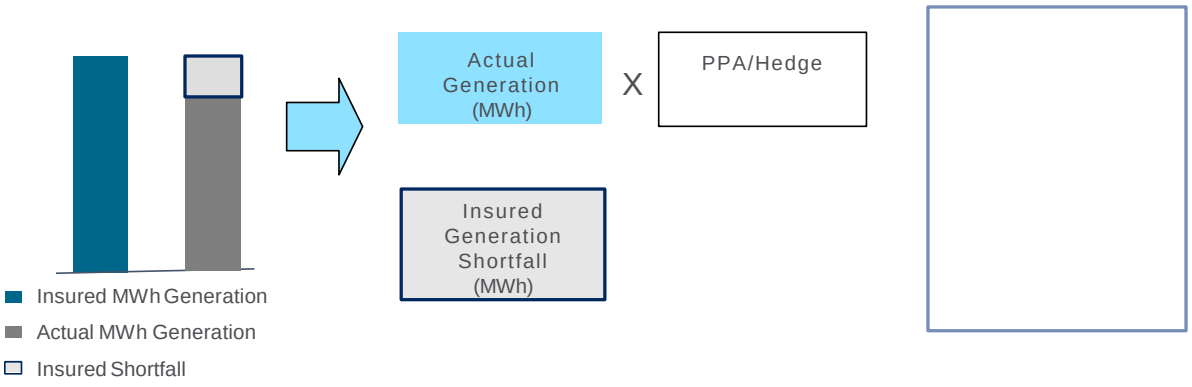
In addition to the forward price visibility PPAs or hedging can provide, the actual generation/production of the asset is another critical variable to ensure the debt service can be met with sufficient cushion. Previously, overestimation of the production forecast was a problem that was only anecdotally noted by lenders and investors. Independent engineers are now remarking that this issue is relatively widespread, in particular across the solar industry. In their recently published "Solar Risk Assessment" report, DNV GL, an assurance and risk management firm that specializes in independent expert advisory services for the renewables industry, noted that most P50 forecasts inherently overestimate production by 3-5%, even after accounting for weather and availability during plant operation.[2] DNV GL noted in their report that this systematic overestimation can be attributed to "optimistic irradiance assumptions, higher-than-expected equipment downtime, and higher-than-expected shading losses".[3]

The use of hedging strategies that apply specifically to production can be one way of improving visibility on the forward cash flows. Hence, production hedging strategies such as solar revenue puts have started to emerge that act as insurance against unpredictable power generation, resulting in tighter target debt service coverage ratios and improved debt capacity. A solar revenue put is a risk mitigation product in which a borrower and an insuring entity enter into an agreement whereby the borrower is compensated via a true-up mechanism for potential lost revenue resulting from sub-optimal generation / plant performance (below a certain pre-agreed threshold). The revenue put covers a wide range of causes for revenue loss, and the sponsor does not have to demonstrate the cause of loss when they file a claim for compensation, as the insuring entity has access to on-site production data as part of the agreement with the borrower. The insuring entity is paid an upfront (and ongoing) fee and the borrower is reimbursed a certain portion of revenues from the generation shortfall up to a specific limit. Solar revenue puts give can give investors and lenders additional comfort during the due diligence process that any lost revenues stemming from reduced production are recuperated. One such transaction recently closed that utilized a solar revenue put was Clearway's Utah Solar, a $296 million financing for a portfolio of seven solar projects.

[2] https://www.projectfinance.law/publications/2020/october/overestimation-of-solar-output/.

[3] https://www.dnvgl.com/publications/solar-risk-assessment-2020-177892.

Figure 5. Solar Revenue Put (SRP) Structure Example



Source: Citi Project & Infrastructure Finance

3. Green Venture Capital and Impact Investing

Impact Investing Group

Bruce Schlein

Citi Ventures

Alex Z Chen

One of the interesting debates amongst the myriad of stakeholders working on climate change, a proxy for many of the other meta-environmental issues the planet faces, is whether or not the technology and tools currently exist to reduce carbon emissions and meet targets on a timetable that avoids an increase in global warming beyond 2 or even 1.5 degrees Celsius, and the higher severity and intensity of storms, wildfires and other related consequences the planet is experiencing in real time.

The debate centers around the notion of urgency to act, and the need to make either/or decisions with respect to the allocation of resources to, in simplified terms, the deployment of existing solutions or the development of new ones. Does chasing new solutions divert attention and resources from immediate mitigation; mitigation that can't wait for new?

The reality is not so binary. Many emerging solutions are a combination of both; the application of newly available and lower cost sensors, controls, data and analytics, and artificial intelligence to optimize and augment the performance of existing hardware.

As with any large issue, there are credible and compelling voices on both sides, or that fall on a continuum in-between, with, as leading representative examples, Generate Capital more oriented towards new deployment and Breakthrough Energy Ventures more oriented to new technology. This dynamic is also reflected in public discourse, with several media sources coming out with views and opinion pieces over the last decade.

- The Innovation Vs. Deployment Debate in Energy: How Did It Get So Heated?, Green Tech Media, December, 2015. https://www.greentechmedia.com/articles/read/revisiting-the-innovation-versus-deployment-debate-where-did-it-come-from
- Clean Energy Innovation: An Important Piece of the Climate Puzzle, Environmental Defense Fund, June 2019. http://blogs.edf.org/climate411/2019/06/19/clean-energy-innovation-an-important-piece-of-the-climate-puzzle/
- Why relying on new technology won't save the planet, Science Daily, April, 2020 https://www.sciencedaily.com/releases/2020/04/200420125510.htm
- Can Technology Really Save Us from Climate Change?, Harvard Business Review, January-February, 2010 https://hbr.org/2010/01/can-technology-really-save-us-from-climate-change

The Citi Impact Fund, a recently launched impact investing platform, comes out somewhere in-between; an "everything on the table" perspective, recognizing that startups with new solutions and business models, and therefore venture capital, will continue to be essential in addressing not only mitigation of carbon emissions, but also adaptation and resilience to adverse impacts.

The effects of climate change have become more apparent over the last several years. Extreme weather conditions have led to devastating fires in California and Australia, and destructive hurricanes in Puerto Rico and the Bahamas. The United Nations has called Climate Change "*the defining issue of our time"* and noted that *"without drastic action today, adapting to these impacts in the future will be more difficult and costly*"; there is a pressing need to develop and deploy solutions quickly. Startups and, in turn, venture capital are needed to develop the scalable solutions that balance deployment and innovation. But the solutions do not come only from alternatives to fossil fuels. Many of the greatest needs reside in how we drive and incentivize sustainable behavioral charges in consumers and enterprises.[4]

Technological and infrastructural advances from the first Cleantech wave have created ecosystems that enable scale. PWC notes that these advances "*have shifted the cost curve down and are enabling solutions to be optimized and scaled* ". Net metering and connected home devices are providing consumers and utilities not only more information about energy usage, but also more control in minimizing consumption. The boom of the residential solar market has created a supply of distributed energy systems that can be leveraged for grid-wide impact. These ecosystems can enable quickly deployable, scalable solutions needed to address our climate challenges. The Citi Impact Fund believes that venture capital is key to enabling the innovation ecosystem that can deliver these solutions.

Equity, Inclusion, and Diversity

With respect to the populations leading and participating in the market of climate solutions, everything is not on the table. From entrepreneurs to workforces to customers, women, and to a greater extent, minorities are dramatically underrepresented across the board. The same is true for economically disadvantaged and vulnerable populations. The result is an overall loss to the system; a loss of perspectives, ideas, approaches, experiences, and doing what is just and right; all necessary for developing and bringing a full set of solutions to a global population that is defined by diversity. Many data points reinforce this imbalance:

- "Only 1 percent of venture capital dollars went to black start-up founders in 2018, according to a study conducted by Silicon Valley Bank and others. The number of black decision-makers in venture capital in 2018 dropped to 1 percent — representing just seven black people at the 102 largest venture capital firms in the United States, according to an annual survey by the Information, a tech-news outlet."

  [https://www.washingtonpost.com/technology/2020/06/10/racial-gap-vc-firms/]

- And in the United Kingdom, "across the past 10 years, under 1% of venture capital investment went to Black entrepreneurs — and only one Black female founder secured Series A funding."

  [https://sifted.eu/articles/black-entrepreneurs-vc-funding/]

- "People of color account for more than a third of the U.S. population, but in 2014 made up less than 16 percent of the staff of environmental organizations." And in the clean-energy industry, "while 13 percent of Americans identify as Black, less than 10 percent of America's clean-energy jobs are held by Black workers. In the solar sector, the share is close to 7 percent — roughly the same as the oil and gas industry we so regularly chastise. The number of women in the clean-energy workforce, meanwhile, remains less than 20 percent."

  [https://energynews.us/2020/10/12/national/commentary-a-call-to-action-on-race-and-equity-in-the-clean-energy-industry/]

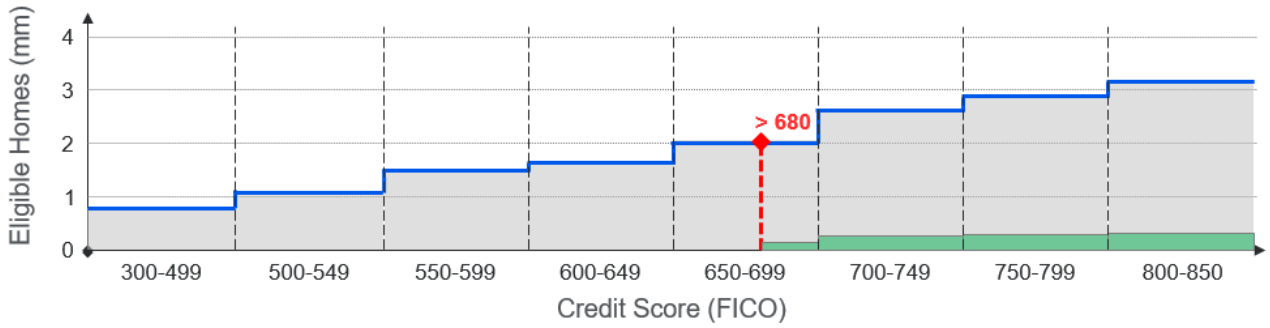
[4] PWC – "The State of Climate Tech 2020"

- The addressable market for single family residential solar PV in the United States is approximately 80 million homes. To date about 3 million homes have solar, the financing of which relies on consumer credit underwriting with 650 FICO being the low end of the credit spectrum excluding roughly 50% of the market. (See Figure 6)
- "According to a report by digitalundivided's Project Diane, firms started by Black women received only .06% of venture capital (VC) funding raised by startups between 2009 and 2017." – Kauffmann Foundation (2019)
- "Just 1% of venture-funded startup founders are Black, according the Crunchbase startup database." – VentureBeat (2020), also cited by BLCK VC

- "According to incubator and research center DigitalUndivided's ProjectDiane and ProjectDiane:Latinx studies, two demographic studies of startup founders, businesses with women of color CEOs get less than 1 percent of all VC funding every year. Of all VC funding over the past decade, Latinx women-led startups have raised only 0.32 percent while black women have raised only .0006 percent."-Girlboss

This fact set is a critical one that the Citi Impact Fund is working to remedy by both prioritizing women and minority entrepreneurs, and companies with products and services that focus on underserved populations.

Figure 6. Addressable Market for Single Family Residential PV, by credit score



Source: Citi Impact Investing Group

Citi Impact Fund

The Citi Impact Fund was launched in January 2020 to complement the corporate functions dedicated to community development and sustainability. The $200 million Impact Investment Fund utilizes Citi's own capital to make equity investments in "double bottom line" U.S.-based private sector companies that are applying innovative solutions to help address some of society's most pressing challenges. We believe we can build a financially attractive portfolio while investing in companies creating clear positive impacts. The Fund plans to expand incrementally into markets outside of the United States.

I**nvestments, which could be as high as $10 million, will primarily be made in companies that have demonstrated proof of concept, built an existing customer base, secured prior rounds of funding and exhibited the potential for scale in multiple markets.** A portion of the fund is designated for earlier stage seed investments, which range from $250,000 to $1 million. With respect to all solutions on the table, the Fund actively seeks opportunities to invest in businesses that are led or owned by women and minority entrepreneurs to help combat the gender and ethnic gap that exists in the startup world. As part of this commitment, all early stage seed investments must be allocated exclusively to businesses that are led or owned by women and minorities.

Two of the Fund's four investment verticals are directly related to climate: Sustainability and Physical and Social Infrastructure. The remaining two, Workforce Development and Financial Inclusion, also have connectivity.

Key factors

A number of key factors are important to effectively addressing climate change, two of which have been previously discussed, and will be further elaborated below.

- **Equity, Inclusion and Diversity:** For all of the abovementioned reasons, this tops our list. But climate change offers yet one more critical reason: mitigating climate change is analogous to mitigating a pandemic. As with a pandemic, the problem only gets solved with nearly full participation. The vast majority of the population needs to be vaccinated; to become immune so as not to further spread the disease in an endless cycle. Carbon is a global, fungible pollutant. Not only must all solutions be on the table, but the entire population has to be able to participate; to pursue low-carbon lives and livelihoods. This requires products, services and business models that serve everyone, especially the underserved.

- **Existing and New:** In addition to the importance of the concept of everything on the table, existing and new also relates to combinations of existing and new technologies or business models. One trend we are seeing is hybrid businesses that combine data/AI/sensors/controls and hardware in new ways, such that the former transforms and optimizes the latter's performance and utilizes hardware in ways previously not possible. This trend is captured in an article in Bloomberg, Is Climate Tech Different Enough From the Cleantech of Old?, which notes that, "the vastly reduced cost of networking and the vastly increased number of connected devices with vastly improved computational capabilities is new", providing "this generation of climate tech entrepreneurs has a vastly improved system to attach itself to".

- **Adaptation and Resilience:** Empirical data show the planet is warming, and that a certain amount of climate change is already baked in, with indications of correlations to negative weather and ecosystem consequences. These events disproportionately impact under-represented and vulnerable communities. We pursue companies that develop adaptation and resilience solutions for these populations because it is essential and supports the causes of environmental justice and equity. Optimum opportunities will be companies with solutions that address both climate mitigation and adaptation.

- **Break the Glass:** The current trajectory of the increased prominence of ESG, new ambitious corporate goals to reduce carbon emissions, and continuous growth in the deployment of solar, wind, efficiency, and more recently storage, while positive, appears to happening in parallel with growing adverse consequences of a warming climate. Disaster insurance payouts have nearly doubled decade over decade, with $19 billion/year average 2001-2010, $31 billion/year average 2011-2020 ($105bn in 2017). In 2020, we have experienced unprecedented scale of wildfires, and the largest number of named storms in a single year ever in the western hemisphere. What happens if the volume and severity of such events increase? What solutions and companies will be best-positioned to scale dramatically in the event of "break the glass" moments for both mitigation and adaptation, and a need to move more rapidly?

Portfolio and Leading Companies

Of the six investments made by the Citi Impact Fund to date, four have products and services related to climate mitigation and adaptations, and dozens of other companies we have looked at provide for helpful insights into how startups are utilizing venture capital to address climate change. A select group of portfolio and leading companies follows below.

- **ICON (portfolio; resilience):** 3D-printed cement homes that are more resilient than traditional construction methods to storm winds and flooding. ICON is a leading 3D printing construction technology company, formed to address the global housing crisis. ICON has created a patented 3D printing model based on two major innovations — a 3D printer that prints large amounts very quickly, and of equal importance, a "Lavacrete" concrete formula. The Lavacrete, which is the main building ingredient for the 3D homes, begins in liquid form in order to mold it into the necessary shape, before quickly hardening in order to build a sturdy, efficient structure.

- **Fulcrum (portfolio, mitigation):** low carbon transportation fuel produced from municipal solid waste, reducing carbon emission as a substitute for fossil fuels, and diverting waste, and subsequent methane emissions, from landfills. Fulcrum designs, develops, owns and operates large-scale plants that convert municipal solid waste to a low-carbon syncrude biofuel, certified for refiner and wholesaler compliance with federal and state renewable and low-carbon fuel standards.

- **PadSplit (portfolio; adaptation):** co-living housing converted from single-family homes to accommodate tenants seeking lower rents, and potentially migration flows that could be caused by climate change-related events. PadSplit is a co-living technology and property management platform that provides flexible, affordable rentals to low- and moderate-income tenants. The company works with real estate investors to convert single-family and multi-family properties to increase occupancy (e.g., by converting a dining room or living room to an additional bedroom).

- **Ketos (portfolio, mitigation):** software and hardware-enabled tools and insights that optimize water usage, ensure resource sustainability and provide water safety assurance. Saved water is saved energy given energy required to move water. Ketos delivers integrated, cloud-based, Internet-of-Things (IoT) solutions for actionable water intelligence that is affordable and accessible. Ketos serves industrial and agricultural enterprises, commercial businesses, institutions, cities and utilities, empowering them to make smarter decisions through real-time water intelligence and predictive analytics.

- **OhmConnect (mitigation):** demand reduction from pools of households that in the aggregate are a substitute for fossil fuel-based peaker plants. OhmConnect ("Ohm") is an energy demand reduction (DR) company that helps regulators reduce the use of expensive peak power capacity in times of critical need. Utilizing a gamified platform and a network of IoT controlled appliances in user homes, OhmConnect pays users to reduce their energy usage and sells the "negative energy" to the grid through the creation of "virtual power plants" (VPP): the automated aggregation and coordination of thousands of households that sign-up to participate in periodic reductions of energy use.

- **PosiGen (mitigation and resilience):** single-family residential solar and energy efficiency that reduces energy use and improves resiliency. PosiGen provides solar and energy efficiency improvements to single-family homes with a focus on serving the low and moderate income (LMI) market. By combining a solar lease with energy efficiency, and by utilizing a "minimum cost-savings" alternative to traditional FICO-based underwriting to qualify customers, and community-based marketing to reach this underserved market segment, the company offers significant energy savings to families that would not have access to clean energy without PosiGen. PosiGen understands its customers' needs, since 61% of its employees come from the communities that it serves.

- **Thrilling (mitigation):** online platform for clothing recycling and reuse, which

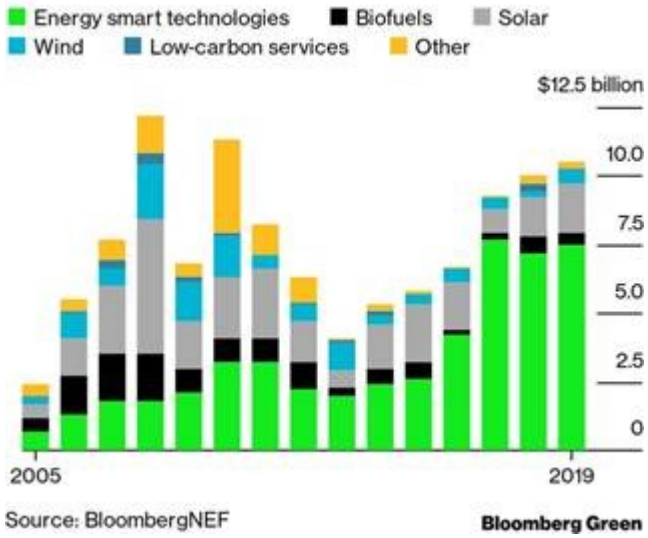
  marketplace dedicated to vintage clothing. The platform curates vintage and secondhand items from the best boutiques across the United States, helping the boutiques to sell and ship directly from the boutique itself and thereby providing stores with the ability to maintain their local presence and expand into the global marketplace. Thrilling enables the joy of finding one of a kind items, supports small, local businesses — the economic and cultural backbone of our communities and neighborhoods, and embodies sustainability and the circular economy as "reuse" is the most environmentally-friendly way to shop.

- **Natel Energy (mitigation and resilience):** fish-friendly distributed hydropower that can restore ecosystems and have less adverse impacts than large hydro. Natel Energy is an end-to-end solutions provider for modern, distributed hydropower; a more environmentally-friendly and resilient form of hydro compared to traditional large scale hydro. Natel's upstream tech includes digital solutions for water resource and environmental decision making powered by satellite data and artificial intelligence (AI). The tech is complemented by the company's hardware; their patented restoration hydro turbine (RHT), which is compact, fish-safe, high efficiency, and can deliver significant savings on installed cost. Natel's solutions are positioned to unlock approximately 65 gigawatts (GW) of untapped hydro potential.

ClimateTech

Citi joins a growing and diverse group of investors working in 'ClimateTech', the venture community's successor to CleanTech, including Acumen, Soros, and Blackstone, among many others. According to PWC's The State of Climate Tech, and cited in TechCrunch, "VC and corporate investment into climate tech grew at a faster rate than overall VC investment as a whole between 2013 and 2019 — to the tune of $60 billion of early-stage capital." And in the chart below, Bloomberg New Energy Finance shows the trajectory overt the past 15 years from a focus on hardware (e.g., solar and wind) to a combination of hardware and "energy smart technologies". Exits are a combination of acquisitions by strategics, including traditional energy companies seeking to diversity and transition, IPOs, and SPACs.

Figure 7. Climate Finance Trends



Source: BNEF

Conclusion

With the continued and significant deployment of capital into ESG and green, in the form of green bonds, green loans, and structured finance, the role of venture capital in standing up new solutions and business models for addressing climate change is essential. The abovementioned companies and hundreds more like them have the potential to deliver profitable solutions necessary for climate mitigation and adaptation. That potential is predicated on the market getting access to ideas and solutions from a diverse set of entrepreneurs serving equally diverse populations, optimizing the mix of existing and new, and blends of the two, and companies that can effectively respond to 'break the glass' plans in the increasingly likely case they will be needed

4. Efficiency as a Service: Taking Pages from the Oil & Gas Playbook

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A 2018 International Energy Agency (IEA) report describes energy efficiency ("efficiency") as "indispensable to achieving global climate targets" and "capable of delivering 40% of the abatement required to be in line with the Paris Agreement". Despite this and many other prominent characterizations of the climate mitigation potential of efficiency, this critical resource continues to be the neglected stepchild of climate change solutions. There are many explanations as to why this is the case; why the efficiency opportunity is not fully realized. Efficiency measures are said to be too small, too fragmented by technology and underlying property type and ownership, too boring compared to shiny new renewable infrastructure. All of these explanations are correct to varying degrees; all are surmountable.

Consistent with the IEA statements are studies that show the efficiency investment opportunity in the aggregate is enormous. In its 2009 report, "Unlocking Energy Efficiency in the US Economy" McKinsey cites "gross energy savings worth more than $1.2 trillion (a 23% reduction), well above the $520 billion needed through 2020 for upfront investment in efficiency measures. The report also notes that this requires "execution at scale" and "a holistic approach", and that, "significant and persistent barriers will need to be addressed at multiple levels to stimulate demand for energy efficiency and manage its delivery across more than 100 million buildings and literally billions of devices".

This is not a hardware challenge. Walk around any large U.S. city on a cold day, and one can observe windows wide open in older multifamily apartment buildings because the units are over-heated and their occupants are hot. The reason? These buildings have a single, monolithic boiler and heating system, with one thermostat; a system incapable of distributing heat evenly. These flaws are easily remedied with simple plumbing changes, valves, and controls. This recurring example, and the solutions, is a proxy for hundreds of use cases, and each use case with millions or billions of iterations globally.

While there are no silver bullets, there are solutions that combine existing and improved hardware together with software and analytics, and most importantly, business and deployment models, either new or derived from other sectors. And most importantly, solutions that work together with and complement the 60% balance of renewables and other abatement measures.

Standardization and Aggregation

An obvious starting point when confronted with fragmented markets and high volumes of small opportunities is standardization and aggregation. The efficiency market follows the 80/20 rule with respect to standardization. Approximately 80% of the opportunity can be addressed with 20% of available improvement measures: lighting, building management systems, heating, ventilation and air conditioning (HVAC), optimization software, and envelope (windows and doors, insulation, etc.). Some of these measures are becoming more commoditized similar to solar panels (e.g., lighting), but others have attributes that are bespoke and more specific to a building and context.

Aggregation benefits from standardization, however, it is a unique challenge for efficiency given the fragmentation and complexity of the deployment 'playing field': the built environment, which is comprised of a wide variety of variables including building types, construction methodologies, property ownership structure, sizes, and vintages.

The need for increased standardization and aggregation is a significant driver for the development of new or adapted business and deployment models. For this we look to another industry in the energy sector: oil and gas.

