Group Economics | Financial Markets & Sustainability Research | 13 June 2022
Marketing Communication

SustainaWeekly

ESG bank bond issuance on the up

- **Strategy Theme:** **The issuance of euro bank bonds in ESG format picked up in May after a slowdown in April. This party reflected a more general rise in issuance of euro bank debt, although the share of ESG labelled bonds rose to 20% in May, which was well above the average share in the first four months of 2022. SNP led the way, followed by covered bonds.**

- **Economics Theme:** **International shipping has various ways to reduce its carbon footprint, however all currently have significant drawbacks. A change in energy carrier is the most crucial step to take but the future shipping fuel of choice has not been defined yet resulting possibly in reluctance to replace old vessels.**

- **Policy & Regulation:** **The European Parliament voted against the proposed plans of EC to reform the ETS. Despite the rejection the impact on the ETS price was rather limited. It has been sent back to the Environmental Committee to renegotiate the proposal, with a further delay to implementing the reforms to the EU ETS as a part of the Fit-for-55 plans likely.**

- **Company & Sector news:** **The steel industry is responsible for about 4-5% of total global CO2 emissions. To further reduce greenhouse gas emissions in the steel sector, many opportunities are already available, but the further development of breakthrough technologies remains essential.**

- **ESG in figures:** **In a regular section of our weekly, we present a chart book on some of the key indicators for ESG financing and the energy transition.**

In this edition of the SustainaWeekly, we start by focusing on recent trends in ESG bank bond issuance. Issuance with this label has picked up in May, with the share in total issuance rising to 20%. We go on to assess decarbonisation options for international shipping, and conclude that unfortunately they all have drawbacks. A similar story is the case with regards to decarbonisation options for the steel industry for the longer term, where further development of breakthrough technologies is essential. Meanwhile, we look into the European Parliament's rejection of the Commission's ETS reform proposals and the way ahead now. Finally, we discuss the emission trend of greenhouse gases in the steel industry and come up with an indicative emission trend based on data from the *World Steel Association* and the monthly production figures. The steel industry still has a long way to go in reducing greenhouse gas emissions and ultimately, low-carbon breakthrough technologies remain critical. Enjoy the read and, as always, let us know if you have any feedback!

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Issuance of ESG bonds picks up in May, strongest positive effects for issuers in covered bonds

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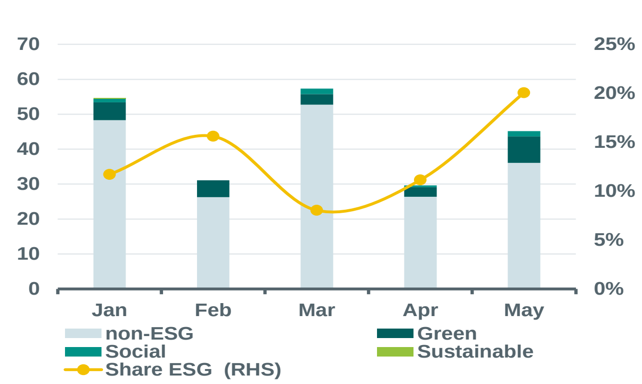
- **Total issuance of euro-denominated bank bonds (including covered bonds) amounted to EUR 9.1bn, the highest monthly total so far this year**
- **Year-to-date, bid-to-cover ratios for ESG bonds have been strongest for covered and SNP bonds**

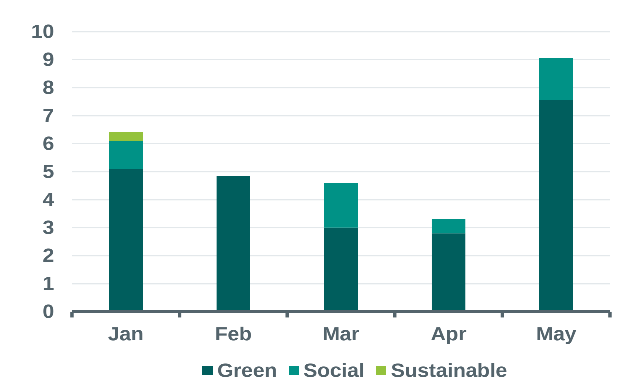
The issuance of euro bank bonds in ESG format (green, social, or sustainable bonds) picked up in May after a slowdown in April. Total issuance of euro-denominated bank bonds (including covered bonds) amounted to EUR 9.1bn, the highest monthly total so far this year. This party reflected a more general rise in issuance of euro bank debt, although the share of ESG labelled bonds rose to 20% in May, which was well above the average share in the first four months of 2022. The higher ESG issuance volume was driven by EUR 7.6bn in issuance of green labelled bonds combined with EUR 1.5bn of issuance in social format.