A Page from Oil and Gas's Playbook

Efficiency is predominantly developed and delivered by energy services companies (ESCO), such as Johnson Controls, Honeywell, Schneider Electric and Siemens, as well as smaller, specialized companies. They engage with property owners or tenants to realize efficiencies and savings through contracts for improvement measures and corresponding loans or leases. In the aforementioned heating example, the property owner would seek out an ESCO to evaluate the existing system and recommend upgrades. The owner then enters into an energy performance contract (EPC) with an ESCO, which develops a solution, guarantees a minimum level of performance, and seeks to structure payments in accordance with the savings derived from reduced operating expenses.

This is the opposite of how the oil and gas industry operates where a property owner outsources the opportunity and receives royalties, all without any outlay of capital. The owner, typically a sovereign, auctions off rights to production blocks for oil and gas companies to use their capital and expertise to explore and produce hydrocarbons. Yet the core function of both industries is identical; to develop energy resources. Two provisions are needed to enable the efficiency sector to take a page or two from the oil and gas sector playbook.

Explore and Produce

First, the efficiency sector requires market and business models that allow for the sector to operate as 'explorers and producers' of efficiency resources. ESCOs and specialized technical firms have the engineering expertise, enhanced by software, big data, and artificial intelligence to more effectively and expediently discover efficiency resources. Similar to how oil and gas geologists and engineers understand geologic formations and employ technology to look below the surface and pinpoint the most promising deposits, efficiency engineers are capable of doing the same with the built environment.

Such capabilities need to be coupled with the sufficient incentives; operating structures that motivate and reward efficiency explorers and producers, and the property owners akin to how oil and gas revenues and royalties respectively flow to the explorers and producers, and owners of hydrocarbon resources. The second key provision is market models that facilitate access to efficiency blocks

Efficiency Blocks

Similar to how the oil and gas sector is set up to explore and produce hydrocarbons from blocks — large, contiguous geographic areas, the efficiency sector needs its own version of exploration and production blocks. This is perhaps the key to unlocking the efficiency sector at scale; not just the blocks, but also the supporting ecosystem of market actors, contracts and norms.

Ironically, actual blocks do exist in the built environment — city and town blocks that are comprised of dozens or hundreds of buildings. But unlike oil and gas blocks, blocks in the built environment are typically not owned or controlled by a single entity. Efficiency blocks need to employ organizing principles of portfolios of properties that are not necessarily contiguous. The simplest version is a single owner-operator: large public and private institutions. But this version leaves out large swaths of the built environment. Derivatives are needed that consider the relationships and sphere of influence of large institutions to portfolios of properties that they do not own or control. Examples include supply chains, franchisees, managed properties, and portfolio companies and assets.

In the parlance of greenhouse gas (GHG) emissions, these types of properties comprise Scope 3 Emissions for the associated institutions; emissions that are the result of activities from assets not owned or controlled by the institution, but that the institution indirectly impacts in its value chain.

Efficiency as a Service

Efficiency as a Service (EaaS) is the product Citi, out of the Asset Finance Group, employs with its institutional clients to help them meet their environmental goals, and to help the market advance the concepts of efficiency explorers and producers and efficiency blocks. EaaS is a third-party model that outsources the development, ownership and operations of efficiency assets, and is similar to the more ubiquitous Power Purchase Agreement (PPA) employed with renewables and other generating assets.

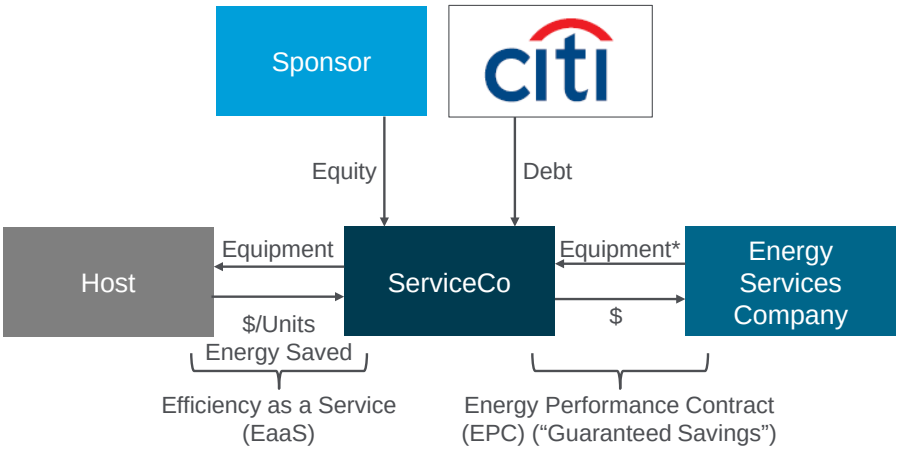
Efficiency as a Service

Efficiency as a Service (EaaS) is another name for the Energy Services Agreements (ESA) or Efficiency Services Agreement (ESA); the change away from “energy” driven by EaaS applicability to other resources such as water and waste. Navigant Research (Guidehouse) combines distributed generation with efficiency in its Energy as a Service Overview and cites, “the annual global market for the deployment of commercial and industrial (C&I) Energy as a Service is expected to reach $278 billion by 2028.

For the company where the efficiency measures are implemented (the “host”), EaaS requires no upfront capital expenditure, is off balance sheet, and is a pay for performance contract (the host pays only for demonstrated resources saved, and therefore does not take any performance risk). In practice, this means that the host can pursue comprehensive, programmatic rollouts in accordance with what are increasingly ambitious goals amongst corporates, without any expenditures or balance sheet impacts. They are, in essence, opening up their facilities to third party explorers and producers.

Structurally there are four parties in EaaS, led by a Sponsor that establishes, and injects equity into, a special purpose vehicle (SPV) that owns, operates and maintains the assets. The Sponsor is also the originator of the two contracts: one with an ESCO to perform the work as it normally does under an EPC, and the second, a services agreement with the host that looks like a utility bill charging for units of resource saved at a discount to the price paid to the utility for that same resource.

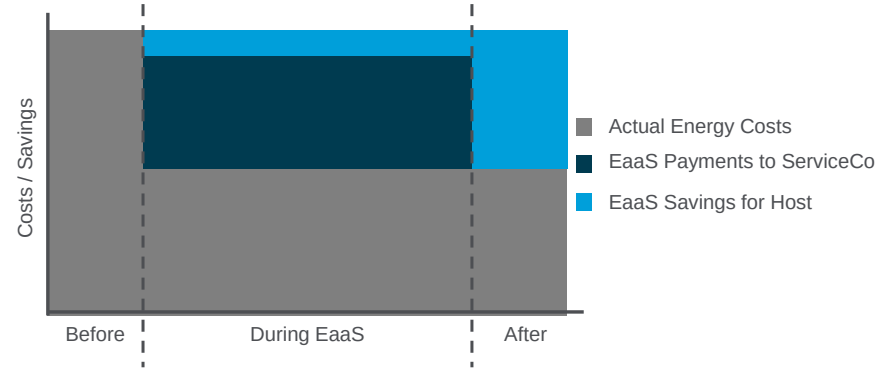
Figure 8. Efficiency as a Service Structure



Source: Citi

Take as an illustrative example a distribution facility that utilizes 100 units of energy/month for lighting, for which the utility charges $1/unit. Pre-EaaS, the host pays $100 to the utility (medium blue). Once new lighting is installed under an EaaS contract, energy use is reduced, on average, 20 units of energy/month, resulting in a utility bill of $80/month and an EaaS bill of $18/month (dark blue). The net result: new equipment with no outlay of capital expenditure, immediate operating expense savings (light blue), and responsibility for operations and maintenance passed to a third party. At the end of the EaaS, the full savings accrue to the host.

Figure 9. Stylized Schematic of EaaS Cost Savings and Distribution to ServiceCo and Host



Source: Citi

There is broad applicability of EaaS across sectors, including retail, logistics, higher education, and industrial, and both public and private. Sectors with a high degree of standardization are more conducive to scale, however, EaaS can also work with more bespoke applications such as industrial process changes. With respect to geography, EMEA is at the fore due largely to more progressive regulations with North America and Asia Pacific following closely. Institutions with global footprints have the opportunity to blend measures and sites, and pursue Scope 3 emissions that are often found in emerging markets. Both are discussed below.

Several attributes of the EaaS, and strategies and features Citi has been developing and refining to help scale and accelerate the market, and the economic, environmental and societal benefits of impactful energy efficiency upgrades, are described below.

Programmatic Approach

As already discussed, the efficiency market in the aggregate is huge, but comes in different shapes and sizes, including small pilots and global programmatic rollouts. We recognize the importance of meeting clients where they are, and putting in place the building blocks that can help them to scale to meet evolving corporate and regulatory requirements. In practice, this means we can both start with small projects (e.g., $5-10m) and roll-out in similarly sized incremental tranches. This is important from a capital-efficiency perspective for large programmatic rollouts that can take several years to implement. In terms of working programmatically, a Master Services Agreement (MSA) is established that governs project-specific contracts that specify baseline energy usage, improvement measures, expected savings, and a monitoring and verification protocol.

Resource Agnostic

To date, most EaaS transactions in the market have been focused on energy savings, however, the structure is applicable to any improvement that reduces operating expense sufficiently to cover the costs of the measures over a roughly 3 to 10 year term. Improvements that reduce water use, or waste can also utilize the structure. Some projects combine resources. For example, a manufacturer with organic waste coming off a production line could use EaaS to finance a bio-digester and combine the economics of the energy generated with the stipulated savings from avoided carting and landfilling of waste.

Blending Technologies and Sites

One of the enduring challenges with efficiency is the pursuit of a 'low hanging fruit' or improvement measures with the fastest paybacks. This approach, while practical for finance teams, handicaps operations teams that must pursue deeper, longer payback measures for which there may not be appetite for the corresponding contract term. The incremental rollout of EaaS allows for the formation of tranches that can blend both technologies and sites. For technologies, this amounts to combining lighting and building management systems (short payback) with HVAC or combined heat and power (CHP) (long payback). For sites, weather and utility rates can affect payback periods and so sites can be combined to achieve optimum term.

Leased Properties

Tenants that pay utility bills in properties they lease may be interested in EaaS as a solution to reduce operating expenses and achieve environmental goals, however, third-party ownership of improvement measures (fixtures in properties), and rights to recover assets in the event of a default, can present hurdles with landlords. Citi has worked with its partners to develop a landlord consent process helping landlords get comfortable with the EaaS construct, including the beneficial notion that the landlord is getting cost-free upgrades to their facilities.

Scope 3 Emissions

What about harder to do properties; properties that may not have access to EaaS or other solutions due to factors such as insufficient credit quality? This is a critical question for efficiency doing its part in meeting global emission reduction targets, which requires extensive market participation.

To reach a larger set of properties with EaaS, Citi developed a derivative product that helps institutions tackle Scope 3 emissions. Scope 3 emissions, as defined by the U.S. Environmental Protection Agency, are the result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly impacts in its value chain. Multiple iterations of such relationship are applicable, including for supply chains, franchisees, managed properties, portfolio companies, among others. Leveraging the knowledge and influence embedded in these relationships is key to unlocking harder-to-do properties.

Technology-Enabled

While realizing the full potential of efficiency is not fundamentally a hardware challenge, the ability to do is increasingly enabled by data, predictive analytics, and sensors for monitoring and verification (M&V). Leading companies are developing solutions that standardize audits, recommended measures and M&V; the latter in particular has the potential to augment capital markets activity. Each EaaS contract includes a baseline of existing energy use, and an M&V protocol for demonstrating savings. Standardizing M&V could enable market participation by a smaller equity players and ESCOs, allowing them to sell EaaS assets to banks for securitization, and expand their activity.

Conclusion

For many of the same reasons that efficiency is challenging to execute at scale, it is challenging to assess progress and determine targets in the aggregate with any precision. Two leading think tanks estimate the efficiency gap is approximately 2-3x existing activity. Rocky Mountain Institute's Seven Challenges for Energy Transformation, states, "to achieve well-below 2°C in the most cost-effective way, we need to globally triple the pace of improving energy productivity in the next decade relative to the last few years." One of the metrics World Resources Institute's (WRI) State of Climate Action: Assessing Progress toward 2030 and 2050 looks at is the renovation rate of buildings, which currently stands at about 1-2 percent per year. According to the report, "the share of the world's buildings that is renovated each year needs to rise to 2.5–3.5 percent in 2030 and 3.5 percent in 2040".

A doubling or tripling of efficiency activity requires step change. The growing collection of ambitious, science-based climate targets from the Fortune 500 and beyond is a strong indication that portions of the market are working to align their goals with what is needed. Similarly, emerging build performance standards, such as those established by New York City's (NYC) 2019 Climate Mobilization Act (CMA), will drive activity, and the adoption of new strategies and solutions. It is estimated that 20% of NYC's building stock that is regulated under CMA (buildings over 25,000 square foot.) will not meet the 2024 standard, and 80% will not meet the 2030 standard.

These figures reflect a significant volume of efficiency to explore and produce, for which the turnkey solution and beneficial accounting treatment of EaaS is well-positioned to meet.

5. Export Credit Agencies, Multilateral Institutions, and Development Finance Institutions

Export Agency Finance, TTS

Jenna Barzelay

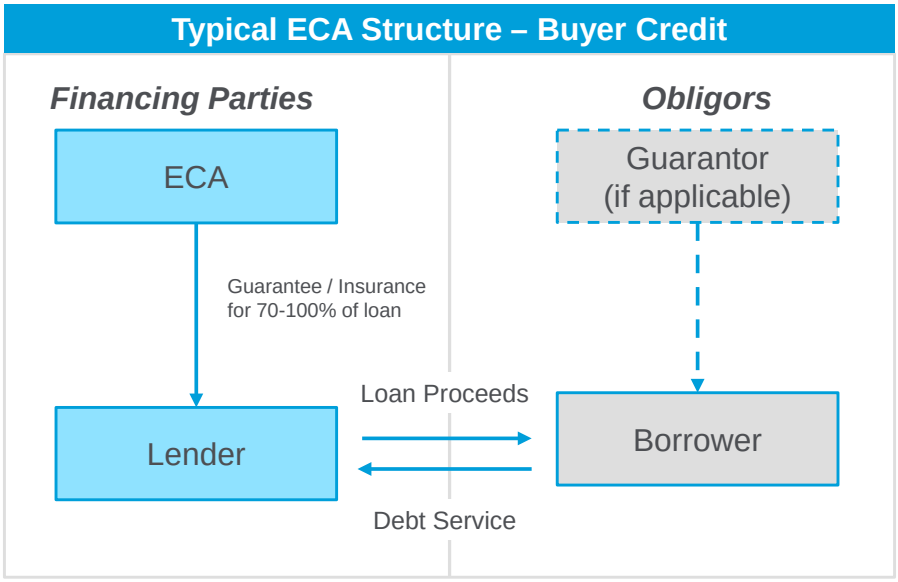
Amanda Helfrich

Darshan Mankad

Kelly Wess

While largely following the key markets for their respective exporters, Export Credit Agencies (ECAs) continue to be an important long-term source of financing (especially in emerging and developing markets), and thus are expected to play an important role in supporting economies in their efforts to transition towards more 'green' financing. In 2018-2019, ECAs supported, in aggregate, an investment of $26 billion in renewable energy projects and continued to collaborate with their banking partners to increase their support in this space. In furtherance of this goal, the International Chamber of Commerce Global Export Finance Sustainability Working Group (ICC SWG) together with the Rockefeller Foundation, commissioned International Financial Consulting Ltd. and Acre Impact Capital to develop a White Paper to review the state of sustainable finance across the export finance industry and recommend both product and policy changes to increase the flow of export financing towards sustainable activity. This paper is due summer 2021.

Figure 10. Typical Export Credit Agency Structure



Source: Citi Export Agency Finance

Export Credit Agencies share a tri-fold mandate: (1) promote domestic exports via insurance products or direct lending; (2) further the policies of their sovereign governments; and (3) seek a level playing field via the Organization for Economic Co-operation and Development (OECD) Consensus. The OECD consensus, which is designed to ensure ECAs abide by coordinated standards, constrains the terms of the support its member ECAs can provide. At the same time, government policies often influence ECA support capacity to certain industries and technologies in line with the national interest of the country. The green financing space has a substantial amount of new sand emerging technologies which impacts credit appetite for these technologies.

However, the OECD in recent years amended their Arrangement and Sector Understanding to drive ECAs to provide enhanced support for 'green-er' projects and encourage a move away from projects with a high risk of harm to the environment. Most notably, the Coal-Fired Electricity Generation Sector Understanding (CFSU) implemented in 2016 provides stricter terms and conditions for the provision of officially supported export credits relating to coal-fired electricity generation projects. The change incentivizes both exporters and buyers of coal-fired power plants to pursue high-efficiency technologies by introducing minimum standards.

Export Credit Agencies Work Towards Sustainable Development

Most European ECAs will no longer finance coal plants. For example, there has been recent press that United Kingdom Export Finance (UKEF), the U.K.'s ECA, has plans to end support of overseas fossil fuel projects in the near future as this is viewed as contrary to U.K.'s emissions targets.

UKEF supported its first offshore wind farm in 2019 creating 376 megawatts of green energy. In addition, UKEF recently published its 2020-2024 business plan which specifies their support for a low carbon economy and sustainable development and participation in the UK's Green Finance Strategy including the development of 40 GW of U.K. offshore wind by 2030. This commitment is evidenced in their allocation of £2 billion (25% of direct lending capacity) to clean energy projects and their relaxation of content requirements: UKEF will accept a relatively lower percentage of U.K. content while still allowing the project to benefit from its cover.

Denmark has a long history of commitment to renewable energy and has numerous renewable energy suppliers, most notably Vestas. As such, Eksport Kredit Fonden (EKF) is one of the more established export credit agencies in the green energy space. EKF financed the most sustainable energy of all OECD ECAs in 2017 and 2018. Since EKF's first wind transaction in 1998, they have supported Vestas turbine technology exports resulting in over 22 GW of wind energy over the years including the Hywind project, where Citi had a lead role. Most recently, EKF was allocated DKK 14 billion (~$ 2.2 billion) by Denmark's "Grønne Fremtidsfond" (Denmark's Green Future Fund) to further the promotion of green energy exporters with the ultimate goal of facilitating global decarbonization. EKF's efforts have encouraged other ECAs, including GIEK (Norway's ECA), to support its green exporters on similar terms, and is able to participate in North Sea floating wind farm projects.

The Export-Import Bank of the United States (US EXIM) provides financing incentives for very low to zero carbon dioxide-emitting renewable energy exports by increasing the resources devoted to promotion, marketing, and execution of such financings. US EXIM is currently launching a $250 million facility dedicated to renewable energy and is committed to financing support for evolving technologies that reduce carbon emissions in the production of energy. John Kerry, the new climate envoy announced January 27, 2021 a commitment for the U.S. to cut fossil fuel funding for overseas projects.

Looking to the Asia-Pacific (APAC), both Japan Bank for International Cooperation (JBIC) and Nippon Export Investment Insurance (NEXI), the two principal ECAs of Japan, launched sustainability programs over the past 2-3 years. JBIC created a global facility to promote quality infrastructure investment for environmental preservation and sustainable growth. They provide a wide range of financing support for infrastructure development expected to help to preserve the global environment. NEXI launched a program entitled "Loan Insurance for Green Innovation" which increased the commercial risk coverage rate to 97.5% for sustainable energy and environmental protection projects, as compared to its usual loan insurance rate of 95%.

In support of global decarbonization, the Korean ECAs — The Import Export Bank of Korea (KEXIM) and Korea Trade Insurance Corporation (K-Sure) — are creating a support program for the electric vehicle battery industry which will benefit large domestic companies. Through these programs, they provide financing support to large original equipment manufacturers that in turn invest in capital expenditure investments for electric vehicles.

Sinosure, one of China's ECAs, recently showed critical support for environmental and green finance projects by adjusting restrictions in its underwriting processes and eligibility criteria.

Development Finance Institutions (DFIs) and Multilaterals Agencies (MLAs)

DFIs and MLAs have specific missions to promote sustainable economic growth in emerging markets. Due to their national or member country mandates, they often support investment in the renewable space.

The U.S. International Development Finance Corporation (DFC) recently announced their 2020-2025 inaugural "Roadmap for Impact". This roadmap is a five-year strategic plan that aims to use $75 billion to maximize development impact while creating strategic and sustainable growth. Within the roadmap there is a specific focus on energy security and diversification. The DFC Roadmap will assist other countries overcome challenges in emerging energy markets and speed the transition to cleaner, less expensive, and more reliable energy sources. The DFC Roadmap highlights the critical developmental and foreign policy benefits from bolstering the energy security of all sovereign nations.

Several Asian MLAs and DFIs play a very active role in support for decarbonization. The Asian Development Bank (ADB) invested more than $20 billion in clean energy from 2008 to 2019 and in the last year alone and reached a record $6.56 billion in 2019. Under Strategy 2030, ADB is targeting $80 billion in cumulative climate financing from its own resources by 2030. The Asian Infrastructure Investment Bank (AIIB) focuses on renewable energy, energy efficiency, rehabilitation and upgrading of existing plants, and transmission and distribution networks. AIIB is looking to develop financial instruments and engage with potential financial intermediaries in renewable energy and energy efficiency investments

The World Bank's guarantee arm, the Multilateral Investment Guarantee Agency (MIGA), is focused on 'climate finance' transactions. MIGA develops specialized climate finance policies and products in collaboration with their clients. MIGA clients then implement their own incentives derived from the specific deal related technical support.

ECAs, MLAs, and DFIs will continue expanding their commitment to partner with the private sector to provide financing for sustainable development initiatives across industries. They are answering the call for decarbonization and working towards implementing incentives for borrowers to embrace emerging energy technology. Their support will be instrumental in providing financing capacity for an expedited transition to more sustainable energy sources globally.

6. Sustainable Supply Chain Finance: Empowering Suppliers to Measure and Make an Impact

Supply Chain Finance, TTS

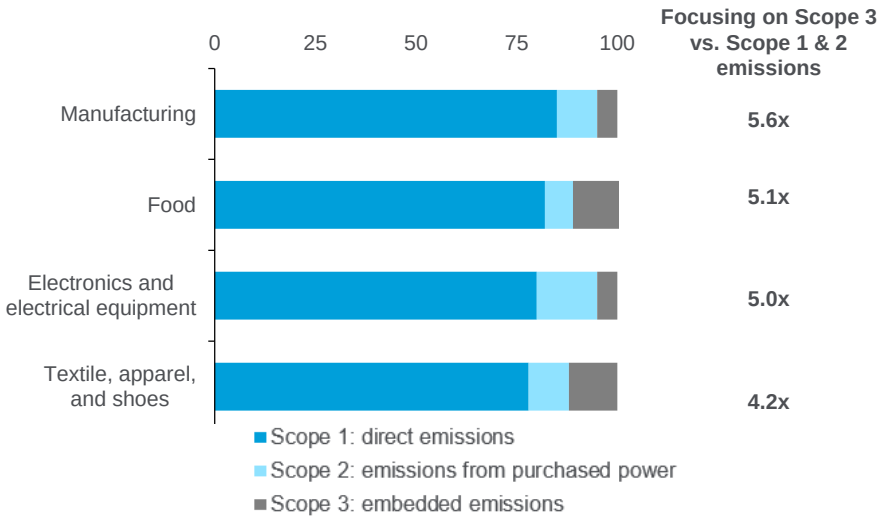
Caitlin Flohr

Supply Chain Finance has been a strategic trade product for corporates to optimize working capital for over nineteen years. The inherent product benefits grant suppliers early payment of their accounts receivable at a discounted price. Moreover, Supply Chain Finance provides companies with a path to engage and strengthen supplier relationships. For this reason, there is a growing interest to integrate ESG goals into the traditional Supply Chain Finance product. While ESG may not be a new concept, the past year has proven to accelerate the conversation and client needs for ESG financial integration, particularly post-COVID-19.

Why Now?

Many large companies have had robust corporate ESG strategies for years, and have made great strides in obtaining their goals. However, corporates have come across a barrier in extending their impact beyond their direct operations. According to a McKinsey study, within the Consumer Goods Industry, ~80% of GHG emission damage is done within the supply chain.[5] Therefore, Sustainable Supply Chain Finance is becoming a popular conduit to financially incentivize suppliers to align with buyers' ESG goals.

Figure 11. Breakdown of Direct & Indirect (Scope 1, 2, 3) GHG Emissions in Supply Chains (%)



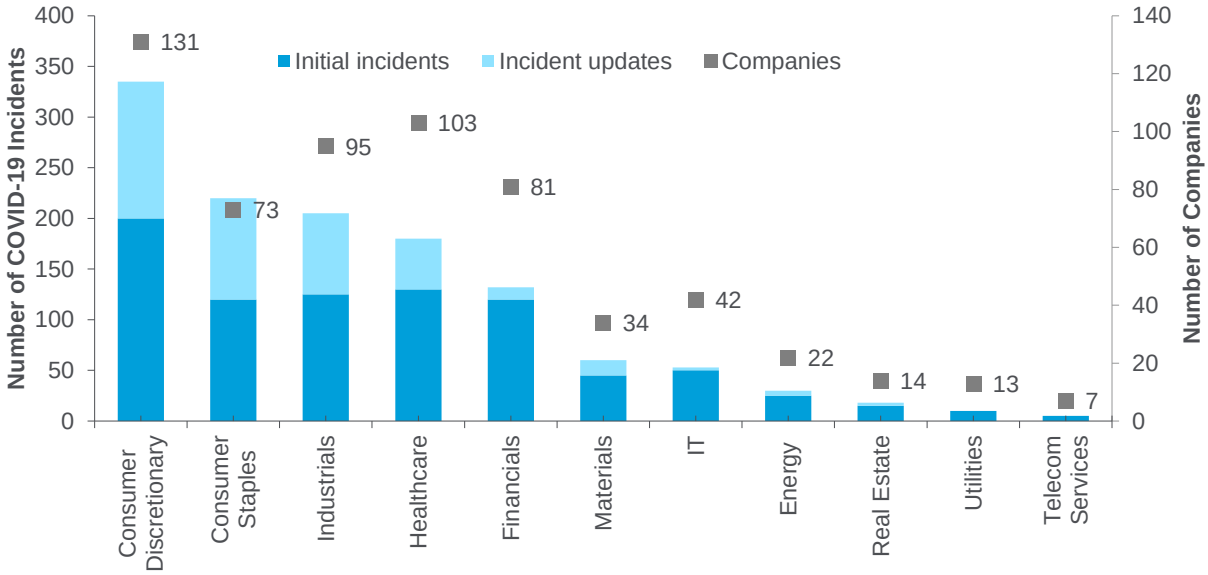
Source: McKinsey, Citi

The concept of sustainable supply chain finance is a tool for buyers to further enhance the benefits of the early payment from traditional Supply Chain Finance. Buyers can set key ESG performance indicators, which then align with incentive pricing for suppliers meeting those key thresholds. Until recently, many corporates were not focused on such opportunities to integrate ESG into Supply Chain Finance.

[5] https://www.mckinsey.com/business-functions/sustainability/our-insights/starting-at-the-source-sustainability-in-supply-chains.

However, over the past year, corporates have shifted from socializing the idea of sustainable supply chain finance internally at their organizations, to actively inquiring how and when to execute. Even though the concept is still in its early stages, the opportunity is estimated to be vast. According to a 2018 BSR report, sustainable supply chain finance is estimated to be a $6 billion revenue for the financial services industry.[6] The market is ready for sustainable supply chain finance, yet the question comes down to what is the best methodology to execute.

Figure 12. COVID-19 Supply Chain Disruptions by Sector



Note: Study sample includes 853 initial incidents and 417 updates associated with 615 firms.
Source: Sustainalytics

COVID-19 undoubtedly exposed a weakness in supply chains that left corporates scrambling to counter-act disruptions. This has urged companies to focus on ways to make supply chains more resilient from disruption, and also how to make them more sustainable. Although these two concepts may at first seem unrelated, resiliency and sustainability weave together to bolster the re-imagination of future supply chains. CDP, an ESG disclosure organization, reported a 24% global increase in companies asking suppliers for environmental transparency through CDP responses since 2019.[7] Nevertheless, the 'E' is not the only aspect of ESG that has gained prominence. COVID-19 has helped to increase focus on the S as much as the E. The concern for employees' wellbeing during the pandemic has expedited the focus on the 'S'. Sustainalytics, an ESG rating company, processed 1,270 corporate incidents related to COVID-19, ~12% of all ESG incidents captured in Q1and Q2 of 2020.[8]

[6] https://www.bsr.org/en/our-insights/report-view/win-win-win-the-sustainable-supply-chain-finance-opportunity.
[7] https://www.cdp.net/en/articles/media/24-percent-jump-in-companies-asking-their-suppliers-for-environmental-transparency.
[8] https://connect.sustainalytics.com/hubfs/INV%20-%20Reports%20and%20Brochure/Reports/SustainalyticsESGSpotlight_COVID-19-Incidents.pdf

These incidents were dispersed amongst all sectors, but most heavily in the Consumer Discretionary industry due to health, safety, and labor concerns. Going beyond health and safety, corporates are also shifting towards social equality, diversity, workers' rights, etc. Moving forward the challenge will be how to create an all-inclusive sustainable supply chain finance program to address all areas of E, S and G.

Path Forward

Sustainable supply chain finance can be a tool to incentivize suppliers to be more sustainable, and help buyers meet their own ESG goals. The biggest challenge is ESG disclosure, by the supplier or the buyer, is in the beginning stages, and suppliers are all at different points in their sustainability journey. Without consistent ESG disclosure, access to useful data is limited. However, ESG rating companies have begun to focus more on Scope 3 impacts, thus increasing the level of transparency in supply chains. Nonetheless, there is still an opportunity for additional disclosure to help expand awareness and management of material ESG issues in various industry supply chains. It is not a question of 'if' sustainable supply chain finance can help corporates achieve their ESG goals, but rather 'how' this tool can continue to evolve within the changing ESG landscape.

7. Green Bonds and KPI-Linked Bonds Are Surging

Overview of the Sustainable DCM Market

A Trillion Dollar Market

Sustainable Debt Capital Markets, BCMA

EMEA: Philip Brown, Sanaa Mehra, Maxime Hu

NAM: Amanda Boggs, Meghan Allen, Kendall Trovato

LatAm: Pablo Barrientos

APAC: Celine Pastor

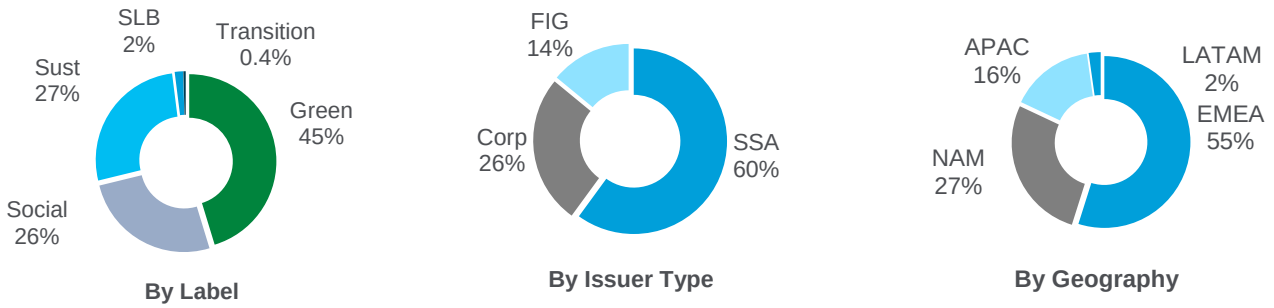
The market for Green, Social and Sustainability (GSS) bonds, where proceeds of these transactions fund environmentally friendly or social projects, now has over one trillion-dollars outstanding and shows no sign of slowing. In a year thrown into disarray by the COVID-19 pandemic, the sustainable bond market has continued to grow in size and significance and is no longer a 'niche' market. A broadening range of issuers and larger individual issuances has characterized primary market activity last year.

GSS bond sales totaled $552 billion in 2020,[9] hugely surpassing volumes for the full year 2019 of $313 billion, +76%. Green bond issuance accounted for $250 billion of last year's total issuance, followed by $147 billion of sustainability banks issuance, $143 billion of social bond issuance, $9 billion of sustainability-linked bond issuance, and $2 billion of transition bond issuance. Social and sustainability bonds have experienced a startling jump, making up over 53% of all issuance in 2020. Meanwhile, we continue to see a pick-up in green bond issuance volume over, with a notable rise in corporate issuance, resulting in total green bond volumes being up by 11% versus same time last year.

In terms of issuer type, Sovereigns, Supranational and Agencies (SSA) made up 60% of all issuance by volumes in 2020[9], followed by corporates 23% and Financial Institutions 16%. Breaking volumes down by geography, 55% of issuance came from EMEA, followed by 27% from North America, 16% from APAC, and 2% from Latin America.

The European Union's plans to take this market to the next level — through the issuance of €225 billion of green bonds as part of its pandemic recovery fund and €100 billion of social bonds under its unemployment support program — promise a bright future ahead. The growing investor focus on sustainable investing, as well as the emergence of the sustainability-linked bond market are also key themes to follow in this market.

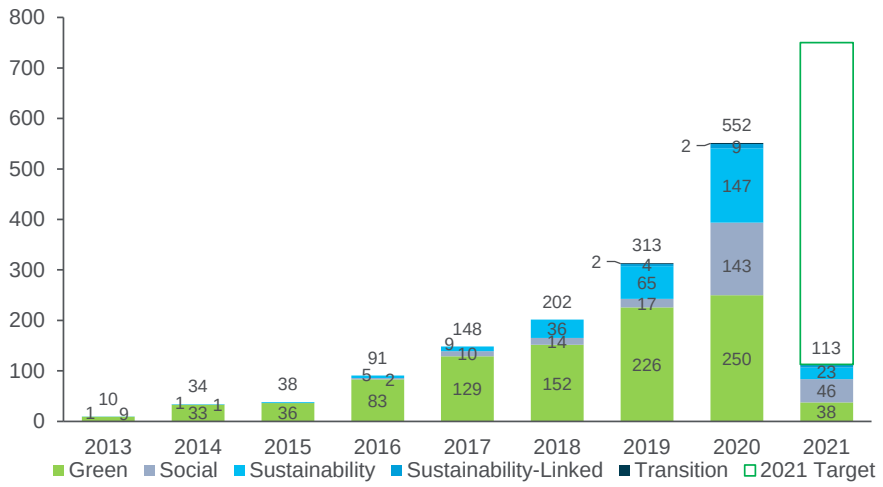
Figure 13. GSS Bond Issuance by Label, Issuer Type, and Geography (YTD Feb 2021



Source:Dealogic

[9] Dealogic, as of February 15, 2021. Volumes include IBRD (World Bank's) green bonds and sustainable development bonds.

Figure 14. Sustainable Bond Issuance Volumes



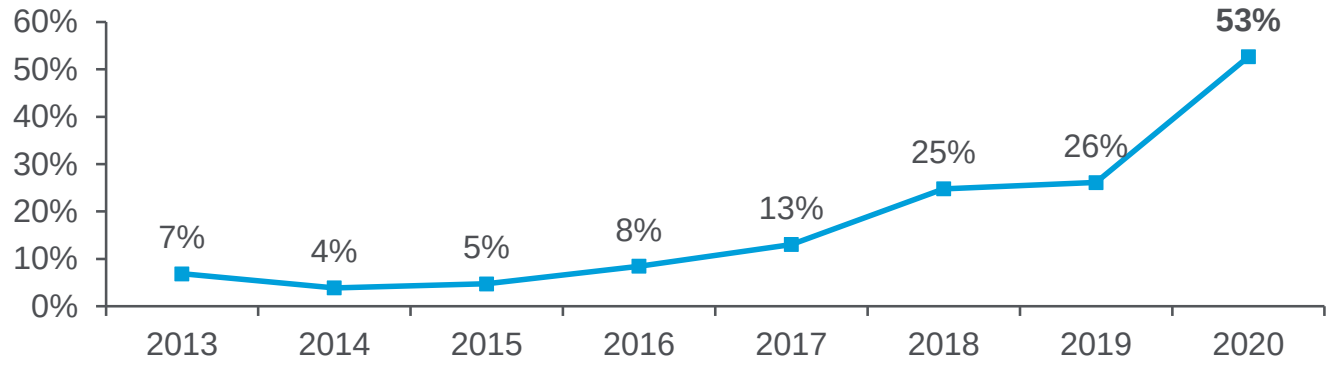
Source: Dealogic, Citi

Growing Share of Social and Sustainability Bonds due to the COVID-19 Pandemic

In the first half of 2020, global green bond issuance volumes were overtaken by social bond issuance as issuers focused on using these instruments to assist in alleviating the negative impact of the pandemic. Green bonds are now regaining their momentum, although the investor focus of Social impact is here to stay.

The key theme in 2020 was indeed the rise of Social and Sustainability bond issuance. Social bond volumes in 2020 totaled more than $143 billion, more than eight times the volumes during full-year 2019. Meanwhile, sustainability bond issuance has more than doubled compared with last year.

Figure 15. Social and Sustainability Bonds Make Up 53% of All Sustainable Bond Issuance in 2020



Source: Dealogic

This is in large part due to public sector issuers setting up social and sustainability bond programs through which they fund their COVID-19 response. COVID-19-related social bonds have met unprecedented demand as the focus switched to the social crisis at hand. Since the outbreak of the pandemic, proceeds from social bonds have been used to finance new medical equipment, medical research, SME loans that support employment generation in affected small businesses, and projects specifically designed to prevent and/or alleviate unemployment stemming from the pandemic.

French agencies were among the largest social bond issuers last year. CADES, the French agency that refinances and pays off social security debt, raised more than $15 billion equivalent of social bonds in September alone and issued nearly $22 billion equivalent of social bonds in 2020 with sizeable euro and dollar tranches. UNEDIC, the French unemployment insurance agency, has also been very active on the social front, with more than $19 billion equivalent of social bonds issuance with sizeable euro tranches.

We expect the social bond market to continue to grow driven by public sector issuers, including the European Union which will complete its €100 billion unemployment support program (SURE) in social bond format as well, syndicated between the second half of October 2020 and the end of 2021. The SURE program will significantly increase the size of the current social bond market and will easily make the EU the biggest non-sovereign euro borrower in the capital markets and the biggest social bond issuer in the capital markets. As of February 2021, the EU has issued €53.5 billion of social bonds in four rounds under the SURE instrument.

There was very strong investor interest in these highly-rated instruments, and the oversubscription resulted in favorable pricing terms for the bonds. Notably, in October 20, the EU issued a €17 billion debut syndicated bond under the SURE program, comprising new €10 billion 10-year and €7 billion 20-year dual-tranche social bonds, the largest social bond to date. The book attracted over €233 billion of demand from investors, achieving almost 14x oversubscription, the largest order book ever seen. The COVID-19 response bond theme is also expected to continue in the coming months as issuers may focus more on the medium/long-term response.

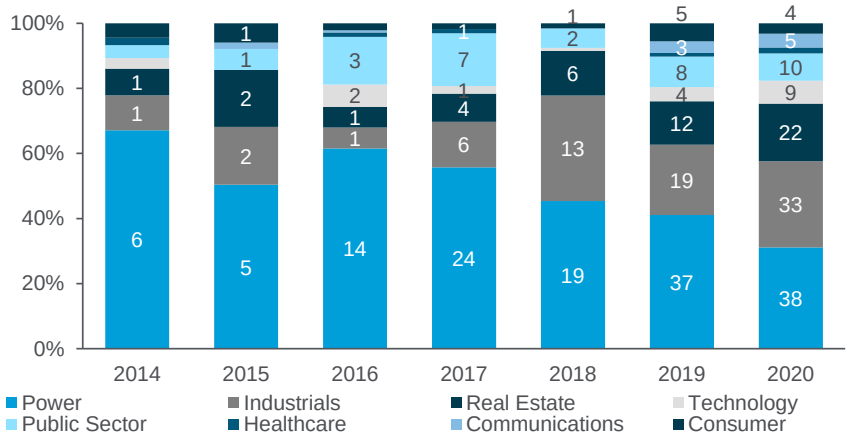
A Broadening Range of Issuers…

Last year saw a significant number of debut issuers come to the market, especially in the corporate space — nearly 310 corporate issuers came to the market in 2020,[10] up 30% compared with the full year 2019, of which 196 were debut issuers (64%). Corporate issuers of GSS and sustainability-linked bonds totaled around $135 billion, up 37% compared with the $99 billion issued throughout 2019 and more than triple the $42 billion issued by corporates in 2018.

Currently, the power sector dominates corporate activity. However, we are seeing increasing diversification into other industries, with a notable rise in issuance from industrials and technology companies in recent years. Meanwhile, the proportion of issuers from the power sector has fallen, with less than a third of global supply coming from this sector in 2020. We expect this diversification trend to continue.

[10] Dealogic, as of February 15, 2021.

Figure 16. GSS Bond and Sustainability-Linked Bond Issuance by Sector



Source: Dealogic

The second half of 2020 is a great illustration of how corporates more broadly are tapping the market, with several auto manufacturers, consumer staples, as well as technology and communication companies printing debut green bonds. German carmakers Daimler and Volkswagen, as well as Volvo Cars have issued sizeable inaugural green bonds throughout September to fund their EV ambitions, all achieving impressive pricing outcome with substantial negative new issue concessions.

Meanwhile in the consumer sector, Coca-Cola FEMSA (the world's largest bottler of Coca-Cola products) issued a $705 million 12-year inaugural green bond to finance its transition towards low-carbon operations, while Adidas pressed ahead with a €500 million 8-year inaugural sustainability bond, which also achieved an impressive pricing outcome. In the communications space, U.S. telecommunications firm Verizon came to the market with a $1 billion 10-year inaugural green bond, while French telecom company Orange successfully issued a €500 million 9-year inaugural sustainability bond.

This increasing number of corporates looking to print GSS bonds is a sign that issuers now more broadly recognize ESG financings as a 'must have' to send an important signal to the market and display their commitment to a low-carbon future.

…and Larger Individual Issuances

Another remarkable development in 2020 was the increasing number of 'jumbo' bond issuance, particularly in the third quarter. During the first nine months of the year, we saw 31 tranches with a size above $2 billion equivalent, compared with only 13 tranches for the full year 2019. 90% of them came from SSA names, notably from French agencies like CADES, UNEDIC or Société du Grand Paris, all tapping the GSS bond market at least four times in 2020 with sizeable tranches. Also worth highlighting is the €6.5 billion debut sovereign green bond from Germany, which represented one of the largest deals in 2020 after the EU's SURE social bonds in October and November.

In the corporate world, only a handful of issuers stood out with bonds valued at over $2 billion. In August, Google's parent company Alphabet issued bonds totaling $5.75 billion to support environmental and social initiatives, marking the largest GSS bond ever issued by a corporate. In September, the Swiss pharmaceutical company Novartis printed a €1.85 billion ($2.2bn) 8-year Sustainability-linked bond.

Also in September, the European Union said it intends to raise 30% of its €750 billion Next Generation EU (NGEU) recovery fund — around €225 billion — through the issuance of green bonds. This also adds to the expectation of jumbo GSS issuance to come.

September 2020 Was a Record Month!

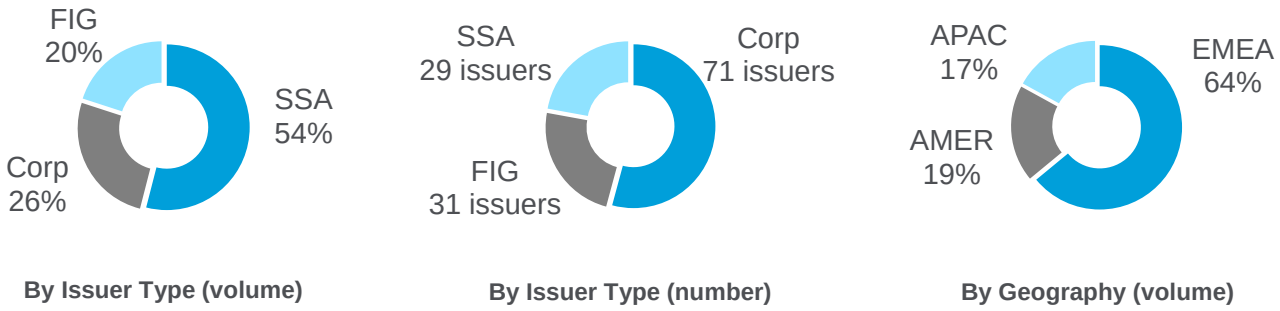
September 2020 was the busiest month ever for GSS bonds issuance, totaling $101 billion. Attractive market conditions ahead of U.S. election volatility, landmark sovereign issuances, and green bond issuance from the auto industry as well as the refocus on the broader green bond market supported this monthly record.

September issuance included $51 billion of green bonds, $22 billion of social bonds, $25 billion of sustainability bonds, and $4 billion of sustainability-linked bonds. The spike in new deals pushed total GSS bond issuance volumes ahead of volumes for the full year 2019 ($313bn).

Sixty-four percent of issuance came from EMEA, followed by 19% from the Americas and 17% from APAC. In terms of issuer type, we saw over 61 Corporates issuing GSS bonds totaling $29 billion.

A key theme in September was the awakening of the sustainability-linked bond (SLB) market, with three new issuers coming to the market – Suzano, Novartis and Chanel (see SLB section below). The European Central Bank also breathed new life into the SLB market, announcing it will accept SLBs as collateral from January 1, 2021.

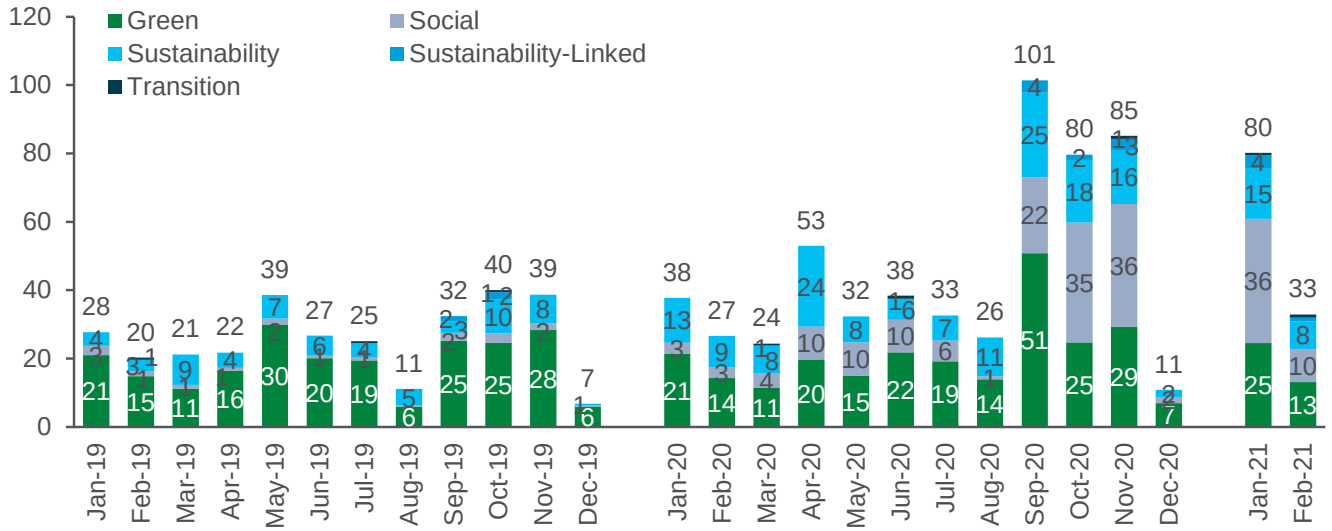
Figure 17. GSS Bond Issuance by Label, Issuer Type, and Geography (September 2020)



By Issuer Type (volume) **By Issuer Type (number)** **By Geography (volume)**

Source: Dealogic

Figure 18. GSS Bond Issuance by Type (Jan 19-Feb 15 2021): September 2020 Was a Record Month with $96 Billion of Sustainable Bond Issuance



Source: Dealogic

Section 2 – Sustainability Linked bonds taking off

Overview of Sustainability Linked Bonds

A new segment of ESG financing has emerged in the form of Sustainability-Linked Bonds (SLBs). Though the market is nascent, with only 20 issuers utilizing this format globally as of February 2021, we anticipate interest and issuance activity in this area to pick up meaningfully in the coming months. Unlike traditional green, social and sustainability bonds, which commit to dedicate proceeds to certain eligible assets, proceeds from SLBs can be used for broader general corporate purposes.

Furthermore, SLBs have a financial or structural cost to the issuer that will be triggered based on whether it achieves predefined sustainability or ESG targets. A similar construct has been used in the Sustainability-Linked Loan market in recent years, in which pricing on Term Loans and Revolving Credit Facilities may vary depending on whether certain sustainability targets are met. In the bond market, issuers make a commitment in the bond documentation to a measurable improvement in one or multiple sustainability-linked Key Performance Indicators (KPIs) over a predetermined amount of time which can trigger a financial change in the notes (such as a step-up in coupon or redemption price) if the target is not met.

In June of last year, the International Capital Market Association (ICMA) published a new set of guidelines known as the Sustainability-Linked Bond Principles[11] outlining best practices for these types of securities. The five core components are:

- **Key Performance Indicator Selections:** KPIs should be material to the issuer's business, measurable, verifiable and able to be benchmarked.