Share ESG rises to 20%



Source: Bloomberg, ABN AMRO Group Economics

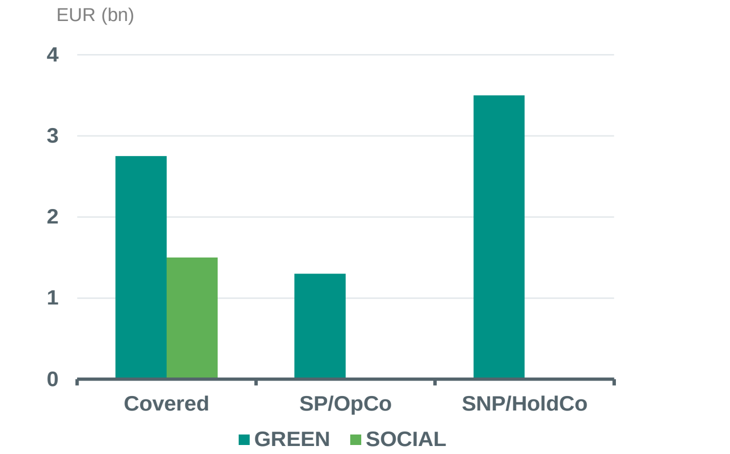
Highest monthly issuance volume of ESG bonds



Source: Bloomberg, ABN AMRO Group Economics

A breakdown of the green bonds by debt rank shows that senior non-preferred paper accounted for the largest volume of new issuance, with a total amount of EUR 3.5bn in May. It was followed by green covered bonds, which saw EUR 2.75bn of issuance last month. Thirdly, EUR 1.3bn of senior preferred paper was issued in green format in May. Meanwhile, new supply of social bonds was fully accounted for by covered bond issuers in May (EUR 1.5bn). Finally, there were no ESG labelled bonds issued among the Tier 2 and AT1 subordinated debt ranks.

Issuance ESG bank bond by debt rank

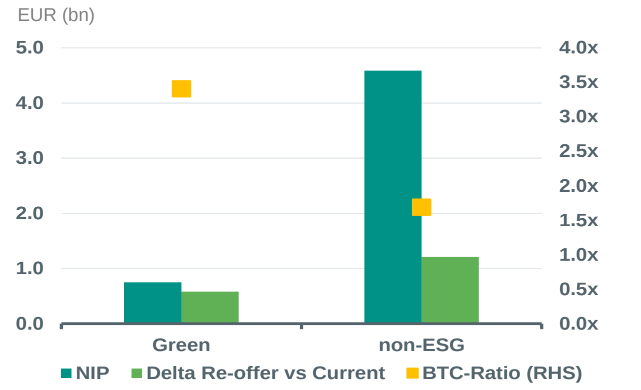


Source: Bloomberg, ABN AMRO Group Economics

In the covered bond space, green issuances attracted more demand in May, with a bid-to-cover ratio of 3.4x on average versus a bid-to-cover ratio of 1.7x on average for non-ESG covered bonds. The increased demand from investors also resulted in lower new issuance premia paid. Indeed, the average new issue premium paid for green covered bond was 0.8bp versus 4.6bp for non-ESG issuers in May. When looking at the performance of green bonds issued in May after re-offer, this is slightly worse than their non-ESG counterparts. However, this is likely related to the fact that they were priced at relatively tighter levels.