[11] ICMA Sustainability-Linked Bond Principles: https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/June-2020/Sustainability-Linked-Bond-PrinciplesJune-2020-100620.pdf

- **Sustainability Performance Targets Calibration (SPTs):** SPTs should be a material improvement or 'reach goal' when compared to a benchmark and the timeline should be set before/alongside the bond issuance.
- **Bond characteristics:** a trigger event occurs when the KPI has or has not met a target by a predefined date, this should result in a penalty for missing the target or a benefit for meeting it, e.g. a step-up coupon.
- **Reporting:** issuers should publish up-to-date information on the KPIs including an assurance report outlining the performance against the SPT.
- **Verification:** independent external reviews are recommended and post issuance verification of the SPT is a necessary element of the Sustainability-Linked Bond Principles.

As this market develops, capital markets participants will continue to evaluate the unique benefits and challenges of the SLB structure. Some issuers are challenged to come up with enough eligible project spending to meet index eligibility requirements of traditional green bonds ($300m in the U.S. market, €500m in the European market). SLBs may therefore be an instrument to allow a new set of issuers in ESG financing. This format is also an excellent means for issuers with strong ESG infrastructure and targets in place to highlight those commitments. Given the limited precedents in the space, issuers should proceed thoughtfully into this market with input from external reviewers and ESG advisors to avoid potential risks of 'greenwashing' if KPIs are not viewed as being material or if targets are not seen as being sufficiently ambitious. It also remains to be seen whether less traditional or 'brown' industries will be able to utilize this format to demonstrate transition to a Paris alignment given credit investors are keenly focused on the overall corporate ESG strategies of their investments.

Recent Sustainability-Linked Bond Activity

Citi worked on the first Sustainability-Linked Bond globally on behalf of Enel in September 2019. The transaction focused on UN Sustainable Development Goal ("SDG") number seven, "Affordable and clean energy." Enel's Key Performance Indicator and related target was for the company's "Renewables Installed Capacity" to be above 55% by December 2021. If the SPT is not met by the trigger date, the coupon on the notes will step up by 25 basis points. Enel has subsequently issued Sustainability-Linked Bonds in both the EUR and GBP markets, focusing on reducing GHG emissions in addition to Renewables Installed Capacity. Since Enel's inaugural transaction, we have seen a handful of other issuers utilize this format across sectors including:

- American energy company **NRG Energy** who priced the first ever SLB from a North American issuer (Citi-led) — a $900 million 7-year note as part of a broader $3.8 billion financing to fund the acquisition of Direct Energy. The ESG characteristics of the offering drove significant demand for the 7-year SLB, saving the company ~10 basis points on final pricing. The Sustainability Performance Target is to reduce absolute U.S.-based GHG emissions to 31.7 million metric tons of carbon dioxide equivalent (MMt CO_{2e}) per calendar year or less by December 31, 2025. GHG emissions are inclusive of Scope 1, 2, and 3 (Scope 3 includes business travel only). If NRG does not reach that goal by the target date, there will be a 25 basis point coupon step up in the 7-year tranche payable June 2026. On the same day, Citi was also a bookrunner on **Schneider Electric's** €650 million 5.5-year convertible bond, the first ever Sustainability-Linked Convertible Bond Globally.

The sustainability linkage is based on three KPIs and the average score on those by December 31, 2025 — which would trigger a 50 basis point premium payment amount upon maturity (both on conversion or redemption) if the minimum score (9 out of 10) is not obtained. The three Sustainability Performance Targets ae (1) Deliver 800 megatons of saved and avoided CO_2 emissions to our customers; (2) Increase gender diversity from hiring to front-line managers and leadership teams (50%/40%/30%); and (3) Train 1 million underprivileged people in energy management.

- Brazilian paper and pulp firm **Suzano**, which priced its inaugural sustainability-linked structure — a $750 million long 10-year offering on September 10. The notes priced with a yield of 3.950% and a coupon of 3.750% and mature in January 2031. The transaction came nearly a year after Enel pioneered the SLB structure and was the first offering to conform to the Sustainability-Linked Bond Principles since they were published in June. Suzano's offering attracted significant interest especially from ESG investors, producing an order book that was approximately 8x oversubscribed. Suzano published a Sustainability-Linked Bond Framework, outlining its Key Performance Indicator as tons of CO_2 emissions per ton of product produced, inclusive of both Scope 1 and 2 emissions. The Company established a SPT to achieve a 10.9% reduction from its 2015 baseline by its observation date of December 31, 2025. Failure to meet this target will result in a 25 basis point coupon step-up.

- Swiss pharmaceutical company **Novartis**, which priced a €1.85 billion 0.00% 8-year Sustainability-Linked Bond on September 16. The offering was not only the first SLB to be issued in the healthcare sector, but also the first SLB to incorporate social targets into its framework. The transaction priced with a yield of 0.081% after attracting €3.75 billion of orders. Novartis established two social targets to achieve by 2025: (1) to increase the number of patients it reaches in low and middle income countries with "strategic, innovative therapies" by 200%; and (2) to increase the patient reach of its Novartis Flagship programs by 50%. The Flagship programs are efforts to extend treatments for leprosy, malaria, Chagas disease and sickle cell disease. Novartis will pay a 25 basis point coupon step-up from the first payment in 2026 if it fails to achieve its social targets.

- French luxury brand **Chanel**, which issued an unrated €600 million dual-tranche Sustainability-Linked Bond across long 5- and 10-year tenors on September 24. The transaction marked the first of SLBs to be issued in the luxury sector and will support Chanel's Mission 1.5° climate strategy by linking the bond terms to carbon reduction targets. The company's selected Key Performance Indicators are its Scope 1, 2 and 3 emissions, along with its renewable energy in its operations. Chanel set three key Sustainability Performance Targets across the two tenors: (1) shift to 100% renewable electricity in Chanel operations by 2025; (2) decreasing Chanel's own emissions (Scope 1 and 2) by 50% by 2030; and (3) decreasing Chanel's supply chain (Scope 3) absolute greenhouse gas emissions by 10% by 2030. Chanel's structure comes at a different price than precedent coupon step-up compensation as seen in the Suzano and Novartis trades. If Chanel's targets are not reached, investors will be compensated in the form of a premium redemption price over par. The 5-year tranche will repay 100.5% of face value at maturity if Chanel is not wholly reliant by then on renewable electricity, and the 10-year tranche will redeem at 100.75% if Chanel falls short on its greenhouse gas emission targets.

We anticipate further activity and innovation in the space and sustainability-linked bonds to become a growing component of overall ESG issuance going forward. The development of this market — and guidelines established by ICMA — should enable a broadening in the potential issuer and sector participants in the overall ESG financing markets. These developments should present new opportunities for investors looking for potential diversification across ESG related issuance and borrowers looking to highlight their overall sustainability strategies and goals.

Section 3 – Greenium – Is There a Pricing Benefit?

Greenium Present in the EUR Market…

The 'greenium', or 'green premium', refers to the pricing advantage offered to issuers by sustainable bonds over conventional issuance. From a credit perspective, investors should not be paying up more for sustainable-labelled bonds as they would carry the same risk as conventional bonds issued by the same issuer.

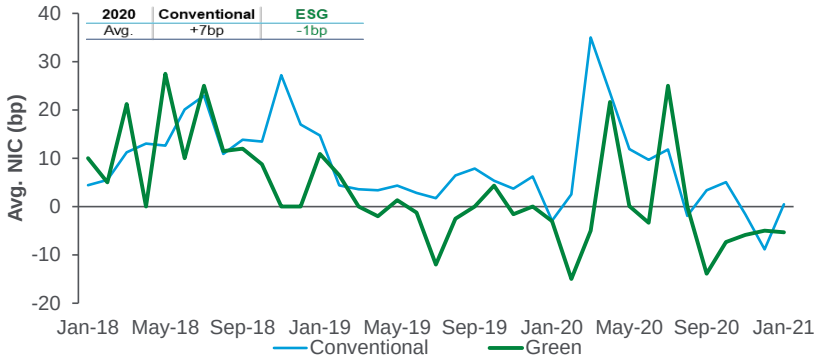
Yet, over time and particularly in the EUR market, we have seen impressive results in green bond execution across issuer types, providing mounting evidence that sustainable bonds can achieve a pricing benefit, as well as better secondary performance for investors. That said, sustainable issuance is still fairly small in size versus the conventional market, so we may be seeing some scarcity value, amidst growing focus from the investor community to grow ESG portfolios, supporting pricing benefits.

We are continuing to see a growing demand for sustainable investments from the asset management and pension community, which is causing a record inflow into ESG funds. Some of the largest fund managers have now adopted ESG integration as part of their broader investing strategy into all their portfolios. Others need to invest in green bonds to meet their investment mandates despite the scarcity of this asset.

However, supply of sustainable bonds has not yet caught up with the demand. Therefore, from recent data points in the sustainable bond market, it is now becoming more evident that sustainable transactions can achieve higher oversubscriptions as they attract incremental demand from mainstream investors as their ESG funds can play, as well as a handful of new investors. The increase in oversubscription allows for greater price tension and on balance, slightly more aggressive price revisions, ultimately leading to lower New Issue Concessions (NIC).

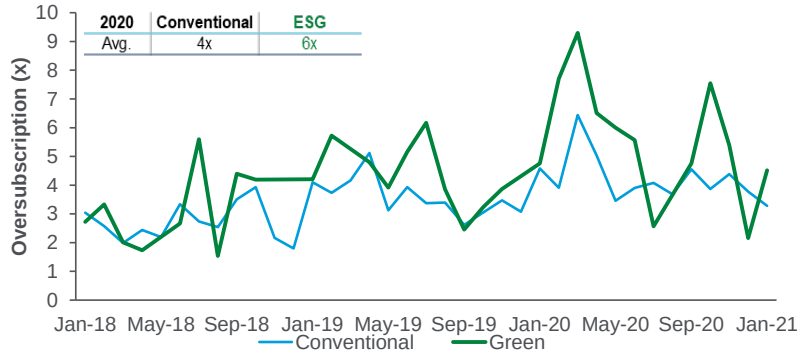
Figure 19. Citi's Corporate Bond Syndicate has Attempted to Quantify 'Greenium', Looking at € Sustainable Trades for IG Corporates

New Issue Concessions (NIC) – Corporates (EUR)



- Average NIC of **negative 5bps** for Green vs. 2bp for Conventional since Jan-21; and -1bp vs. +7bps for the full year 2020
- Generally tighter NIC's from Green vs. Conventional
  (Caveat: Distortion in 2018 and early 2019 due to lots of issuance from utility names which typically pay lower NICs)

Oversubscription Levels (final book) – Corporates (EUR)



- Average oversubscription of 4.5x for Green vs. 3.1x for Conventional since Jan-21; and 5.7x vs. 4x for the full year 2020
- Generally slightly higher subscription levels vs. Conventional trades

Source: Citi's Corporate Bond Syndicates

The investment-grade (IG) corporate space in Europe has recently seen quite astounding results in execution. The average sustainable bond trade in September paid a negative 14 basis points NIC, while the 'Conventional' trades have paid ~3 basis points. Quoting but a few successful deals across issuer types:

- In Corporates, auto manufacturers have achieved impressive results in green bond execution in September 2020. Daimler priced a €1 billion 10-year inaugural Green bond with negative ~25 basis point new issue concession, while Volkswagen priced its €2 billion dual-tranche 8-year and 12-year inaugural Green bond with negative ~15 basis points and ~17 basis points new issue concession, respectively. Volvo Cars priced later in the month with an even more impressive outcome. The Geely-owned car maker ultimately priced its €500 million 7-year inaugural Green bond with a substantial negative ~35 basis points new issue concession, after announcing IPTs flat to fair value or a 'conventional' bond. The appealing nature of electric vehicles to ESG investors has undoubtedly contributed to these successful pricing outcomes.

- In the Financial Institutions space, in September 2020, the German reinsurance company Munich Re priced a €1.25 billion long 20NC10 inaugural Green Tier 2 ~10 basis points through fair value following a series of investor calls with a very high investor engagement (Citi-led). In October, BNP priced a €750 million 7NC6 Green Non-Preferred Senior bond with a new issue concession of minus ~8 basis points, which was another testimony of the strong appetite for green bonds.

- In the Sovereign world, an interesting precedent testing the 'greenium' was Germany's inaugural €6.5 billion 10-year Green Bond. The maturity and coupon on the bond matched that of an outstanding 'twin' conventional German federal security. The transaction attracted over €33 billion in demand and the pricing was set at DBR 0 Aug-30s (twin) – 1 basis point, highlighting a cost saving for the green bond versus its twin. Germany is expected to issue another green bond in the coming months in its ambition to build a European green curve. Labelling debt as green is an opportunity for governments to display their commitment to a low-carbon future while increasing the visibility of sustainable finance among the general public.

… and Coming Up in the US dollar Market

Meanwhile in the U.S. dollar market, we are beginning to see more pricing differentiation than we had in the past. The increasing demand from large institutional buyers who have a significant focus on ESG, as well as European investors coming into U.S. dollar trades have been driving the increasing differential in this market.

The differential may also have been greater when there is perceived scarcity value (i.e., Verizon's recent green bond was issued as a single 'will not grow' tranche) and this also depends on the name, the sector, the size, as well as secondary trading levels.

Section 4 – Impact of Regulation Such as the EU Taxonomy on the Sustainable Debt Capital Market.

In Europe, we see a wave of regulation coming with respect to Sustainable Finance, which will affect debt capital markets.

EU Sustainable Taxonomy ("Taxonomy")

In March 2020, the EU's Technical Expert Group (TEG) published its first technical report on the EU Sustainable Taxonomy (EUST). The Taxonomy aims to define what a sustainable economy activity across several different industries.

The technical report includes three categories of activities for climate mitigation, applicable across 70 activities, that builds up the necessary inputs for a low-carbon economy:

- **Green projects,** activities that are already transitioned;

- **Enabling projects,** that create the necessary inputs to a low-carbon economy; and

- **Transition projects,** which could critically contribute to move toward a net-zero economy but are currently quite far from being environmentally sustainable and require regular revision of their technical screening criteria.

It also defines economic activities that contribute significantly to climate change mitigation and sets out performance thresholds (referred to as "technical screening criteria") for 68 activities that can make a substantial contribution to climate change mitigation.

For an activity to be Taxonomy-eligible, it must:

- Make **a substantive contribution to one of six environmental objectives:** (Climate change mitigation, climate change adaptation, sustainable and protection of water and marine resources, transition to a circular economy, pollution, prevention and control and protection and restoration of biodiversity and ecosystems);
- **Do no significant harm (DNSH)** to the other five, where relevant; and
- **Meet minimum safeguards** (e.g. OECD Guidelines of Multinational Enterprises and the UN Guiding Principles on Business and Human Rights).

The technical report does not cover all industries; Mining, aviation and nuclear, for example have either not yet been considered or need further deliberation.

The taxonomy is the bedrock for the implementation of several other regulations within the next two years. These are aiming for the creation of a more transparent financial market that promotes the robust growth of environmentally sustainable products:

- The **Non-financial Reporting Directive (NFRD)** to ensure large companies disclose non-financial performance in their annual reports
- Financial products sustainability-related disclosures, directed toward investment firms
- The Eco-label, the Green Bond Standard and the EU Climate Benchmarks.

Next steps: In November 2020, the European Commission published its draft Delegated Acts to outline its proposed technical screening criteria for climate adaptation and mitigation objectives. In particular:

- The first technical screening criteria, for activities which substantially contribute to climate change mitigation or adaptation, will enter into application by the end of 2021. The second screening criteria, which will cover economic activities substantially contributing to the other four environmental objectives, should be adopted by end 2021 and enter into application by end 2022.
- By June 1, 2021, The European Commission should adopt a delegated act specifying how the corporate disclosure obligations should be applied in practice.
- Further development of the Taxonomy will be managed by the European Commission with input from a yet to be established Platform on Sustainable Finance.

In the Sustainable Debt Capital Markets, we are already seeing issuers align eligibility criteria to that stated within the Technical report where possible. We are also seeing investors ask for alignment with the taxonomy. We expect the taxonomy to facilitate issuance in the sustainable debt capital markets from broader set of industries as they can confidently use the sustainability criteria defined in the taxonomy to align their KPIs or use of proceeds eligibility criteria to structure transactions.

Furthermore, as the Taxonomy gains traction in Europe, we expect its framework to be adopted by issuers and investors beyond the EU as well.

Section 5 – How do we see this market progressing in 2021

The $1 trillion Sustainable Debt Capital Markets can no longer be referred to as a niche market and is truly here to stay. The mainstreaming of ESG integration in to investment funds will drive issuance in the Sustainable Debt Capital markets in 2021. Other factors such as a possible 'greenium' in certain markets, makes this an attractive instrument to Treasurers as a tool to potentially driving down their cost of capital. Furthermore, the emergence of new instruments such as sustainability-linked bonds allows more issuers to access this market and provides greater diversification. This allows investors to recognize issuers more holistically with respect to their Sustainability related targets and ambitions. Lastly, we expect regulation of sustainability definitions and enhanced sustainability related requirements to facilitate further activity in the sustainable debt capital markets, as both the investment and issuer communities will be required to demonstrate how their strategies are aligned with the transition to a low carbon and sustainable economy.

8. Green Municipal Bonds: Why Muni's Will Help Finance a Greener Planet

U.S. Municipals

Vikram Rai

ESG has long been touted as the next 'disruptive' change in investment strategy, but this fixed income sector has not grown as per expectations. Some say ESG supply and demand suffer from a chicken-and-egg problem, and we are inclined to agree.

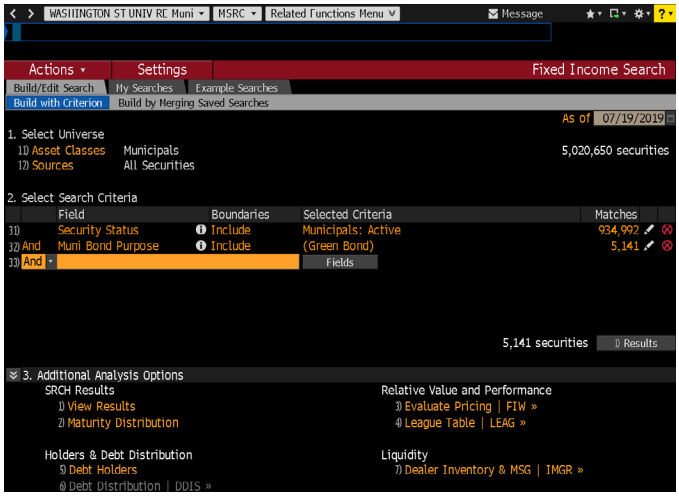
Interestingly, we think the U.S. municipal market embodies ESG philosophies and by our calculations, about 76% of U.S. municipals ($2.9 trillion) are likely to be ESG-aligned (although more work will be needed to establish this for individual investors). And, a large portion of this market is likely to offer many pure-green or environmentally friendly projects and act as the cornerstone for rebuilding the fabric of the US economy (supportive of the United Nations' Sustainable Development Goals, or SDGs. This includes the physical fabric via investments in roads, bridges, waterways, energy utilities, etc., as well as the social fabric via investments in hospitals, schools, universities, affordable housing, etc. Finally, we think many municipal issuers employ good governance practices (G).

How do most municipals automatically qualify as green investments?

Those wishing to invest actively in ESG themes remain somewhat constrained by a small investible universe. Investing only in bonds that are officially labeled green is not a practical strategy given existing volumes, and there are hardly any bonds that acquire official labels for the 'social' and 'good governance' buckets. As a result, several investors and fund families employ ESG scoring in their deal-level credit analysis, while institutions such as Citi have adopted an Environmental and Social Policy Framework. Even then, scarcity of ESG eligible paper (particularly paper attached directly to real-world outcomes) remains a significant challenge. Thus, we believe that investors should look towards the municipal market, and below we make the case that many municipal bonds are likely to screen well for ESG investors (although we acknowledge that much more work will be needed to establish ESG-alignment):

- **There are several different sources measuring the size of the municipal Green bond universe. Beginning with the Climate Bonds Initiative (CBI), S&P manages an index that includes all CBI-flagged municipal Green bonds and according to the index, there are currently 1,973 individual flagged bonds with par amounts of at least $2 million, for a total par value of $27.5 billion.** Bloomberg's measure of the universe does not restrict by maturity size (Figure 130), and is therefore larger at 5,141 active municipal securities totaling $34.9 billion. This accounts for all self-labeled Green bonds that the curators deem aligned with the Green Bond Principles (GBP).

Figure 20. Bloomberg MSRC<GO> for Finding Green Municipal Bonds



Source: Bloomberg

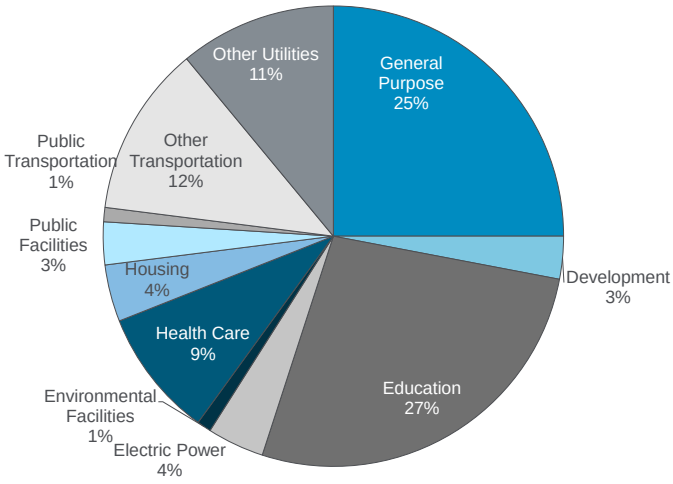
Figure 21. Example of Green Municipal Bond Loaded on Bloomberg

Source: Bloomberg

However, the GBP recommend external verification and CBI notes that approximately 35% of municipal Green bond issues in recent years have come with external verification. This equates to $12 billion, which we think is a minimum, because the verified issuers are usually the larger ones. The CBI itself has certified about $10.8 billion worth of municipals. However, we suspect there are many more environmentally-friendly bonds than just the $35 billion or so that self-label as 'green.'

- **Municipals finance not only basic government functions but also a variety of public needs, which are vital for the economic prosperity of the nation (Figure 22).** Thus, the municipal market has always been the cornerstone for rebuilding the fabric of U.S. economy. This includes the physical fabric via investments in roads, bridges, waterways, energy utilities, etc., as well as the social fabric via investments in public needs such as hospitals, schools, universities, affordable housing, etc. These outcomes are very likely to be aligned with the SDGs in many respects, but may also screen well for some ESG investors on the social front. Obviously, human rights practices, employment practices, involvement with controversial activities, health impacts and a number of other issues come into the S factor. However, the underlying social utility of these projects will likely help these bonds screen well for ESG.

Figure 22. The $3.8 Trillion Municipal Market Finances Not Only Basic Government Function But Also a Variety of Public Needs



Source: Citi Research, Bloomberg

Figure 23. ESG-Aligned Municipal Bonds (Par Amount) by Sector

Sector	% of ESG-compatible market	Total ($mn)
Education	24%	690,604
General Obligation	22%	640,181
Hospital	9%	257,820
Water & Sewer	8%	243,370
Other Tax Securitization	5%	154,040
Lease-backed	5%	153,129
Housing	5%	136,739
Sales Tax Securitization	3%	96,446
Appropriated Debt	3%	91,581
Development	3%	77,280
Special Tax District	1%	37,990
CCRC	1%	32,952
Other	10%	290,536
Total	**100%**	**2,902,669**

Source: Citi Research, Bloomberg

Now, in the most conservative approach, we would eliminate sectors that derive revenues from oft-screened activities such as tobacco, liquor taxes, fuel taxes, and casinos, as well as sectors that use proceeds for non-ESG purposes. These include airports and toll roads (even though they represent the "S", we can eliminate them to be conservative because they are opposed to the "E"). Electric power utilities fall under that conservative exclusion as well, because even though so many have undertaken renewable efforts, they still do burn coal and/or natural gas for their baseloads. What remains is a handful of revenue bond sectors that all benefit the environment or the public good (the physical and social fabric of US infrastructure). In addition to the ESG-aligned revenue bond sectors, we included GOs in the ESG total.

Even then, we believe that about $2.9 trillion, or 76% of the municipal market, is likely to screen well for ESG investors (Figure 23).

9. SPACs: Green Equity Investment in High Growth Companies

Banking, Capital Markets, and Advisory (BCMA)

Sandip Sen

Greg Kantrowitz

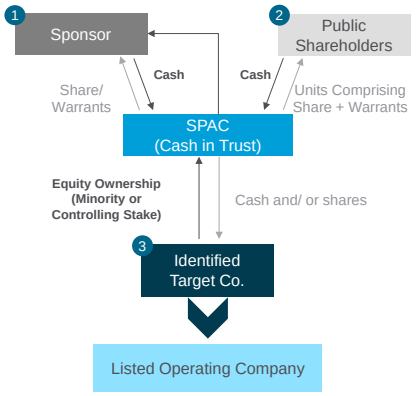
Commodities Research

Eric Lee

While they have been around for over two decades, Special Purpose Acquisition Companies, or SPACs, have been taking off in 2020, with a recent wave of ESG SPACs, particularly those focusing on EVs and mobility. Going forward, this looks to be an emerging significant source of capital for high-growth companies that are ready to go public, as an alternative to an IPO, while also being attractive to SPAC sponsors and public investors that are increasingly demanding green investment opportunities. This comes against a supportive backdrop for SPACs, with excess liquidity in the global financial system looking for a home, and an IPO market expected to remain volatile, with M&A likely to be selective. Historically, it has mostly been a U.S. phenomenon, but there is a growing focus in Europe too.

What is a SPAC? A SPAC, also known as a 'blank check company', is an acquisition vehicle that raises money to buy a private operating company. Once identified, this private operating company is referred to as the 'identified target'. (The target company may not be pre-identified prior to the IPO of the SPAC.) Post-acquisition, the SPAC combines with the identified target, typically taking a minority stake, to form a publicly listed operating company. A SPAC typically has 24 months to announce the 'business combination'. Failing that, it liquidates, and the money is returned to public investors.

Figure 24. SPAC Schematic



Source: Citi BCMA

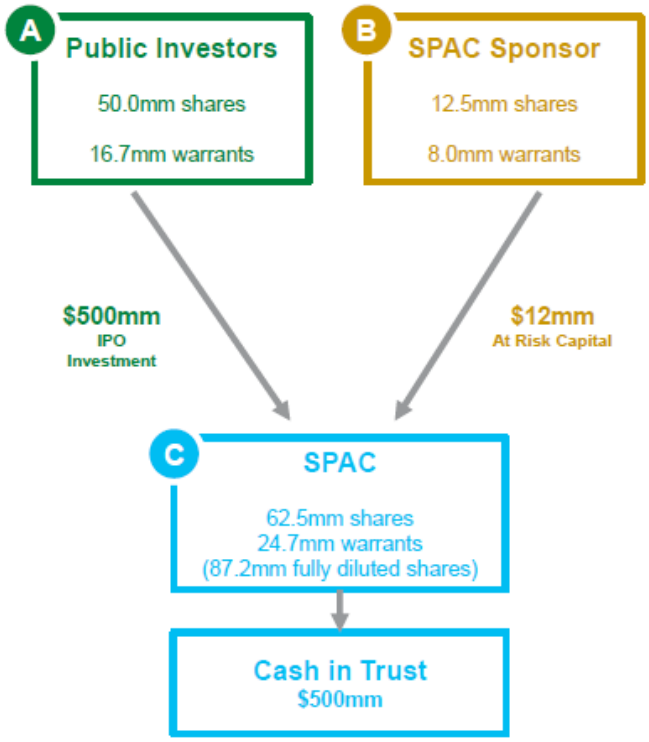
The key parties are (1) the sponsor(s); (2) the public shareholders; and (3) the identified target and its shareholders. The sponsors are the founders of the SPAC, and are responsible for its success. The public shareholders are the institutional investors who invest in the SPAC IPO. The identified target is the company identified by the sponsor to be acquired, post-IPO, with the shareholders of the identified target becoming shareholders of the new listed operating company.

What are the benefits to each party? The SPAC structure has evolved to allow private companies to go public more quickly, get access to immediate cash liquidity as well as public market valuations and public market upside, while avoiding a longer underwriting process, expenses, and mispricing, by IPO underwriters.

For the sponsor, SPACs can provide highly compelling economics of potentially over 10x multiples over invested capital (MOIC), and can enhance public market brand recognition and extension of the investment strategy. We are seeing increasing adoption among sophisticated financial sponsors, with new types of sponsors emerging too, such as corporates.

For public investors, SPACs provide a private-equity-like investment with downside protection (redemption right on the back-end related to the initial business combination) and the liquidity of publicly traded securities. IPO investors typically receive warrant compensation; there are no management fees or salaries prior to acquisition. They provide access to private companies 'ahead of the Street'. They provide a longer time to do due diligence on assets, versus a traditional IPO.

Figure 25. Illustrative SPAC Organization



Source: Citi BCMA

Figure 26. Illustrative SPAC Formation Summary

A Public invests $500mm cash via IPO in newly formed SPAC

- Public receives 50 units at $10.00 each
- Each unit bundles 1 share and 1/3 warrant (struck at $11.50)

B Sponsor invests "At-Risk Capital" of $12mm
(2% of IPO proceeds + $2mm for overhead expenses)

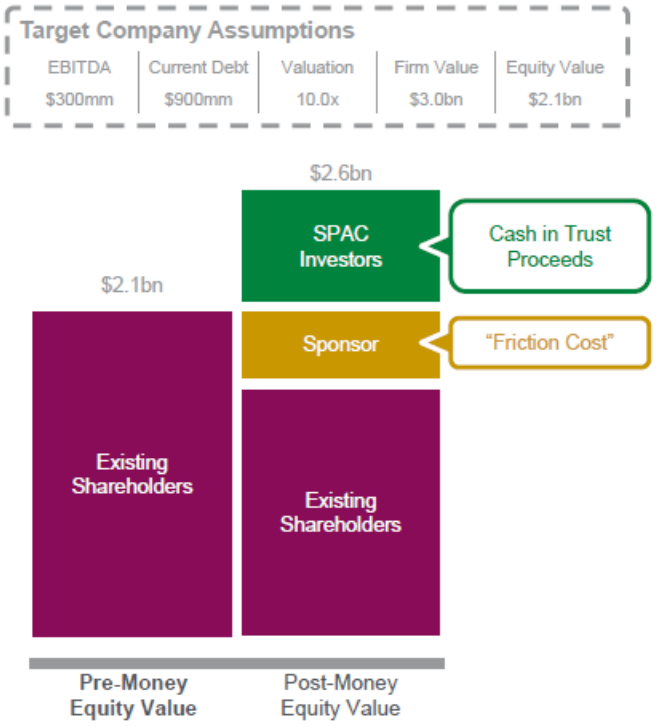
- Sponsor receives 8.0mm warrants at $1.50 each
- Sponsor receives 12.5mm shares (25% of IPO capital)

C New SPAC is formed with cash in trust

- 62.5mm shares outstanding
- 24.7mm warrants outstanding
- 87.2mm fully diluted shares (upon warrant exercise)

Source: Citi BCMA

Figure 27. Illustrative SPAC Target Acquisition



Source: Citi BCMA

Figure 28. Illustrative Transaction Sources and Uses

Sources ($mm)	
SPAC Cash in Trust	$500
FPA Proceeds	$0
Sponsor Promote	$125
Rollover Debt	$430
Seller Equity Rollover	$1,945
Total	$3,000

SPAC cash used for transaction costs and debt paydown

Uses ($mm)	
Transaction Costs	$30
Debt Paydown	$470
Secondary Sale	$0
Sponsor Promote	$125
Rollover Debt	$430
Seller Equity Rollover	$1,945
Total	$3,000

Source: Citi BCMA

For identified target companies, SPACs provide a liquidity alternative outside of a traditional IPO or M&A. They have a greater ability to articulate a clear financial outlook, including the filing of forward-looking projections showing fast growth. They receive assistance in articulating the equity story from sophisticated, experienced sponsors. They can engage with a wider investor universe through a longer marketing period. There are other opportunities and unique upsides post-transaction. Unlike an IPO, the target company may receive an 'earn-out' consideration to bridge valuation gaps (e.g., additional shares issued to the seller/target if the stock trades above a certain trigger price, post-closing). And beyond the benefits of partnering with a credible sponsor/management to further validate the investment thesis, there is the potential for the target company to retain stock through rollover or control in the pro forma company.

What makes a good de-SPAC target? The target company should be ready to be public, with strong management, corporate governance, and reporting policies in place, or in process. It would need to be likely to be well received by public investors, including having a capital structure with low to moderate leverage. It should have revenue/earnings growth potential, with a strong customer base and a large and/or growing end market, and be a scalable solution with a unique focus and few if any direct peers.

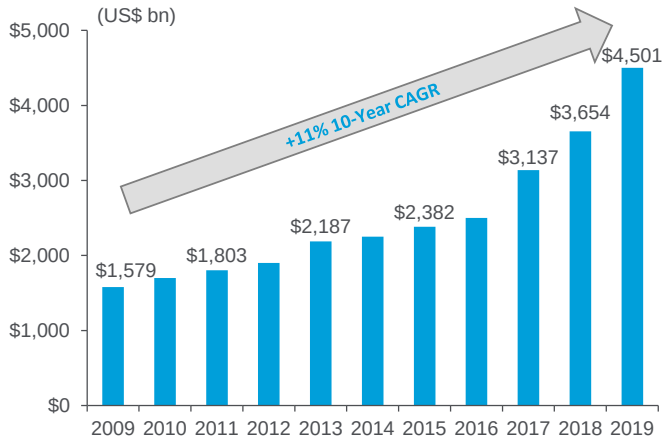
The de-SPAC process allows tremendous latitude in communication that the traditional IPO restricts. Companies that can take advantage of the key benefits of the de-SPAC process, which are not mutually exclusive, are well-suited targets. There are two sets of key benefits. The first set pertains to the SPAC structure and process, and the second is coming from a sophisticated, experienced sponsor that can provide validation benefits.

Structural/process benefits. (1) As mentioned earlier, the ability to market with projections and allow the company and sponsor to control the equity narrative without relying on third parties—for a traditional IPO, these would be third-party research analysts. (2) Counterparties agree to the terms and structure privately, and subsequently confirm this through an over-the-wall (OTW) process with key investors, which likely includes a private investment in public equity (PIPE) raise alongside the SPAC. (3) The process gives valuation visibility and reduces execution uncertainty in a private manner, prior to public announcement. All of these are particularly helpful for target companies, which have high growth stories with nuanced total addressable market (TAM) or economic models. Additionally these companies are near inflection points where access to projections and management is critical to getting credit; which involve complicated stories that require considerable due diligence and numerous building blocks for growth and value; and for which good comparables do not exist, and where positioning and valuation can be highly variable.

SPAC sponsorship/validation benefits. The sponsor: (1) in effect becomes a lead or anchor investor that sets terms and structure that allow others to follow; (2) can help to confirm or ameliorate some part of the narrative in a strategic fashion (including growth strategy, valuation, acquisition origination, etc.); and (3) adds a competency or attribute not existent in the company prior to the SPAC. All of these benefits are particularly helpful for companies that have the following characteristics. (1) They are looking to grow in adjacent sectors, and where the sponsor can add competency; (2) Where deal-making acumen accretive to value is lacking with current management; (3) That have an initial market focus primarily in one area (e.g., healthcare) where a sponsor can endorse another part of the strategy (e.g., software or tech); and (4) Have an amorphous comparable

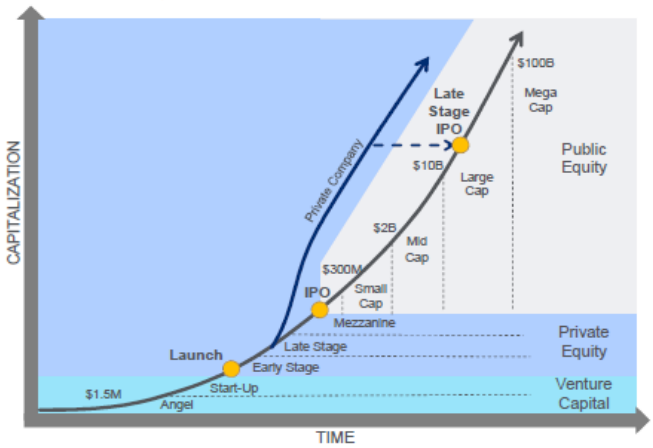
environment or a not easily accessible story, for which sponsors can provide a kind of 'smart money' validation of value.

Figure 29. Growth in Private Equity AUM (2009-2019)



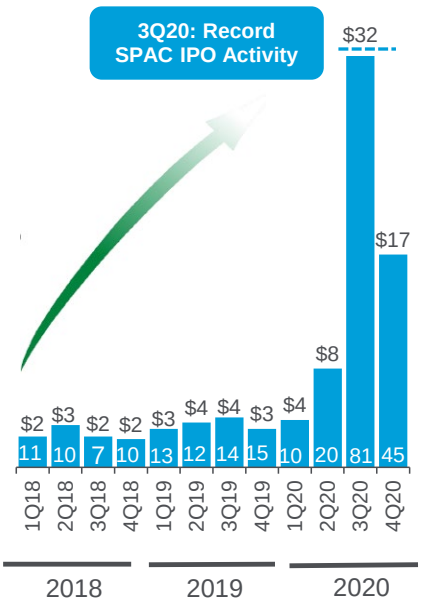
Source: Citi Business Advisory Services

Figure 30. Emerging Company Lifecycle



Source: Citi Business Advisory Services

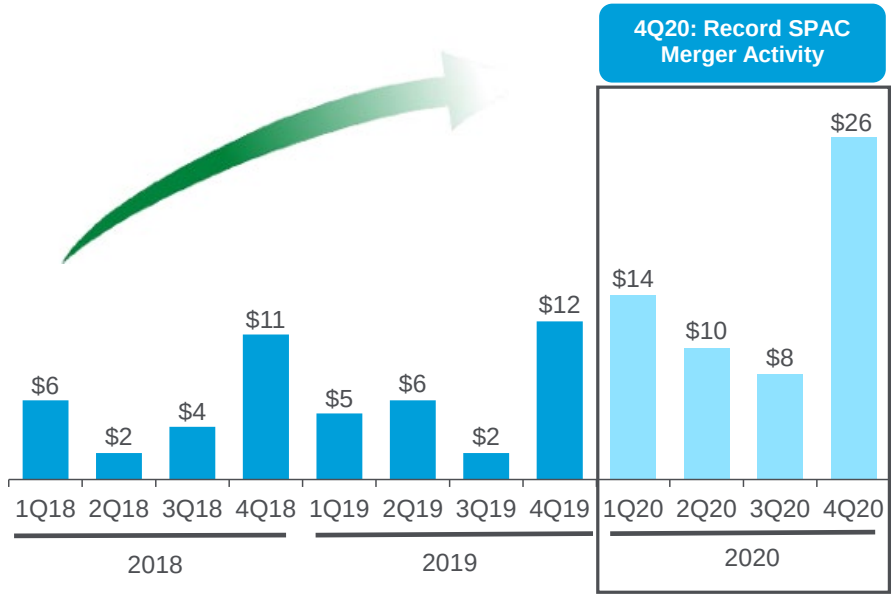
Figure 31. SPAC IPO Activity (2018-2020*)



Note: Includes SPACs > $100m in size
Source: Company Filings, Citi BCMA

2020 has been the year of the SPAC. 3Q 2020 saw record SPAC IPO activity, with 80 IPOs worth $32.1 billion in the quarter, up from $2-$4 billion per quarter over 2018-19. SPAC merger activity is also at all-time highs too, with 4Q'20 hitting new records too. SPACs have been increasing in size and quality too, with 52% of SPAC IPOs through October 2020 at over $300 million, up from 27% in 2019 and 32% in 2018. SPACs were originally a vehicle for smaller IPOs, with an average deal size of less than $200 million proceeds until 2016. Indeed, up until 2019, the largest annual SPAC on record was less than $1 billion. The average SPAC IPO transaction size has grown at a 19% compound annual growth rate over the last ten years, while mega-SPAC IPOs are emerging, with the Pershing Square Tontine SPAC raising $4 billion in 2020. COVID-19 also created a new class of distressed assets in many sectors (such as hospitality and travel), increasing the need for capital across private companies. As of the fourth quarter 2020, SPAC capital outstanding stands at $73 billion in 208 SPACs, of which 40 ($11bn) have announced a business combination, with the remaining $62 billion in 168 SPACs still searching for targets.

Figure 32. SPAC Merger Activity Is Also at All-Time Highs (2018-2020*)



Note: Includes SPACs > $100m in size
Source: Company Filings, Citi BCMA

There has been a broader change in company growth patterns, supporting the rise of SPACs — expanding private equity allowing for private companies to grow for longer before going public, and the search for alternatives to traditional IPOs. Expanding private equity assets under management AUM has created a broad pool of capital that is allowing for more rapid growth for private vs. public companies, and providing a path for them to stay private for much longer. Up until 2007, there were more public than private equity (PE)-backed private companies in the U.S., but the ratio flipped that year. By 2018, the Milken Institute estimates that there were just under 8,000 PE-backed private companies vs. only ~3,400 public companies in the US. Along with reduced IPO activity, particularly in growth companies, there has been a need for expanded options to exit private companies. The suitability of non-IPO exit strategies differs, however, with well-known late stage firms favoring direct listings and less-known firms, in need of capital validation, preferring SPACs.

SPAC issuance is likely to hit new records, given key tailwinds. (1) Sponsor quality is improving, with greater diversity of sponsor teams, and embrace of product from a wider range of institutions, from private equity to family offices to hedge funds. (2) Investor breadth, with a wider universe of investors participating in SPAC IPOs and through business combinations, as well as strong interest in participating via SPAC PIPEs. (3) Seller awareness. Companies that could be identified targets recognize this as an attractive alternative liquidity mechanism, with the opportunity to partner with quality sponsor teams. (4) Marketing transparency, with the ability to market company forward-looking projections, and achieve more efficient cost of capital to allow private companies to access public markets earlier. (5) Positive aftermarket performance. Business combinations from high quality sponsor teams have shown strong market performance, and transactions are getting larger and larger. (6) Exit alternatives are volatile, with choppy IPO market mispricing, and subdued M&A activity.

SPACs can be particularly suitable for ESG-related companies. Other than the compelling benefits of SPACs themselves, there has been a continued deterioration in traditional oil and gas investment opportunities. There is pressure from LPs to shift investment strategies and focus on ESG opportunities; the ability to add a growth equity platform to historic skillsets around power and infrastructure; and an equity market premium placed on high growth and total addressable market-driven investment stories, which increases the range of potential targets.

There is a massive opportunity set for SPACs in the decarbonization and cleantech space, including in next generation fuels, grid flexibility and resilience, the electrification of transportation, the greening of fossil fuels, in proven agriculture and natural resource plays, in next horizon resource use plays, and in manufacturing and mining, among others. With some estimates pointing to over $6 trillion in annual capital investment required globally to achieve science-based climate targets (a 2 or even 1.5 degree Celsius world), this is a potentially massive opportunity set for SPACs.

Recent de-SPACs have been geared toward sustainability, with green-related target companies so far mostly in the alternative vehicles and mobility space, but increasingly in broader energy transition and decarbonization. The recent SPAC mergers have covered passenger cars to trucks to electric skateboards, EV charging networks to battery systems and LiDAR-based autonomous vehicle technology. Looking ahead, ESG-focused SPACs still outstanding have broad interests in sustainability, energy transition, decarbonization, carbon removal, climate resilience, next-generation transportation, and sustainable industrial technology sectors.

Figure 33. Recent De-SPACs Geared Towards Sustainability Have Been Focused on Mobility, But Outstanding SPACs Target Wider Decarbonization Sectors

	Chargepoint	EOS	Luminar	Canoo	Lordstown	Fisker	Hyliion	Nikola
Company Description	Electric Vehicle charging network	Battery system designer and deployer	Designer of LiDAR-based autonomous technology	EV Skateboard developer focused on urban mobility	Automotive manufacturer of electric pickup trucks	Electric Car designer and manufacturer	Developer of electric class 8 truck powertrain tech	Developer of hydrogen-based FCEV trucks
SPAC Sponsor	Switchback Acq.	B. Riley Financial	Gores Metropoulos	Hennessy Capital IV	DiamondPeak	Spartan Energy Acq.	Tortoise Acquisition	VectoIQ Acquisition
SPAC Pricing Date	July 25, 2019	June 4, 2020	January 31, 2019	February 28, 2019	February 27, 2019	August 9, 2018	February 27, 2019	May 15, 2018
Deal Announcement	September 24, 2020	September 8, 2020	August 24, 2020	August 18, 2020	August 3, 2020	July 13, 2020	June 19, 2020	March 3, 2020
Closing Date	Exp. Q4 2020	Exp. Q4 2020	Exp. Q4 2020	Exp. Q4 2020	-	Exp. Q4 2020	Exp. Q3 2020	June 3, 2020
SPAC Size	$300mm	$225mm	$400mm	$300mm	$280mm	$552mm	$233mm	$230mm
PIPE Size	$225mm	$40mm	$170mm	$323mm	$500mm	$500mm	$325mm	$525mm
Transaction Value	$2.4bn	$548mm	$2.9bn	$1.8bn	$965mm	$1.9bn	$1.1bn	$3.3bn
Key Valuation Metric	2025 FV / Revenue	2022 FV / Revenue	2025 FV / Revenue	2025 FV / Revenue	2024 FV / EBITDA	2023 FV / Revenue	2024 FV / EBITDA	2024 FV / Revenue
Transaction Valuation	1.7x 2025 Revenue 13.5x 2025 EBITDA	2.0x 2022 Revenue 0.7x 2023 Revenue	3.5x 2025 Revenue 7.9x 2025 EBITDA	0.8x 2025 Revenue 3.5x 2025 EBITDA	3.2x 2023 EBITDA 1.6x 2024 EBITDA	0.6 x 2023 Revenue 0.2x 2024 Revenue	5.1x 2023 EBITDA 1.8x 2024 EBITDA	2.4x 2023 Revenue 1.0x 2024 Revenue
% Change Since IPO	**+32.3%**	**+0.1%**	**+2.0%**	**+2.5%**	**+30.5%**	**+1.0%**	**+89.2%**	**+83.1%**

Source: Citi BCMA

10. A Green Pipeline from Private Financing into Public Capital Markets

GMSG Strategy

Michael Anderson

Christopher Chapman

Arup Ghosh

Wei Guan

Matthew James

Shuo Li

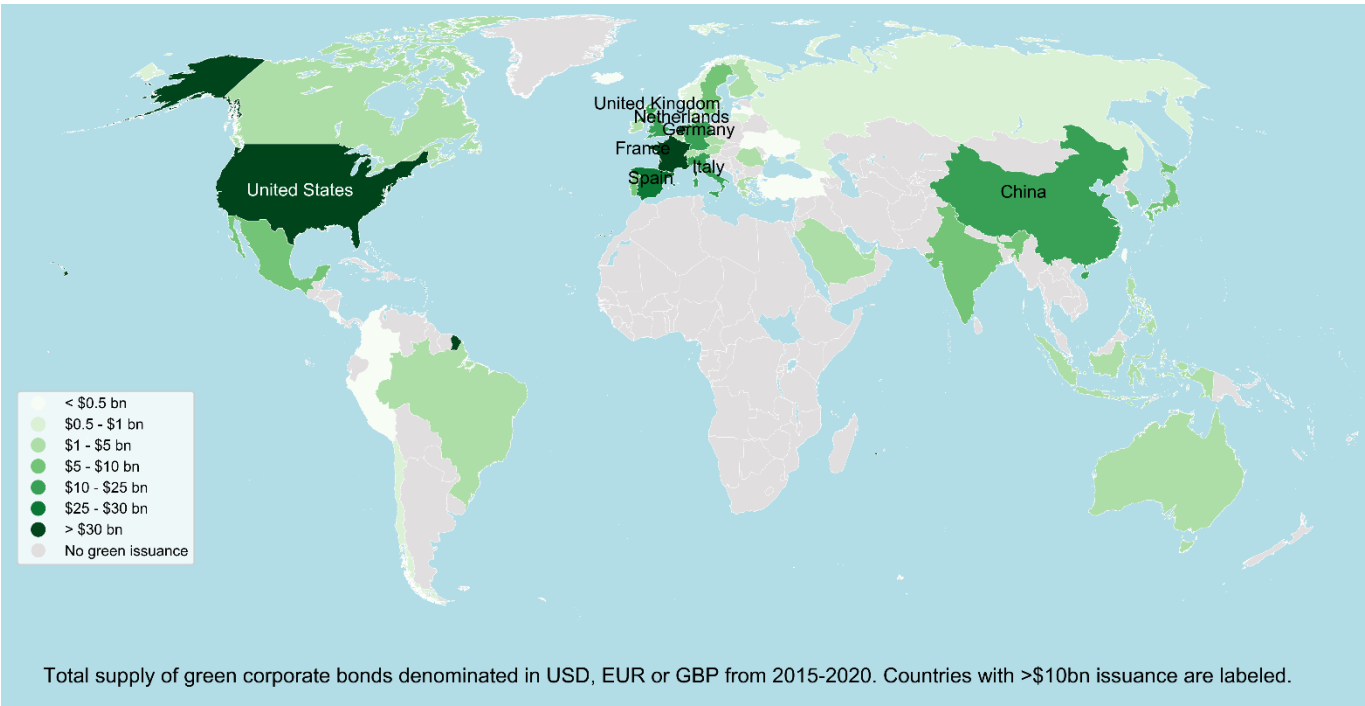
Hans Lorenzen

Daniel Sorid

A green revolution is underway across global bond markets. Since the 1990s and the growth of wind and solar renewable energy projects, financing for environmentally sustainable projects has largely been through the bank lending or project finance markets. This began to shift over the last fifteen years into the public bond markets. The move was driven by the desire of capital owners to allocate funds specifically towards investments that promote sustainability or to deallocate funds from investments that were detrimental to the environment. Asset managers began to devise mandates to fit the demands of capital owners and the assets in sustainable investing strategies now exceeds $30 trillion[12]. If anything, we believe that the increase in capital allocated towards environmental investing has accelerated in the last two years.