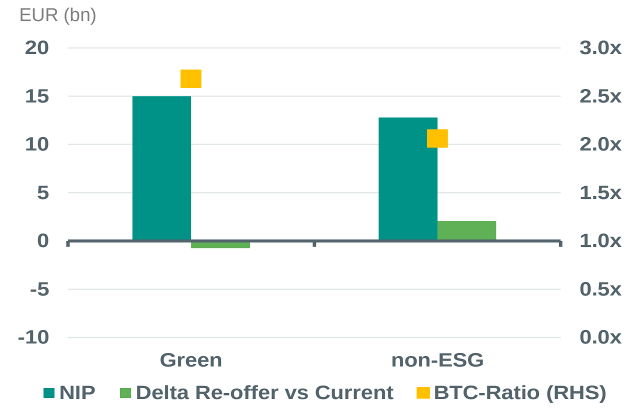
In the senior debt space, there was an interesting difference between the two ranks of debt. The bid-to-cover ratios were higher on average for green issuances vs non-ESG issuance in May. However, with senior preferred debt, this increased demand did not result in a lower new issue premia paid, while for senior non-preferred debt this was the case. This in contrast to developments so far this year and is likely caused by market developments and the timing of new deals (market sentiment turning adverse on the day of issuance). Still, green bonds of both senior debt ranks and issued in May outperformed their non-ESG counterparts last month.

Green label most beneficial for covered bond issuers



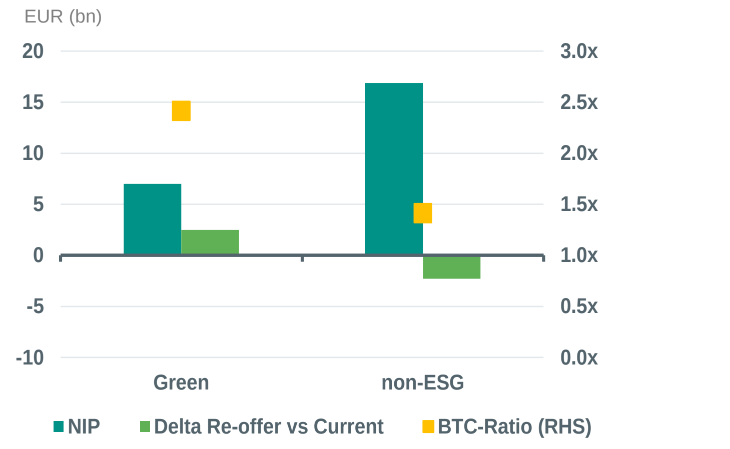
Source: Bloomberg, ABN AMRO Group Economics

For SP increased demand did not decrease NIP



Source: Bloomberg, ABN AMRO Group Economics

Green SNP performed well vs non-ESG

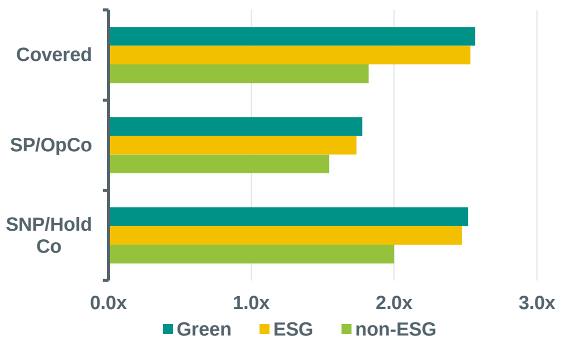


Source: Bloomberg, ABN AMRO Group Economics

Year-to-date, bid-to-cover ratio's for ESG bonds have been strongest for covered bonds and senior non-preferred bonds. The greenium of ESG bank bonds have been most observable in the covered bond space.