The potential scale of financing that could transition from the existing stock of environmentally-friendly private lending (i.e., bank loans and project finance for green assets) into the public debt markets (i.e., senior bonds or asset-based securities) is immense as this report has shown. This does not include the incremental transition finance required by existing borrowers looking to replace environmentally-unfriendly assets (e.g., coal plants) with environmentally-friendly assets (e.g., wind farms).

Figure 34. Green Corporate and Sovereign Bond Issuance (2015-2020) as of Total Debt Issuance



Source: Dealogic, Citi Research

[12] Global Sustainable Investment Alliance (GSIA) measure as of early 2018 here. GSIA next report update for 2020 is expected to be released in early 2021.

Many challenges remain for investors seeking environmentally-friendly securities, particularly for fixed income portfolios. Unlike equity investors, bond investors have far less ability to influence companies' environmental behavior, aside from price. Bond investors face markedly less transparency or access to key metrics of environmental behavior, and even less recourse for non-compliance. Finally, there is a wide range of views as to what type of assets are environmentally beneficial, which makes defining mandates and eligible securities a challenge.

This situation has improved over the last few years.

Investment groups and policymakers are creating standardized definitions for environmentally-beneficial securities — the birth of the 'green bond'. Key performance metrics for environmental activities are becoming more prevalent. Supra-national borrowers ("supras") and Government-Sponsored Entities (GSEs) have been encouraging issuance and further standardization of green bonds. Most importantly, capital continues to be allocated to this space. If the pace of growth continues, the green bond market will be a liquid, mature and distinct global asset class.

In this chapter, we look to explore the current state and recent growth in publicly traded green bonds in more detail. We assess the drivers of issuance and how the stock of bonds has grown across private-sector issuers as well as supras. We also look at the challenges and constraints that asset managers face in constructing a green bond portfolio, given the existing stock and primary issuance.

Finally, we focus on three factors which, if resolved, could lead to a significant shift higher in investor demand and markedly enhance the maturity and liquidity of the broader green bond market. These include **(1) standardization of criteria to be deemed a green bond; (2) greater availability, consistency and transparency of key environment performance metrics; and (3) structural incurrence language** to compel borrowers to maintain compliance with green bond eligibility criteria.

The Greening of Bond Markets

The debt capital market's key response to the global environmental crisis is the green bond. While there are varied descriptions of what defines a green bond, it is **broadly any bond issuance whose proceeds are earmarked for the financing of projects which aim for or claim environmental benefits or reduced climate impact.**[13]

First appearing more than a decade ago and still small in size in 2014, the green bond market has expanded tremendously over the last several years. In 2020 alone, there has been $120 billion in issuance in this space—increasing the stock by 25%. Currently, Bloomberg tracks data on over $450 billion of corporate or sovereign bonds with a 'green' label, denominated in $, €, or £.

[13] ICMA (International Capital Markets Association) published a voluntary set of guidelines in The Green Bond Principals (GBP), which define four types of Green Bonds. In this publication, we will focus only on the first type – Standard Green Use of Proceeds Bonds – where proceeds are dedicated entirely towards sustainable projects with full recourse to the borrower. The other types are non-recourse to the issuer – Green Project Bonds, Green Revenue Bonds and Green Securitized Bonds – and are discussed elsewhere in this GPS publication.

Green bonds and the broader availability of green finance have been a key strategic goal of European governments. There has not been as coordinated an effort from U.S. or Asian governments to jump-start this market, which explains the difference in growth rates between these geographic markets. That said, investor demand continues to grow within the U.S. dollar market and issuer demand remains present, should pricing be competitive.

The broader goal of policymakers — particularly European — is to create a viable avenue by which current private market financing of environmental projects (largely via bank loans and project finance) can shift into the publicly-traded bond market.

There is little question that supra-national borrowers — particularly European ones — have been instrumental in developing the green bond market. Thus, these entities were the first to structure and issue green bonds and remain among the more active and ongoing issuers of green bonds to date. **Supras also designed the use of segregated proceeds for specific projects and also provided transparency on funds invested, key environmental performance metrics, and specific project details.**

There is debate about who issued the first green bond but either way, it was a Supra. The competing examples are below:

- In June 2007, the EIB issued a €600 million, 5y, zero-coupon structured note with principal protection, a minimum redemption of 105% at maturity, and whose return was tied to the FTSE4Good Environmental Leaders Europe 40 index. In addition, part of the return could be redeemed in carbon allowances. The proceeds of this Climate Awareness Bond (CAB), as it was called, were allocated to specific renewable energy projects.

- In November 2008, the World Bank issued a SEK2.7 billion (€275m), 3.5%, 6y bond whose proceeds were to be used for environmentally-beneficial projects that met specific, predefined criteria. Importantly, both bonds were issued in response to inquiries by institutional investors (mainly Swedish pension funds) looking to finance environmentally friendly projects. The World Bank issue provided a specific framework for eligible use of proceeds. Also noteworthy, the World Bank coined the term ‘green bond’ in its press release at the time. The World Bank’s bond issue also more readily conforms to a ‘plain vanilla’ bond structure, which is why it is more widely known as the first green bond.

Since those first two bond issues, supras have remained active and consistent issuers of green bonds. This trend should only grow, given increased focus by governments and policymakers on achieving various environmental targets for industries, for countries and for the European Union in aggregate. For example, almost one-third of the European Union’s €750 billion Rescue Fund has been allocated towards green finance projects. Similarly, the European Central Bank (ECB) has announced the intention to make green objectives a central part of its Asset Purchase Plan. Most supras have already established frameworks for green bonds that define the use of proceeds, including procedures for project selection, evaluation and reporting of key metrics. Most eligible green bond projects focus on mitigating climate change or other environmental activities.[14]

[14] Mitigating climate change would directly finance renewable energy projects or energy efficiency projects. Other environmental projects may include waste management, clean transportation, etc…

More specific details on the broad range of supranational issuers and the type of green bonds they finance, in addition to other ESG-related financing, are shown in Figure 35 and Figure 36.

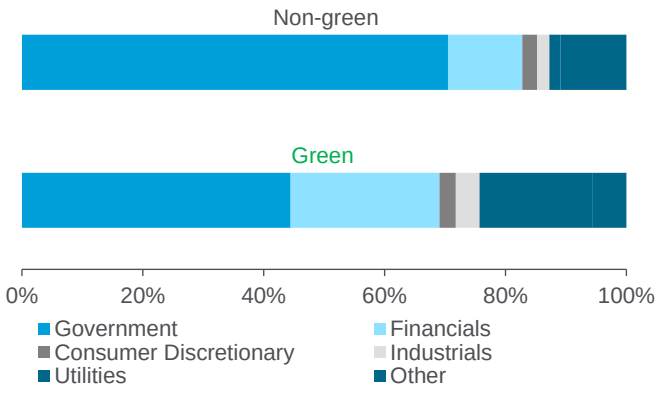
In that light, green bond issuance by these entities continues to be significant and must be included in any assessment of the entire green bond market. **The majority of green bond issuance by supras has been in euros, accounting for half of the issuance over 2020.** Initially, supra issuance was led by development banks. However, supranational agencies have recently formalized their green bond programs, and now account for roughly two-thirds of green bond issuance by supra-nationals (Figure 45and Figure 46).

Supras will remain a key growth driver for the green bond market, given their unique position to allocate across many projects in size and breadth. Equally importantly, supras' green bond issuance attracts a different investor base that the traditional corporate green bonds would not—those looking for highly-rated (AA or AAA) with low risk-weightings and green credentials.

Outside of supras' issuance, corporate borrowers have become more active in green bond issuance over the last few years. Within the U.S. dollar market, the bulk of green bond (or sustainable bond) issuance has been concentrated in the utility, telecoms and real estate sectors (Figure 36). For context, utilities accounted for nearly one-third of U.S. dollar green bond issuance in 2019-2020, while comprising only 7% of the 'vanilla' issuance otherwise.

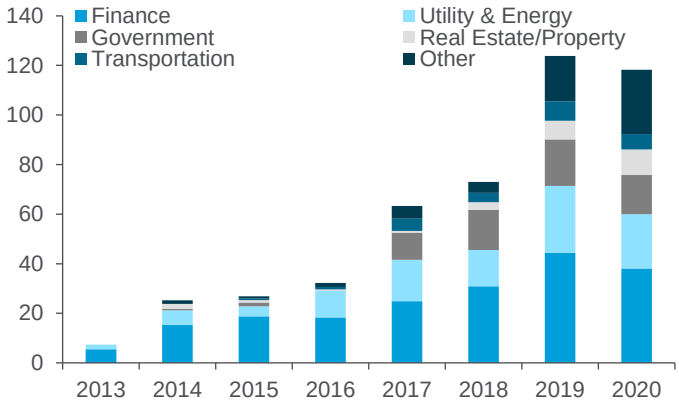
The bulk of green bonds today have investment grade ratings and are issued by governments, supras, financials or utilities, though more recently from other sectors. Given the skew towards banks and utilities sectors, which tend to be higher rated than the corporate bond universe as a whole, the average credit spread on green bonds tends to be tighter than the broader index (Figure 38).

Figure 35. Outstanding Green and Non-Green Bonds by Issuer Sector (% of Universe)



Source: Bloomberg, Citi Research

Figure 36. Unsecured Green Bond Issuance by Sector ($bn)



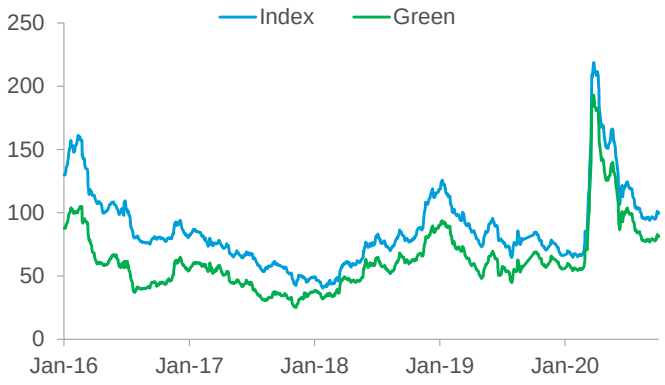
Source: Dealogic, Citi Research

What is the cost of being green? Does green earn a premium or discount? As discussed, the amount of green bond issuance by corporates has accelerated over the last four years, in particular over 2019 (see Figure 37). This growth begs the question: **what financial incentive did borrowers have to issue green bonds over normal 'vanilla' bonds? Is there a significant financial advantage (i.e., lower funding costs) or do investors demand a premium for a new product or reduced liquidity?**

To answer the relative pricing question, we compared green bonds to 'vanilla' or 'brown' bonds[15] issued by the same issuer (after adjusting for differences in maturity, seniority, etc.) in both the secondary market (i.e. where bonds are trading) and in the primary market (i.e. where bonds are issued).

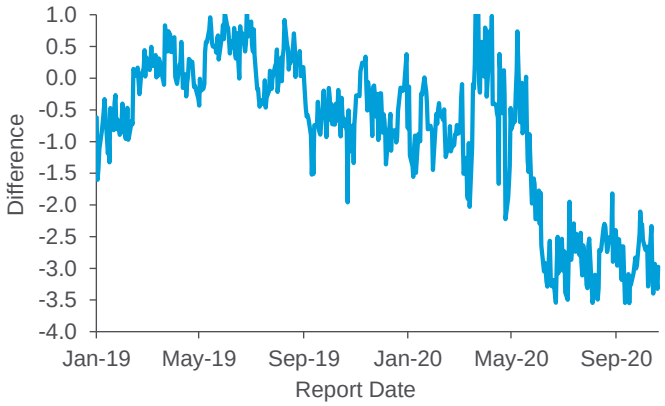
Currently, green bonds trade 2bp to 3bp tighter than comparable non-green bond peers — creating a green premia (sometimes referred to as a 'greenium'). Essentially, investors were willing to pay a higher price over comparable securities in the secondary market. Or, more directly, investors were willing to sell a non-green bond and buy a nearly-identical green bond at a loss of yield (see Figure 38).

Figure 37. Spread on an Index of Green Bonds, Weighted by Outstanding and Duration vs. iBoxx Corp Index, Spread-to-Swaps (basis points)



Source: Citi Research

Figure 38. Average Spread Difference Between Matched € Green and Non-Green Bonds from the Same Issuer (basis points)



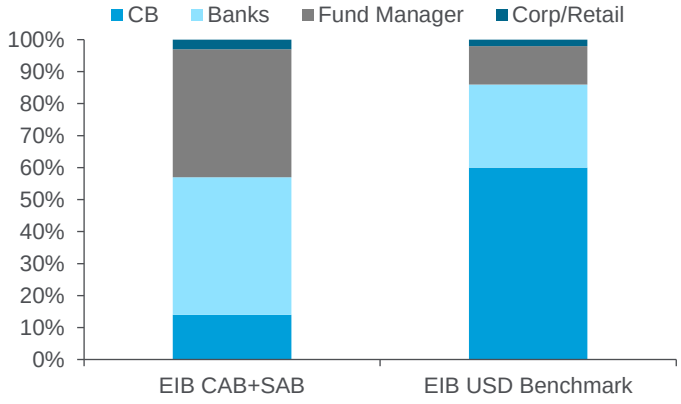
Source: Citi Research

The primary market for green bonds tell a different, more consistent story. When borrowers issue bonds, they typically have to offer a new issue premium versus where comparable bonds trade in the secondary market. Simply put, the issuer has to present a 'carrot' to incentivize investors to buy the bonds initially. **What is worth noting is the amount of new issue premium that green bonds required upon primary issuance has been consistently less than that for comparable non-green bonds** (Figure 41) — i.e., a smaller 'carrot' was required to incentivize investors into a new green bond than a comparable 'vanilla' bond. Indeed, we have observed companies able to issue green bonds as much as 15bp inside where their existing bonds trade, providing a clear reduction in funding costs to the borrower by choosing green. For context, a 15 basis point reduction in funding costs is material when comparing to the total yield of 66bp (0.66%) on the Bloomberg Barclays € Green Bond index (GBEUOAS).

[15] Whereas 'Green' bonds is debt financing targeted towards specific investments that are beneficial to the environment or reduce existing environmental impact, 'Brown' bonds refers to debt financing for borrowers that are viewed to be environmentally-unfriendly. 'Vanilla' bonds covers the remainder: debt financing for entities that are not 'Brown' and where proceeds are not specifically allocated towards environmentally-friendly investments.

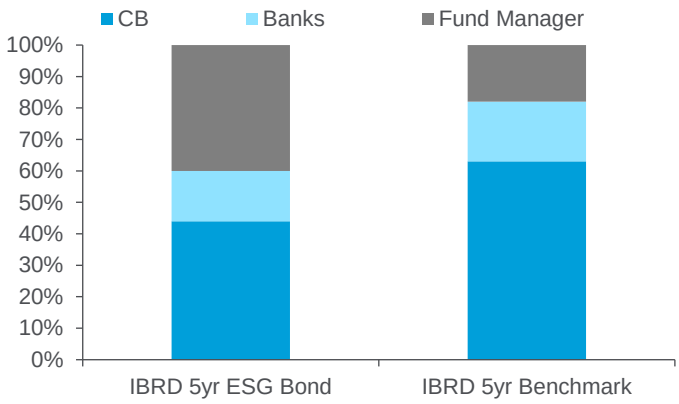
In the supra sector, green bonds appear to attract a higher percentage of fund managers than normal SSA benchmarks. While traditional SSA buyers — central banks—usually focus on five-year and below tenors, $SSA green bonds in longer tenors started to show pricing premiums to non-green benchmark deals.

Figure 39. Investor Allocation for EIB Green Bond Program vs. Regular EIB USD Benchmarks



Source: Issuer's Websites, Citi Research

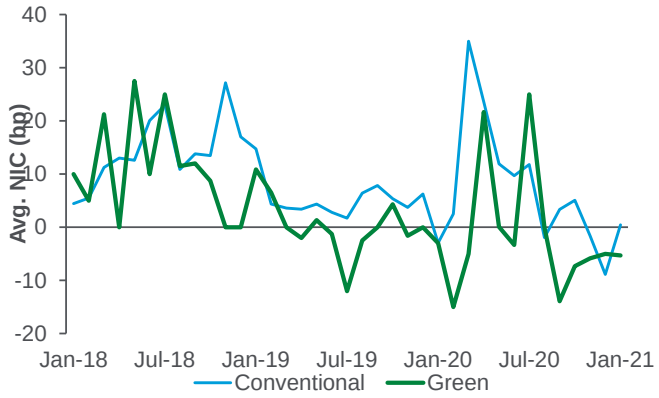
Figure 40. Investor Allocation for a 5yr IBRD Green Bond vs. a 5yr IBRD Benchmark



Source: Issuer's Websites, Citi Research

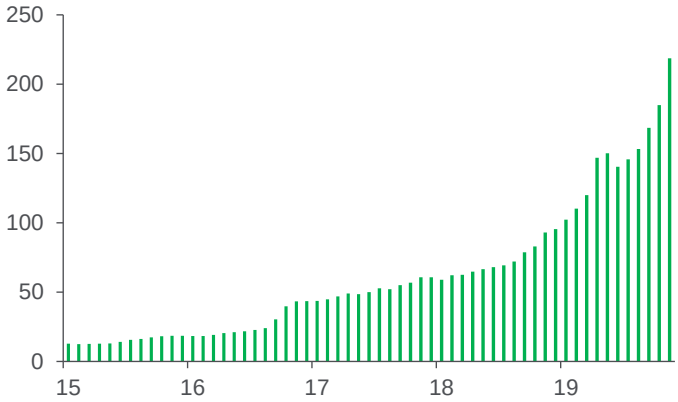
This illustrates that despite the surge in issuance volumes of green bonds, demand has been more than able to keep up in both the primary market and secondary market. This was confirmed by a recent (April 2020) survey of corporate treasurers by the Climate Bond Initiative — 70% of corporates who had issued green bonds in the last year saw higher demand for green bonds than for vanilla equivalents

Figure 41. New Issue Premium for Green and Non-Green Bonds



Source: Citi Research

Figure 42. AUM for SRI/ESG Funds ($bn)



Source: Citi Research, EPFR

If You Build It, They Will Come [16]

The development of the green bond market is well underway, and there has been a visible acceleration in both investor demand and issuer demand over the last two years. At present, the green bond market is seeing asset growth from three fronts: (1) the highly-rated, low yield, stable supranational issuance, largely from European issuers; (2) the investment-grade-rated, largely corporate issuers globally; and (3) a smattering of growth of high-yield — largely energy-related — names. This asset growth also matches the growth in visible green finance mandates, which are concentrated across both institutional investors (e.g. pension funds, endowments) and retail investors (e.g., mutual funds, UCITs and ETFs).

While specific data for the aggregate amount of green bond mandates are difficult, we do have metrics showing the growth in mutual funds and ETFs that focus solely on environmental mandates. EPFR notes that mutual funds with broader ESG mandates have grown from ~$10 billion to over $230 billion over the last five years (Figure 42). More importantly, the growth rate in assets under management is accelerating. Although these funds are generally able to invest in a wider ESG universe, they manage assets roughly half of the size of the green bond universe.

Importantly, capital owners are becoming more specific and more vocal about their environmental goals. They are being more direct in asking asset managers to develop and implement ESG strategies or, more specifically, green strategies.

Asset managers have been challenged to create robust investment frameworks, given variation and limits in data, performance metrics, suitable investment criteria and, in some markets, a sufficient supply of green bond assets.

We highlight a recent survey[17] by the Credit Roundtable, which noted a few common themes by fixed-income asset managers. Importantly, climate change and environmental degradation were by far the highest priority focus by asset managers across all ESG themes. However, and interestingly, about two-thirds of asset managers stated that they do not specifically target green bonds.

"As policymakers and the private sector hone in on climate finance, we need a shared language and set of metrics. This doesn't just apply to green bonds. This market is a litmus test for wider climate finance" – Aldo Romani, European Investment Bank

Some of the specific challenges for the asset managers in the survey included the following:

- **Data quality remains a key constraint** for investing in ESG (including green bonds). This includes a lack of reliability, history, consistency or comparability of data. Asset managers find it difficult to access data that are known to be available, but not necessarily released by issuers.
- **The lack of standardization in terms and definitions** of green bonds is the dominant deterrence to investing, as per two-thirds of asset manager responses. Existing guidelines are still voluntary and differ across regions.

[16] With apologies to Phil Robinson's 1989 movie, Field of Dreams, and Kevin Costner (Ray Kinsella).

[17] The Credit Roundtable survey was conducted between mid-August and mid-September 2020, including 47 asset managers covering an aggregate fixed-income AUM of $6.0 trillion. Circa two-thirds were asset managers and one third were insurance investors. More than 55% of respondents managed more than $100bn in fixed-income AUM.

"The need for standardization in this market is self-evident and urgent. We need a definition of what is green." – Julien Bras, Portfolio Manager – Socially Responsible Investments, Allianz

- **Limited or a lack of transparency of key performance metrics** by green bond issuers is a deterrence to investing, as per two-thirds of asset manager responses. This is also cited with respect to limited ability to monitor compliance with stated goals.
- **Asset managers are reluctant to become overly reliant upon outside firms to certify the credentials of a green bond.** Given the above consideration, asset managers currently either rely heavily upon third-party rating services (e.g., MSCI, Sustainalytics), or they have invested in their own proprietary models. Both avenues pose business risks (upfront costs and possible direct legal exposure from proprietary systems) and potentially contradictory signals. Moreover, current ESG ratings are occasionally contradictory for identical issuers,[18] which can be disconcerting.

The green bond market is still some way from being a mature, stable, liquid asset class with a permanent pool of capital owners, borrowers and transparent pricing. This is not an insurmountable challenge. We believe that the green bond market needs to address some specific factors to be able to move to the next level.

Looking Forward—Criteria for Maturation of the Green Bond Market

Can this phenomenal rate of growth continue? We believe it can over the coming years, but in order to do so, the green bond market needs to mature. We believe that the structure, sentiment and dynamics exist today to allow a rapid growth in the green bond market, provided some key elements are addressed.

In order to sustain demand, the market needs *diversification*. A common argument against 'green debt' mandates is that by reducing the opportunity set, investors are foregoing potential returns and concentrating risk, as active managers are constrained in their portfolio allocation. In a recent Refinitiv survey, investors answered that **the most important change needed to shift demand for green bonds to the next phase of growth was a broadening of the number of issuers across a much wider number of sectors.**

This is slowly occurring. Over 2020, much of the incremental growth in green bond issuance was driven by new sectors — such as financials and real estate. We still need to see greater issuance by other sectors, but this may be simply a factor of which sectors are more entrenched in environmentally exposed businesses. We have also begun to see different types of green bonds being issued. For example, some banks have begun to issue subordinated bank capital securities under a green label — in July '20, the Spanish bank BBVA issued an Alternative Tier 1 green security. Increases in subordinated and high-yield bond issuance would help broaden the range of yield available across the green bond universe. The green bond market also has been more highly concentrated in euros rather than U.S. dollars, which compounds the diversification constraints for global asset managers.

Another challenge is the inconsistency on the definitions for green finance. Given the current vagaries of definitions across regions, across markets on 'what is green?' and 'what is excluded?', the market would benefit from greater standardization of terms. This should lead to better distribution and use of key data metrics to facilitate measurement and, ultimately, provide accountability.

[18] Different ESG rating firms could give very different ratings for the same issuer.