Strongest BTC for green covered bonds & SNP

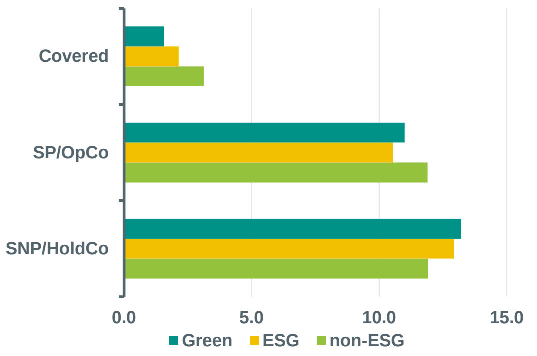
Bid-to-cover ratio



Source: Bloomberg, ABN AMRO Group Economics

Greenium most observable for covered bonds

EUR (bn)



Source: Bloomberg, ABN AMRO Group Economics

Decarbonisation options for international shipping

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- **We assessed the different decarbonisation options for international shipping**
- **International shipping has various ways to reduce its carbon footprint, however all currently have significant drawbacks**
- **A change in energy carrier is the most crucial step to take but the future shipping fuel of choice has not been defined yet resulting in possibly reluctance to replace old ships**
- **Other ways to decarbonize are more efficient design, voyage optimization, machinery and carbon capture and storage on board**

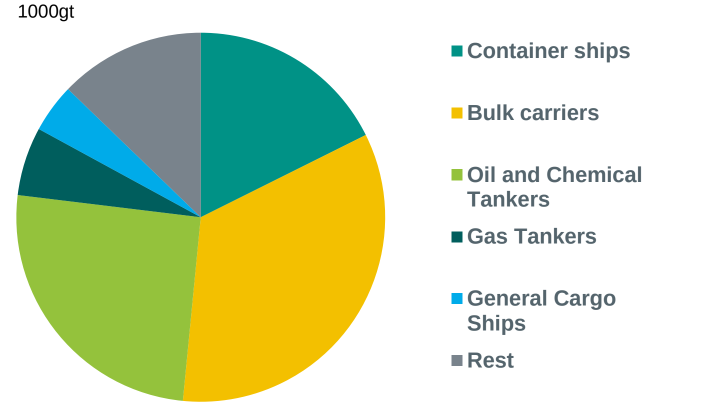
Introduction

This note represents the third in the series on shipping's pathway to Net Zero. Having looking at the current regulatory framework for shipping and different emission pathways, we now focus on decarbonisation options for shipping. The good news is that there are a number of options, the bad news is that each of these have drawbacks for now. We start we the breakdown of the fleet and the age of the vessels. The type of vessel is important for the possibility of decarbonation options. The age of the vessel indicates when a certain type of vessel is expected to be replaced by a new vessel. This is the moment to significantly improve the carbon foot print. However during the life of a ship certain measures could be taken and the vessels could be adjusted to reduce already some emissions. After the fleet breakdown we discuss the decarbonisation options for international shipping.

Breakdown of fleet of vessels

Before getting into the decarbonisation options, it is helpful to put these into context by briefly settling out the breakdown of the global fleet of vessels in terms of type and age. Shipping carries the vast majority of international trade with its share ranging between 80-90%, bulk and container carriers, as well as oil and chemical tankers - make up 27% of global fleet in terms of the number of vessels. However, if the gross tonnage of the ship is taken into account the share of these vessels is much larger. Container ships, bulk carriers, oil and chemical tankers and general cargo ships account for 87% of the global fleet in terms of gross tonnage (see graph on the left below, Equasis 2020). Gross tonnage is a nonlinear measure of ship's overall internal volume.

World fleet in gross tonnage



Source: World fleet Equasis 2020

Age of the world fleet based on gross tonnage

1000 gt

World fleet	Gross tonnage	%	0 - 4 years old	%	5-14 years old	%	15-24 years old	%	+ 25 years old	%
Container ships	256,721	17.6	50,004	3.4	142,174	9.8	58,905	4.0	5,637	0.4
Bulk carriers	493,288	33.9	95,095	6.5	311,970	21.4	73,310	5.0	12,914	0.9
Oil and Chemical Tankers	369,205	25.4	79,325	5.5	181,602	12.5	98,984	6.8	9,293	0.6
Gas Tankers	87,459	6.0	26,413	1.8	40,961	2.8	14,857	1.0	5,229	0.4
General Cargo Ships	62,279	4.3	5,203	0.4	26,846	1.8	13,769	0.9	16,462	1.1
Rest	186,051	12.8	24,517	1.7	70,382	4.8	45,787	3.1	45,366	3.1
	1,455,003	100.0	280,557	19.3	773,935	53.2	305,612	21.0	94,901	6.5