Blurred lines between green and other types of socially-responsible investing are not helpful either. Within the broad confines of Environmental, Social and Governance (ESG) investment mandates, there are a variety of subjective assessments and prioritizations, which can result in very different company rankings. On occasion, the same corporate issuer could be evaluated with a highest as well as lowest ESG score under competing measurement criteria.

Another key facet of the green bond market that needs to adjust is *accountability*. The Bank for International Settlements recently published a report highlighting that green bonds to date do not provide legal assurance that the proceeds are actually used for projects delivering comparatively low or falling carbon emissions. Nor are issuers required to quantify their climate exposure.

Most bonds outstanding today are issued under ICMA's voluntary Green Bond Principles,[19] which, by themselves, provide no recourse should the issuer not spend the proceeds on eligible projects. The term 'greenwashing' has been coined[20] to describe the prospect that a company claims green credentials that its operations do not actually warrant. Investors as yet have little power to intervene. Examples of greenwashing in the media could weaken the selling point of green funds and undermine well-intentioned investment flows. We believe it is important that the green finance brand remains untarnished.

These constraints — diversification, standardization, and accountability — are surmountable. This requires coordination and collaboration by policymakers, industry associations (of both investors, intermediaries and issuers), as well as regulators. It is also important that these constraints are addressed globally. We have already begun to see initial steps occur.

Europe Takes the First Steps in Standardization of Green Finance

In December 2019, the EU Council and the European Parliament agreed upon a set of standards and definitions for the green finance label. **Specifically, the European regulations set out specific activities that qualify as environmental, and also specify requirements than an issuer must meet in order to qualify for the EU Green Bond standard.** The regulations stress "do no significant harm" as a guiding requirement across all sectors — both on the activity as well as an obligation on the issuer. At this point, the agreed taxonomy behind the EU Green Bond qualification has not been enshrined in law, but that is scheduled to occur in the near future.

We believe the European move towards a common standard is important to allow the green bond market to grow and mature, which is beneficial for both issuers and investors. Hopefully, the framework will lead to better disclosures from issuers and greater transparency for investors.

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[19] https://www.efama.org/Pages/Submitted after 2018-03-12T16 22 07/EFAMA-responses-to-European-Commission-consultations-on-MiFID,-UCITS-and-AIFMD-Delegated-Acts.aspx

[20] The term 'Greenwashing' was first used in an essay published by noted environmentalist, Jay Westerveld in 1986. Jay noted that hotels were using 'Save the Towel' cards as promoting environmentally friendly policies, when in actuality it was designed as a cost-saving measure to reduce laundry expense. The essay argued "Wash my towels please, just don't greenwash me." The term was then broadly applied to corporations who promoted or presented environmentally-friendly actions or services, which were not in fact environmentally-friendly.

We note prior examples of standardization leading to rapid growth in a new market: German pfandbrief, Danish realkredit, bank capital securities, or the subordinated 'hybrid' corporate bond market.

The EU Commission is also working on integrating sustainability (a word which of course goes beyond 'green') factors into regulations governing the European fund management industry. The proposals, currently at the consultation stage, would require managers to disclose how their investments comply with sustainability and environmental objectives.

While regulation can play a pivotal role in accelerating market growth by compelling harmonization, it requires balance and flexibility. An overly rigid taxonomy might hinder issuance if it is too onerous or not sufficiently aligned with issuers funding needs. It is already clear that some existing green finance securities would not comply under the proposed taxonomy. Similarly, asset managers currently have a wide range of marketing themes across "green finance" and, more broadly, ESG investing. A taxonomy that is too restrictive might not align with the environmentally-focused themes that capital owners desire.

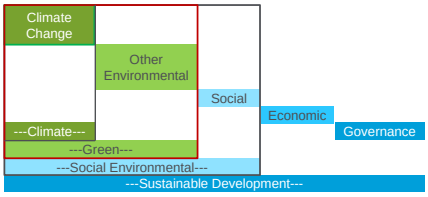
The European Fund and Asset Management Association (EFAMA) has strongly welcomed the Green Bond Standard, but it has expressed concern that the current proposal may not be flexible enough in several regards to facilitate sustainable investing becoming increasingly mainstream.

Encouraging Accountability Among Green Finance Issuers

Another key aspect is strengthening enforceability — what if environmental targets initially set are not subsequently met? In that regard, the inclusion of Key Performance Indicators in few recent issues is a welcome development. These bonds have a step-up in coupon if the KPIs that set on quantifiable green objectives are not met.

Green/sustainability investors are, not surprisingly, very keen on such features. It remains to be seen, however, how many issuers are willing to introduce such features in their bonds. In an exceptionally issuer-friendly market, issuers could be reluctant to issue bonds with step-up coupon without a meaningful spread discount. In a future environment, where supply and demand is more balanced, issuers may be more willing to offer such features.

Figure 43. SSA ESG Bond Categories



Source: Citi Research

The market for forward-looking, performance-based instruments like sustainability-linked bonds was recently bolstered by a set of voluntary guidelines for issuers, published in June 2020 by the International Capital Market Association. The guidelines provide a checklist for issuers covering the selection of performance indicators, bond characteristics, and issuer standards on reporting and verification. For example, the ICMA standards for sustainability-linked notes encourage issuers to set performance targets that can be compared to a benchmark or an external reference, and provide investors a detailed description of fallback mechanisms in the case of extreme events or if performance targets cannot be measured.

For both green bonds and sustainability-linked bonds, ICMA guidelines encourage issuers to obtain external reviews to increase investor trust in the integrity of vehicles financed under the banner of environmentalism. One form of review known as a second-party opinion involves an outside organization assessing the goals, features and processes of a green bond program. Such reviews can be provided to investors to assist in comparing a program's structure to current market practice.

For example, if an issuer plans to use green bond proceeds to improve the energy efficiency of an office building, a second-party review might discuss the efficiency standards the company follows are credible, and might highlight whether the issuer has committed to a quantifiable energy savings goal.

Positioned for Growth

At slightly more than a decade old, the green bond market is approaching "adolescence". Rapid growth has left a sprawling universe of investors, issuers, financing purposes and products. We see every reason to believe that the market will continue to grow, fueled above all, by a sincere desire to facilitate a transition to a more sustainable global economy.

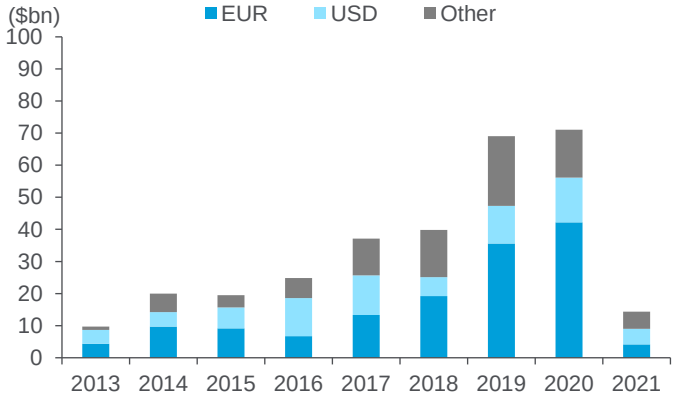
However, with maturity inevitably comes greater scrutiny and the need for regulation to deliver a (more) level playing field. The diffuse nature of what is 'green' likely means that the universe will remain more dispersed in terms of actors, features and documentation than, say covered bonds or financial sub debt. But provided that the trust in the original objective can be sustained, this should not impede the green bond market from becoming a substantial part of the broader global fixed income market.

Figure 44. Green/Social/Sustainability Bond Program for Major SSA Issuers and Their Targeted Projects

		Climate	Other Environmental	Social Environmental	Sustainable Development
Supranational Banks					
EIB	CAB (Climate Awareness Bonds)	X			
	SAB (Sustainability Awareness Bonds)		X	X	
IBRD	Green Bonds	X	X		
IADB	SDG				X
	EYE			X	
IFC	Green Bonds	X	X		
	Social Bonds				X
ASIA	Green Bonds	X	X		
	Water Bonds				X
EBRD	ESB (Environmental Sustainability Bond)	X	X		
	Social Bond			X	
AFDB	Green Bonds	X	X		
	Social Bonds			X	X
AIIB	ESF (Environmental and Social)	X	X	X	X
NVEDBB	Green Bonds	X	X		
	Social Bonds			X	X
ISDB	Green Sukuk	X	X		
	Social Sukuk			X	X
EUROF	Green Bonds	X	X		
COE	Social Inclusion Bond			X	
NIB	NEB (NIB Enviornmental Bond)	X	X		
	Response Bonds			X	
CAF	Green Bond	X	X		
CABEI	Green Bond	X	X		
EU Agencies					
KFW	Green Bonds	X			
RENTEN	Green Bonds	X			
NRWBK	Green Bonds	X	X		
	Social Bonds			X	
AGFRNC	Sustainability Bond	X	X	X	X
SNCF		X	X		
CDCEPS	Green Bond	X	X	X	
	Sustainability Bond			X	X
SOGRPR	Green EMTN		X		
ALSFR	Sustainability Bond			X	
NEDFIN	Sustainability Bond	X	X		
BNG	Sustainability Bond				X
NEDWBK	Water Bond	X	X		
	SDG Housing Bond			X	
OKB	Sustainability Bond	X	X	X	
ICO	Green Bond	X	X		
	Social Bond			X	
Nordic Agencies					
KBN	Green Bonds	X	X		
KOMINS	Green Bonds	X	X		
KOMMUN	Green Bonds	X	X		
KUNTA	Green Bonds	X	X		
	Social Bonds			X	
SEK	Green Bonds	X	X		
Other Agencies					
EDC	Green Bonds	X	X		
CPPIBC	Green Bonds	X	X		
DBJJP	SRI Bond	X	X	X	
JFM	Green Bond		X		
EIBKOR	Green Bond	X	X		
Regional Governments					
NRW	Sustainability Bond	X	X	X	X
Q	Green Bond	X	X		
ONT	Green Bond	X	X		
Sovereigns					
Germany	Green Bond	X	X		
France	Green OAT	X	X		
Belgium	Green OLO	X	X		
Luxembur	Sustainability Bond	X	X	X	X
Sweden	Green Bond	X	X		

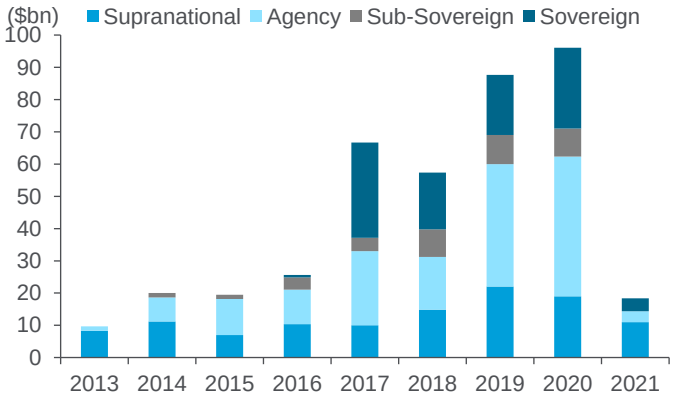
Source: Citi Research

Figure 45. SSA Green Bond Issuance (ex-Sovereign Issuance) by Currency



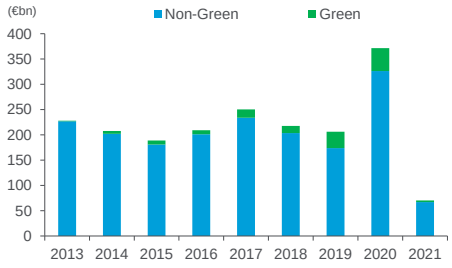
Source: Citi Research

Figure 46. SSA Green Bond Issuance (in all currencies) by Issuer Type



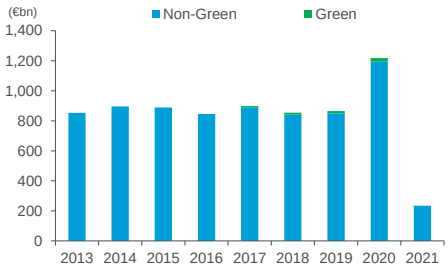
Source: Citi Research

Figure 47. Euro SSA Supply



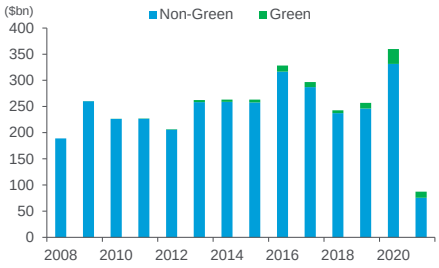
Source: Citi Research

Figure 48. Euro Sovereign Bond Supply



Source: Citi Research

Figure 49. USD SSA Supply



Source: Citi Research

Figure 50. Uses of Proceeds Under Green Bond Program Frameworks from Supranational Banks

	EIB	IBRD	IADB	IFC	ASIA	EBRD	AFDB	NIB	AIIB	NVEDBB	ISDB	EUROF	CAF	CABEI
Renewable energy	X	X		X	X	X	X	X		X	X		X	X
Energy efficiency	X	X		X	X	X	X	X		X	X	X	X	
Water management (water supply/distribution & storage)		X			X	X	X	X		X			X	X
Waste water management (sanitation/sewage networks)		X				X	X				X		X	
Solid waste management (methane emissions)			X			X	X	X		X	X		X	
Land Management (soil/agricultural/land use/enviornment)										X	X		X	X
Forestation management			X								X			X
Flood protection (flood control/drainage systems)		X	X		X						X			X
Clean Transportation (public transit)			X		X	X	X	X		X	X	X		X
Food security (slow down deforestation)			X							X				
Biodiversity conservation (reduce emission)							X							
Industrial Process (reduce emission)							X							
Green buildings								X		X				
Climate change adaption										X				
Other (R&D, clean tech, carbon capture, etc.)				X			X	X		X				
Education and professional development		X		X				X			X			
Healthcare and social-healthcare		X				X		X			X			
Employment/SME financing				X		X		X			X			
Youth development				X										
Affordable housing								X			X			
Affordable basic infrastructure														
Access to essential services/digital				X				X			X			
Agribusiness											X			
Social inclusion and equality				X										
Gender equality and diversity				X										
Economy solidarity				X										
Productivity and innovation				X										
Sustainable development projects														
Strenghtening capacity to climate related disasters				X										
Integrate climate change into policies and planning				X										
Education on climate change				X										
Other				X										

Source: Citi Research

Figure 51. Uses of Proceeds Under Green Bond Program Frameworks from Other Agencies, Sub-Sovereigns, and Sovereign Governments

	KFW	RENTEN	NRWBK	AGFRNC	CDCEPS	SNCF	SOGPRP	ALSFR	NEDFIN	BNG	NEDWBK	OKB	ICO
Renewable energy	X	X	X	X	X				X			X	X
Energy efficiency	X		X	X	X				X			X	X
Water management (water supply/distribution & storage)			X	X							X	X	X
Waste water management (sanitation/sewage networks)			X						X		X	X	X
Solid waste management (methane emissions)			X	X	X				X			X	X
Land Management (soil/agricultural/land use/enviornment)			X	X	X				X			X	X
Forestation management				X					X			X	
Flood protection (flood control/drainage systems)				X							X	X	
Clean Transportation (public transit)			X	X	X	X	X		X			X	X
Food security (slow down deforestation)													
Biodiversity conservation (reduce emission)			X									X	
Industrial Process (reduce emission)													
Green buildings			X		X								
Climate change adaption									X			X	
Other (R&D, clean tech, carbon capture, etc.)			X						X				
Education and professional development				X									
Healthcare and social-healthcare				X	X								
Employment/SME financing				X									
Youth development													
Affordable housing				X									
Affordable basic infrastructure													
Access to essential services/digital													
Agribusiness													
Social inclusion and equality				X									
Gender equality and diversity													
Economy solidarity													
Productivity and innovation													
Sustainable development projects													
Strenghtening capacity to climate related disasters													
Integrate climate change into policies and planning													
Education on climate change													
Other										Sustainability	Municipality		

Source: Citi Research

Figure 52. Use of Proceeds Under Green Bond Program Frameworks From Other Agencies, Sub-Sovereigns and Sovereign Governments

	KBN	KOMINS	KOMMUN	KUNTA	FINNVE	SEK	EDC	EIBKOR	CPPIB	DBJJP	JFM	Q	ONT	Germany	France	Belgium	Luxemburg	Sweden
Renewable energy	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X
Energy efficiency	X	X	X	X		X	X	X		X		X	X	X	X	X	X	X
Water management (water supply/distribution & storage)	X	X	X	X		X	X	X	X		X	X					X	X
Waste water management (sanitation/sewage networks)	X	X	X	X		X			X		X	X					X	X
Solid waste management (methane emissions)	X	X		X		X	X	X				X				X	X	X
Land Management (soil/agricultural/land use/enviornment)	X	X		X		X	X					X	X	X	X	X		X
Forestation management						X	X					X	X	X				
Flood protection (flood control/drainage systems)														X				
Clean Transportation (public transit)	X	X	X	X		X	X	X		X		X	X	X	X	X	X	X
Food security (slow down deforestation)																		
Biodiversity conservation (reduce emission)						X	X	X										X
Industrial Process (reduce emission)																		
Green buildings	X	X		X		X			X	X					X		X	
Climate change adaption												X	X		X			
Other (R&D, clean tech, carbon capture, etc.)						X								X	X	X	X	X
Education and professional development																	X	
Healthcare and social-healthcare										X							X	
Employment/SME financing										X							X	
Youth development																		
Affordable housing										X								
Affordable basic infrastructure										X							X	
Access to essential services/digital										X							X	
Agribusiness																		
Social inclusion and equality																	X	
Gender equality and diversity																		
Economy solidarity																		
Productivity and innovation																		
Sustainable development projects																		
Strenghtening capacity to climate related disasters																		
Integrate climate change into policies and planning																		
Education on climate change																		
Other																		

Source: Citi Research

11. Green Bonds in Emerging Market Portfolios

GMSG EM Strategy

W. R. Eric Ollom

Ayoti Mittra

How big is the AUM following ESG strategies? This is a good question, as it goes to the heart of the effectiveness of the framework. The Global Sustainable Investment Alliance (GSIA) estimates that $30 trillion (as of April 2019) of asset under management (AUM) is following broad "sustainable investment strategies" across all asset classes. Much of this involves equities. As this total is from a survey of fund managers, a significant amount of double counting may be included. The Net-Zero Asset Owner Alliance is a UN-convened group of global asset managers that is pledged to ESG guidelines, representing approximately $7 trillion of AUM, and can be considered a core group of investors. For EM fixed income, the World Bank estimates that there is $25 billion of defined EM ESG Fixed Income Assets under management, a rather small amount compared to a $1.3 trillion asset class. However, this only includes dedicated public portfolios. We note many asset managers have pledged to integrate ESG standards into their overall investment process, and the ESG influenced AUM for EM fixed income is likely many times larger.

What are the main strategies being followed in EM? We have identified several different types of ESG 'mainstream' strategies being followed by EM debt investors. All take into account ESG 'awareness', and some are more exclusionary than others. Some seek to actively influence ESG outcomes, a strategy that may likely gain traction going forward. Using the World Bank sample of 20 large global asset managers, we have placed these investors into the different portfolio strategies as we define them. Some follow more than one strategy, and hence are double counted (Figure 53). As can be seen, the 'best in class' strategy is the most popular, followed by 'screening'. We would argue these are very similar, as screening is necessary to determine best in class. From an active management perspective, we see screening as the alpha generator, yet it would require more robust and forward looking risk assessment tools and standards than are generally available. We discuss this dilemma later in this chapter, but suffice to say we believe these issues will be clarified in time given the large amount of market focus on this problem.

Figure 53. Representative ESG Investment Strategies in EM Fixed Income

Strategy Category	% of Asset Managers	Investor Approach
Best-in-Class / ESG Integration	65%	- Score Sovereigns using a proprietary ESG framework - Mix of quantitative and qualitative analysis - Analyze creditworthiness, spreads, and cost of borrowing using ESG factors - Assess strengths and vulnerabilities not visible in macro data, improving portfolio quality - Outperform and reward by selecting issuers with improving and strong ESG performance
Screening	35%	- Identify and assess risk/reward in EM debt - Mitigate risks with regard to ESG issues - Identify areas of mispricing
Engagement	25%	- Engagement allows for full understanding of ESG risk - Can create new investment opportunities - Connect with government officials about their cost of borrowing - Far fewer opportunities to engage with sovereign issuers than corporate
Thematic Investment	15%	- ESG factors can influence the trajectory of the economy

Source: World Bank, Company Reports, Citi Research

Green Finance in EM: Issuance and Pricing

What qualifies and how much has come to market? The ICMA has developed criteria of how a company or country could access the growing ESG specific mandate through Green, Social, Sustainable and Linked frameworks (Figure 54). These programs apply a specific set of criteria that is consistent with the UN SDGs as set out for a country or goals set out by a company. For green bonds, a qualifying issuer may be a company or sovereign that seeks to use proceeds from a bond offering to invest in renewable energy projects, or green buildings, or community environmental remediation. The issue needs to use criteria set in the Indenture on what portion of the proceeds must be used for the green project, as well as third party external review requirements in many cases. A Social bond is tied to things like housing, education, and equality. While companies and sovereigns can issue either green or social bonds, we believe companies will constitute most of the green bonds and sovereigns most of the social bonds. Sustainable bonds are tied more loosely to either green or social projects. Linked bonds are bonds that have a broad allowance for use of proceeds, but have a covenant linking to an SDG compliant program through Key Performance Indicators (KPI) like specific carbon reduction goals. In many cases, this is an upward coupon adjustment if the KPI goal is not achieved.

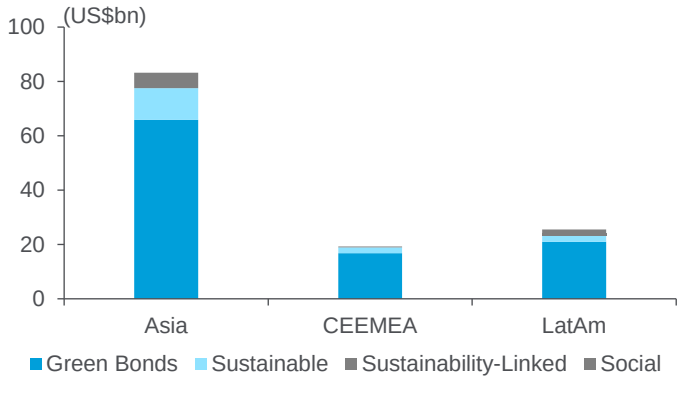
Figure 54. What Qualifies as an ESG Bond?

ESG Bond	Definition	Types of Bonds	Eligible Projects
Green Bond	Capital raising and investment for new and existing projects with environmental benefits.	Standard Green Use of Proceeds Bond: a standard recourse-to-the-issuer debt obligation aligned with the GBP (Green Bond Principles). Green Revenue Bond: a non-recourse-to-the-issuer debt obligation aligned with the GBP in which the credit exposure in the bond is to the pledged cash flows of the revenue streams, fees, taxes etc., and whose use of proceeds go to related or unrelated Green Project(s). Green Project Bond: a project bond for a single or multiple Green Project(s) for which the investor has direct exposure to the risk of the project(s) with or without potential recourse to the issuer, and that is aligned with the GBP. Green Securitized Bond: a bond collateralized by one or more specific Green Project(s) and aligned with the GBP. The first source of repayment is generally the cash flows of the asset.	Renewable energy, energy efficiency, pollution prevention and control, environmentally sustainable management of living natural resources and land use, terrestrial and aquatic biodiversity conservation, clean transportation, sustainable water and wastewater management, climate change adaption, eco-efficient and/ or circular economy adapted products production technologies and processes.
Social Bonds	Raise funds for new and existing projects with positive social outcomes.	Social Revenue Bond: a non-recourse-to-the-issuer debt obligation aligned with the SBP in which the credit exposure in the bond is to the pledged cash flows of the revenue streams, fees, taxes etc., and whose use of proceeds go to related or unrelated Social Project(s). Standard Social Use of Proceeds Bond: a standard recourse-to-the-issuer debt obligation aligned with the SBP. Social Project Bond: a project bond for a single or multiple Social Project(s) for which the investor has direct exposure to the risk of the project(s) with or without potential recourse to the issuer, and that is aligned with the SBP. Social Securitized and Covered Bond: a bond collateralized by one or more specific Social Project(s) This type of bond covers, for example, covered bonds backed by social housing, hospitals, and schools.	Affordable basic infrastructure, Access to essential services, Affordable housing, Employment generation, Food security and sustainable food systems, Socioeconomic advancement and empowerment.
Sustainable Bond	Proceeds will be exclusively applied to re-finance a combination of both Green and Social projects.	The four types of Green Bonds and Social Bonds referred to in the Appendix I of the GBP and the SBP. Respectively applies to Sustainability Bonds when Green and Social Projects are combined.	
Sustainability Linked Bonds	Type of bond instrument for which the financial and/or structural characteristics can vary depending on whether the issuer achieves predefined Sustainability/ ESG objectives.	The cornerstone of a SLB is that the bond's financial and/or structural characteristics can vary depending on whether the selected KPI (Key Performance Indicators) reach (or not) the predefined SPT (Sustainability Performance Targets). The SLB will need to include a financial and/or structural impact involving trigger event(s). Potential coupon variation is the most common example, but it is also possible to consider the variation of other SLB's financial and/or structural characteristics.	The proceeds of SLBs are intended to be used for general purposes, hence the use of proceeds is not a determinant in its categorization. Regardless, in select cases, issuers may choose to combine the GBP/SBP approach with the SLBP.

Source: ICMA, Citi Research

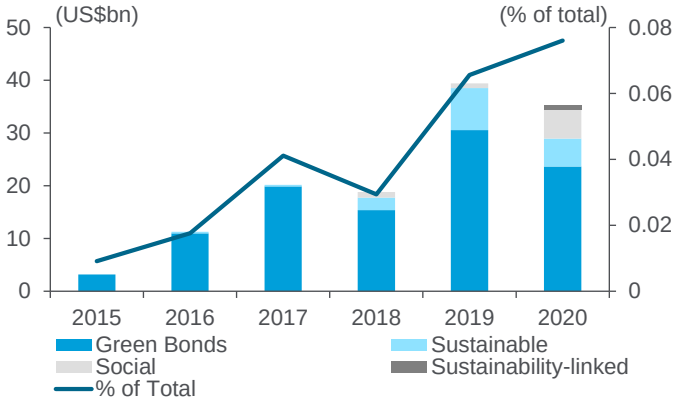
ESG bond issuance has been accelerating the past few years but remains a relatively small part of the overall primary activity in EM credit with $128 billion issued since 2015 (Figure 55 and Figure 56). Green issuance is by far the largest type of structure used with $103 billion, and corporations and financial institutions far exceed sovereigns in terms of outstanding bonds. In Figure 57 and Figure 58, we show a variety of ESG bond statistics by issuance, composition in the Citi FTSE EMBBI index, and a table of selected 'case studies' of ESG bond issuers. Asian issuers are the largest region, and financials are the largest sector (in many cases, its Asian banks doing the issuance).

Figure 55. Regional Issuance of ESG Bonds (2015-2020)



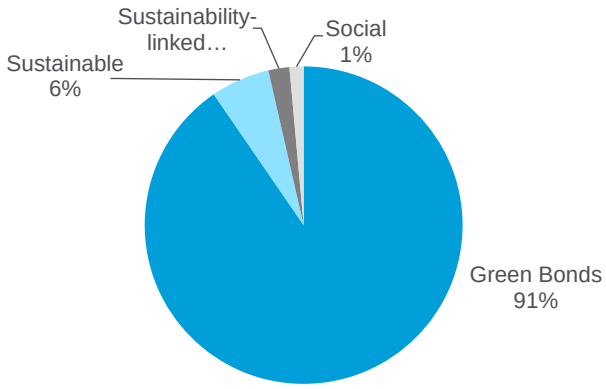
Source: Bond Radar, Bloomberg, Citi Research

Figure 56. Annual Issuance of ESG Bonds



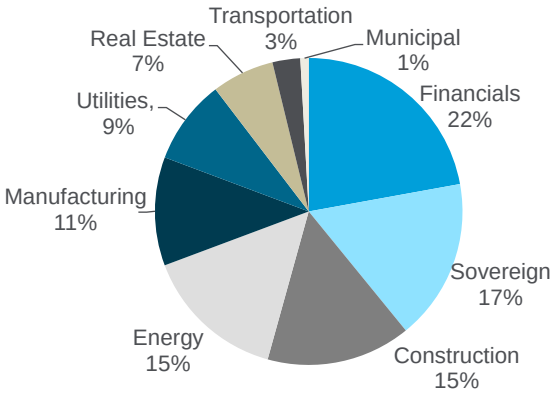
Source: Bond Radar, Bloomberg, Citi Research

Figure 57. Citi Index: EMBBI ESG Bonds



Source: Citi Research

Figure 58. Citi Index: EMBBI ESG by Sector



Source: Citi Research

Beware of 'greenwashing'. Criticisms of the ICMA framework mainly fall under the idea of 'greenwashing'. This basically recognizes that money is fungible, and proceeds meant to be used for a designated green or social project may in fact be used for something else. It also means that without an external review of how the money is spent, investors have no way to verify the use of proceeds. Depending on how stringent the ESG strategy being followed by investors is, any ESG compliant bond that becomes considered non-compliant may be excluded from an ESG portfolio, and any pricing premium associated with that issuance may be lost. In other words, the cost of non-compliance is borne by investors, not issuers. In KPI-linked bonds, the upward coupon adjustment compensates investors in the event the KPI goals are not achieved. For this reason, this is our preferred structure as it best protects investors.

Green finance in practice: how does the EM world price ESG bonds? This is an interesting question, as other than the KPI-linked bonds, there is nothing differentiating a Green or Social bond as anything different in credit terms from a non-ESG bond. Default risk is the same, recovery in default presumably would be the same, and at maturity, you get your money back at par. **Our analysis finds that ESG compliant bonds typically price 10-20 basis point through the existing curve.** However, we also note that all ESG compliant bonds are not treated the same way. 'Green bonds' typically price through their curve, but pricing of 'Sustainable bonds' has been more mixed. In Figure 59 we show the pricing of green/social/sustainable bonds. There is also a distinction between investment grade (IG) and high yield (HY) issuer.

Figure 59. Case Studies: Selected Sovereign and Corporate ESG Issuance

Issuer	Type of Structure	Use of Proceeds	External Audit	KPI-Linked	Specified Targets	ESG Compression at new issue	spread differential of ESG vs. Non-ESG
Sovereign							
Ecuador Social Bond SARL	Social	Affordable Housing	Yes	No	Support Ecuador to finance its social housing program, reducing the housing deficit and promoting economic growth, by providing mortgages to the Program beneficiaries	NA	NA
Guatemala	Social	Eligible Social Investments	Yes	No	COVID-19 response, food security, affordable basic infrastructure, access to essential services, socioeconomic advancement and empowerment	NA	NA
Mexico	Sustainability	Fund programs aligned with the SDGs.	No	No	No specific targets but the Government of Mexico is committed to the SDG goals and therofore will use proceeds towards poverty alleviation and equality	NA	NA
Chile	Green	Eligible Green Projects	Yes	No	Green projects - portfolio included projects from Clean Transporation sector that were certified by Climate Bonds Initiative	-13	-6
Indonesia	Green (Sukuk)	Eligible Green Projects	Yes	No	Combat climate change and reducing GHGs emission. 100% of the proceeds go to finance/refinance green projects in 9 eligible sectors which fall under 3 shades of green.	-8	-2
Corporates							
Suzano	Sustainability Linked	Finance Tender	Yes	Yes	Reduce Greenhouse Gas Emissions Intensity to 0.181 tCO2e/ton by end of 2030, a 15% reduction compared to 2015. 2025 target is 0.190 tCO2e/ton, a 10.9% reduction.	-42	-37
Saudi Electric	Green	Eligible Green Projects (objective-Climate Change Mitigation)	Yes	No	Reduce Scope 1 (direct) and 2 (indirect) emmissions by 25% by 2025 to the 2016 baseline. Increase renewable capacity to 27.6 GW by 2025.	-21	-5
Celulosa Arauco	Sustainable	Eligible Green and Social Projects	Yes	No	Re-value 50% of industrial waste in 2020 (an increase from 38% in 2019). Aim to certify carbon neutrality in 2020.	20	-7
China Construction bank	Green	Eligible green bonds	No	No	Mertro projects for clean transportation in the Sichuan and Yunan Province	-40	34
QNB	Green	Eligible green bonds	Yes	No	allocate the proceeds from green, social and sustainability bonds to an eligible green and social loan portfolio.	-11	-15

Source: Company Reports, Citi Research

Measuring the amount of ESG IPT compression. Our calculation is fairly simple. Using the issue date of the ESG compliant bond, we construct a spread/yield curve of a non-ESG curve of the same issuer on that given date. We use this non-ESG curve to determine what the fair value would be if the new bond was a regular, i.e., non-ESG bond. Based on this 'fair-value' we subtract the final issue spread. This is our ESG compression. We should also highlight that our analysis does not take into account any 'new issue concession' that typically ranges from 5-25bp depending upon market conditions and rating category. If we add this 'new issue concession' then the compression for the ESG bonds will be even larger than we currently calculate. It is noteworthy that KPI-linked bonds have the largest concession, which is consistent with our view that KPI-linked bonds have real teeth, and the cost of non-compliance with the SDG goals falls on the issuer through higher compensation, and not the investor via normalizing at the issuer yield curve for non-ESG issues.

Figure 60. Sovereign and Corporate ESG Premium is Roughly 10bp for Investment Grade

	Issue Date	Maturity Date	IPT (bp): A	Issue Spread (bp): B	Compression (bp): (A)-(B)	ESG compression to existing curve (bp)	Rating
Indonesia	6/16/2020	23-Jun-25	T+265.5	T+195.3	70	-13	BBB
Chile	1/22/2020	25-Jan-50	T+120.0	T+105.0	20	-4	A
Chile	1/22/2020	27-Jan-32	T+95.0	T+80.0	15	-13	A
Korea	6/12/2019	19-Jun-24	T+55.0	T+30.0	25	-14	AA
Indonesia	2/12/2019	20-Aug-24	T+170.0	T+140.7	29	-7	BBB
Indonesia	2/22/2018	1-Mar-23	T+139.0	T+109.5	29	-8	BBB
Corporates							
SAUDI ELEC GLB SUKUK	10-Sep-20	17-Sep-30	T+200	T+173	-27	-21	A-
SAUDI ELEC GLB SUKUK	10-Sep-20	17-Sep-25	T+170	T+147	-23	-7	A-
CHINA CONSTRUCT BANK/HK	28-Jul-20	4-Aug-25	T+150	T+105	-46	-89	BBB+
CHINA CONSTRUCT BANK/HK	28-Jul-20	4-Aug-23	T+135	T+93	-42	-65	BBB+
QNB FINANCE LTD	15-Sep-20	22-Sep-25	T+160	T+141	-19	-11	AA-
KOREA GAS CORP	9-Jul-19	16-Jul-29	T+120	T+93	-28	-2	AA
CELULOSA ARAUCO CONSTITU	24-Oct-19	29-Jan-30	T+265	T+245	-20	27	BBB-
CELULOSA ARAUCO CONSTITU	24-Oct-19	29-Jan-50	T+315	T+295	-20	20	BBB-
SUZANO AUSTRIA GMBH	10-Sep-20	15-Jan-31	T+380	T+325	-55	-42	BBB-

Source: Bond Radar, Bloomberg, Citi Research. Note: Bond rating is the average of Moody's, Fitch & S&P ratings

Does the IPT concession hold up over time? By looking at the current spread differential between ESG bonds and non-ESG bonds in Figure 60, we see that the differential more or less holds over time, except for those in the HY sector (many idiosyncratic factors may be at work) and those issues that lack an external review on compliance with stated goals.

Green Finance in EM is growing and investors see value in it. Given the strong interest in building ESG compliant portfolios, investor demand has been strong for these products and the market is willing to own them through the normal yield curve of the issuer. The lone exception is the Sustainable framework, which has weak use of proceeds and verification language. Linked bonds, however, are the most desired as they offer investors compensation for non-compliance with stated SDG goals. They also offer issuers more flexibility in use of proceeds.

12. Green Securitization

Global Securitized Products

Mary Kane

Roger Ashworth

Jeff Berenbaum

Securitization is a broad term, but is simply a specialized secured financing technique utilized in both private and public markets. In this section, we discuss public or quasi-public (144-A) securities issued in term capital markets. Briefly, securitization financing utilizes a special purpose financing vehicle (SPV) or trust to own a designated pool of assets, which is bankruptcy remote from the assets of the selling entity. The sale of the assets to the SPV is referred to as a 'true sale' and the assets are independent of the seller/originator. The SPV issues bonds secured by the trust assets and the related cash flows the assets generate for the trust. The structure typically prioritizes the cash flows, facilitating the creation of assorted classes of bond credit risks, typically rated from triple-A to non-investment grade. Rating agencies define their methodologies for rating securitizations by product and these criteria are widely available.

Term securitization in the capital markets is useful in that it can re-finance a critical mass of smaller projects initially financed by banks in conduits or on balance sheet. The term securitization market also refinances assets originated by finance companies and other lenders and provides a capital markets takeout on a term basis. Moreover, 'tranching' cash flow creates an assortment of credit risks specifically tailored to investors' risk and maturity preferences.

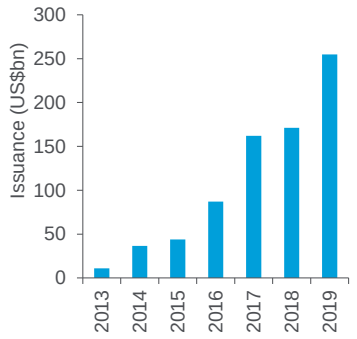
'Green securitization' has financed a diverse variety of assets over time, and the most well-known are green bonds issued by the U.S. housing finance Agencies (Freddie Mac / Fannie Mae). Their respective shelves finance both residential and commercial multi-family properties and the primary purpose is to promote more energy-efficient housing. These securitizations additionally promote more diversity of ownership and housing affordability.

Securitization Financing for Decarbonization

The securitization market is addressing the significant financing needs for decarbonization in multiple ways, from residential mortgage green bonds to commercial mortgages for more energy-efficient multifamily properties. In the asset-backed market, a wide range of diverse structures finance needs ranging from installment loans for home improvement to auto loan asset-backed securities (ABS) dedicating the proceeds for the purchase of hybrid vehicles. We briefly discuss some of these.

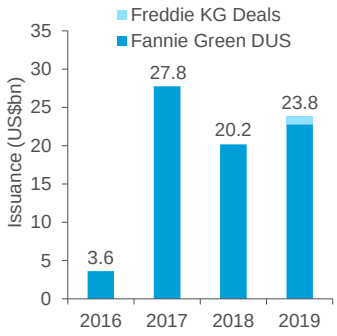
- **World's Biggest Green Bond Issuer: Fannie Mae has been the world's largest 'green bond' issuer for several years; its multifamily green bond program has $75 billion outstanding.** Freddie Mac introduced its KG shelf in 2019, combining environmental and social impact benefits. The mortgage Government Sponsored Entities (GSEs) Fannie Mae and Freddie Mac are taking a leading role in reporting and transparency, with environmental impact estimates on bonds.

Figure 61. Total Green Bond Supply



Source: Climate Bonds Initiative, Citi Research

Figure 62. Green Multifamily MBS Supply



Source: Fannie Mae, Freddie Mac, Citi Research

- **Other Green ABS Sectors Support Decarbonization:** Other 'green' sectors include solar lease/loan ABS, commercial and residential PACE (property-assessed clean energy financing), and select auto ABS. There is potential to expand financing for utilities and other projects. Total 2019 green ABS amounted to roughly $2.8 billion.

- **Crisis Lessons Learned: In many ways, the lessons learned from the financial crisis have instilled sounder ESG investing practices for securitizations than other capital markets**. Dodd-Frank and other post-crisis regulations have imposed market discipline, contrasting with excesses observed in other markets.

Securitization Supports Green Finance

Multifamily Properties and Energy Efficiency

Securitization houses the largest Green Bond issuer. In 2019, global Green Bond issuance surged to a record $255 billion, up 49% from $171 billion in 2018 (Figure 61). Securitization comprised about $33 billion of the total, driven in large part by Fannie Mae's $22.8 billion of green multifamily supply (Figure 62). This makes the Government Sponsored Entity (GSE) the world's largest issuer according to the Climate Bonds Initiative. More recently, Fannie Mae started issuing Green Bonds collateralized by single-family mortgages which could expand reporting to the ~$6 trillion outstanding agency mortgage-backed security (MBS) market.

- Green bonds are used to finance sustainability projects, such as renewable energy, energy efficiency, sustainable transportation, water quality and conservation, and green buildings, according to Green Bond Principles.[21]

Enhanced Disclosures/Benchmarks on Commercial Properties

As the world's largest issuer, Fannie Mae has taken a leadership role in reporting and transparency. The GSE publishes impact reports highlighting Fannie Mae's multifamily Green Bond efforts, including progress on detailed reporting.[22] Fannie also now publishes estimates of the projected environmental impact of each Green MBS and an allocated portion to each bond which includes metrics like projected annual energy/water savings and CO_2 emissions.

In addition, 28 cities now require annual benchmarking, according to a tally by the Institute for Market Transformation. Benchmarking data should allow investors to assess building energy use and emission levels and gauge performance relative to other buildings. This could become key information as investors seek tangible parameters for ESG allocations to commercial mortgage-backed securities (CMBS). At the very least, the benchmarking data could help investors demonstrate how they process and monitor environmental considerations in their portfolios.

[21] *Green Bond Principles: Voluntary Process Guidelines for Issuing Green Bonds*, ICMA, June 2018.
[22] "Multifamily Green Bond Impact Report: 2012-2018," Fannie Mae, March 2019.

Consumer ABS and Decarbonization

- **Hybrid/Electric Auto Financing:** Toyota has originated the largest and most significant 'green; ABS to date, issuing a standard securitization that dedicates 100% of the proceeds for financing hybrid vehicles and vehicles meeting specific criteria like fuel efficiency. Toyota began its green ABS program in 2014 and has issued a handful of deals which typically range in size from roughly $1.5 billion to $2.0 billion. These green ABS have experienced strong demand and demonstrate that there is a viable market for such investments.

  Given the significant strides the auto OEMs have made in reducing vehicles' carbon footprint, it is perhaps surprising that only one auto OEM to date has brought a green bond shelf to market. The reason for this is multifold, ranging from the additional and ongoing reporting burden to de minimis cost savings for issuing a green bond. The deal economics or reporting expectations might change in the future and the sector might take a more prominent role in such financing transactions.

- **Solar in ABS:** We count five issuers that have solar-related bonds outstanding. The underlying assets range from solar leases to unsecured consumer loans that have a purpose of achieving more consumer energy efficiency. Some of these loans have a purpose of purchasing, rather than leasing, solar panels. These transactions range in size from about $50 million to $500 million, which is small by ABS market standards. The volume of new issuance for solar transactions amounted to nearly $2.0 billion in 2019. The most recent solar lease transaction in 2020 was a small ($250m) deal rated single-A at the senior level. A total of $1.1 billion from 4 solar shelves was priced in 2020.

- **Some Solar is debated:** But other solar deals bring controversy. PACE (property-assessed clean energy financing) lien ABS are controversial because they represent a lien on the property with a super-senior interest ranking above the first mortgage lender. While government mortgage agencies object, the securitization issuance of these solar and efficiency finance loans during 2019 was $705m. Supply amounted to only $480 million from three shelves through October 2020.

- **Energy efficiency loans may grow:** Certain renewable energy asset classes have the potential to be more meaningful and 'cleaner' in the future, such as the securitization of on-bill clean energy loans. At least 20 states have approved their utilities to make personal and commercial loans for upgrading the related property owners' energy efficiency. Securitization seems like a natural financing source (Figure 63).

Figure 63. 'Green' Securitized Supply (2017-2019, $mn)

	2017	2018	2019
Solar	1,446	2165	1,972
PACE	1,625	819	705
Stranded Assets	NA	NA	118
Total ABS	3,071	2,983	2,795
Agency CMBS	27,800	20,200	23,800

Source: Bloomberg, Fannie Mae, Freddie Mac

Measuring Green in Securitization is Not Clear Cut

While the "E" can be easier to quantify, "S" and "G" don't appear as clear cut. A variety of factors may influence ESG ratings and affect investment considerations, even within an asset class. **Structured securities depend not only on collateral risk but equally importantly seller/servicer risk.** Seller/servicer size, capitalization, liquidity sources, length of operating history, underwriting standards, management and other factors merit scrutiny. Structure and credit enhancement attempt to mitigate some of the other risks that may reside in the trust but cannot compensate for all. For example, the senior class ratings of aircraft ABS top out at single-A, owing to collateral and industry concentrations and other unique structural and business risks. Or consider mortgage lending to support home ownership; is that a social good or potentially predatory underwriting? Existing loan level data may be sufficient to many investors, but more detailed reporting may be necessary to fully evaluate the 'green-ness' of an asset class and issuer.

Relevance and Materiality

Many rating agency scorecards and methodologies try to decide if an ESG issue is relevant for a particular rating and whether or not it has a material outcome on the rating. In most cases, the ultimate ESG evaluation relies on the analyst rating a particular security. Most rating agency commentary highlights that ESG is another way of stating credit risks that were always considered.

Securitization Itself Has Green Shoots

While we focus on some of the greenest finance in securitization in our discussion, it's important to note that securitization serves other green roles like provide a significant subsidy towards home ownership with mortgage backed securities in the U.S. In addition, securitization itself contains many green characteristics. It is an efficient form of transferring risk and usually bankruptcy remote. Finally, the historical practice of providing detailed, transparent collateral information should help expand socially responsible investing in the future. Figure 64 includes some ESG considerations for securitizations.

Figure 64. Some ESG Investment Considerations for Securitizations

Social

- Promotes home ownership
- Housing affordability & access
- Underserved consumer credit access
- Responsible lending
- More energy-efficient home imp.
- Customer privacy
- Data security
- Product suitability / customer welfare
- Marketing practices and disclosures

Environmental

- Energy efficiency improvements
- Wind, solar, water projects
- Solutions for utility stranded assets
- Other carbon or climate impact financing

Governance

- True sale / bankruptcy remote
- Non-consolidation
- Legal opinions
- Disclosure adequacy
- Investor protections / Reps. & warrantees
- Servicing practices & experience
- Underwriting and fair lending practices
- Underwriting exceptions
- Loss mitigation practices.
- Corporate capital adequacy & funding diversity
- State of technology
- Technology safeguards
- Industry competition
- Corporate market share.

Source: Citi Research

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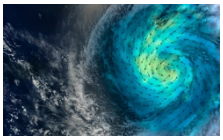

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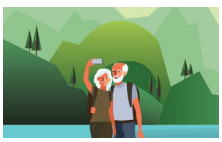

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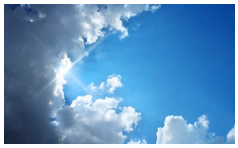

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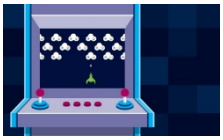

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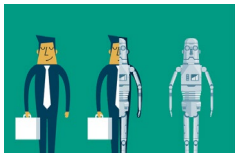

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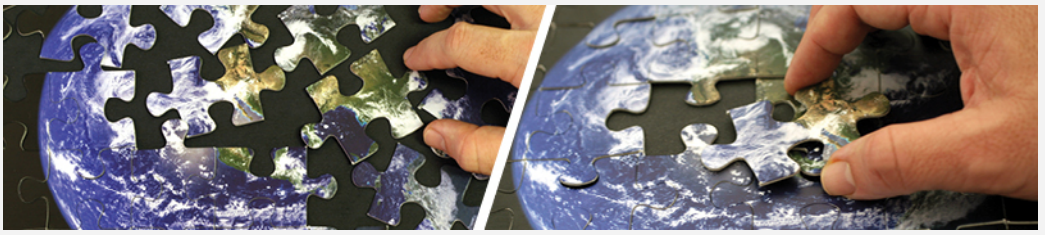
Key Insights regarding the future of Climate Finance

REGULATION

The Paris Agreement was the first step in pulling together a coordinated response to climate issues. / New momentum on global coordinated climate policy looks possible despite the recession brought on by the COVID-19 pandemic as commitments to net zero emissions targets are being made both by countries and companies.



INNOVATION

Decarbonization needs to take place across the power, transportation, industrial, agriculture, and building sectors as part of a portfolio of mitigation. / Financial innovation and investor comfort with emerging technologies is increasing, but early-stage technology risks are acute. Blended public/private finance could help de-risking.

SUSTAINABILITY

The demand for private funding to finance Paris Agreement commitments is huge, as is the desire from investors to put green finance to work. But the hurdles to investing in green projects are significant. / The $3-$5 trillion investment gap must be closed to meet climate goals and the solution includes both public and private investment A green framework is essential for green finance to truly flow.