Source: World fleet Equasis 2020

The life of a vessel is around 25 to 30 years. Based on the number of ships around 60% of the world fleet is older than 15 year and 40% is older than 25 years. This means that a large percentage of ship needs to be replaced in the next 5 years. However, based on gross tonnage this is much smaller. Then 27.5% of the total fleet is older than 15 years. Again, taking gross tonnage as the basis, 17.6% of the vessels in the group of container, bulk, tankers and cargo ships are between 0-4 years old, 48% between 5-14 years old, 18% 15 – 24 years old and only 3.4% is older than 25 years.

Decarbonisation options

Shipping is only responsible for 3% of the global greenhouse gas emissions. Despite the relatively low share of international shipping to global greenhouse gas emissions to limit global warming to only 1.5 degree international shipping also has an important role to play in lowering greenhouse gas emissions. This mainly addressing deep-sea shipping which accounts for the largest part of GHG emissions and has fewer available solutions compared to short-sea shipping. There are several options to do this: change the energy carrier, alter the design of the ship, voyage optimization, machinery and after treatment measure.

Change of energy carrier

The first and most important way to reduce greenhouse gas emissions is the choice of energy carrier. The main proportion of energy consumption in international shipping relates to propulsion of the ship at steady speed over long distance. Vessels mainly have diesel engines that use marine fuel oils. The industry is working on other alternatives such as methanol, ammonia, hydrogen and biofuels. All alternative fuels for shipping face challenges and barriers to their uptake – although the severity of each barrier will vary between fuel types. Typical key barriers include the cost of required machinery and fuel storage on board vessels, additional storage space demand, low technical maturity, high fuel price, limited availability of fuel, and a lack of global bunkering infrastructure. Safety will also be a primary concern, with a lack of prescriptive rules and regulations complicating the use of such machinery and storage systems (**DNV**). So, the options for the deep-sea trade are currently limited to LNG and LPG. Below we provide more details on the different energy carriers.

LNG

Liquified Natural Gas (LNG) is an attractive option to meet the new regulations on sulphur content in marine fuels, as sulphur levels are less than 0.004% by mass (**KPMG**). LNG is the least polluting fossil energy source, which compared to heavy fuel oil, could reduce sulphur emissions by 99 per cent, nitrogen oxides by 80 per cent, and CO2 emissions by up to 20 per cent, along with most particulate matters (**UNCTAD**). LNG/dual-fuel engines emit fewer grams of CO2 equivalent per kw than diesel engines. Dual-fuel engines can use existing technology, enabling ships to be operated on different types of fuel and comply with regulations while remaining competitive. In January 2021 the IMO sulphur cap (IMO2020) entered into force, prompting greater investment in bunkering port infrastructure and in LNG-fuelled ships. Currently, these represent a small share of the fleet and of the orderbook. But their numbers are expected to grow significantly in the 2021–2022 period (**UNCTAD**). According to Shell LNG is the 'cleanest' fuel currently available to shipping in meaningful volumes. But it has a methane slip. This is the methane that is not used as a fuel in an engine and escapes into the atmosphere. So even as it lowers the CO2 emissions and has lower sulphur levels, the methane slip needs to be reduced as well. Methane is a more potent greenhouse gas emission than CO2 is. The industry is working on the technology could reduce the methane slip. There is a risk that LNG ships and infrastructure will become stranded assets in the future as it is not (or not sufficiently) reducing lifecycle greenhouse gas emissions. Next to this the energy density of LNG is lower than marine fuel oil (see table below) so LNG tanks take up vessel space. Plus LNG is still a fossil fuel and thus a temporary solution towards 2050, unless the emissions can be compensated elsewhere leading to a net zero situation

Comparison of different marine fuels

GJ = gigajoules, m3 = cubic metres, LHV = lower heating value

Fuel type	LHV (MJ/kg)	Volumetric energy density (GJ/m³)	Storage pressure (bar)	Storage temperature (°C)
MGO	42.7	36.6	1	120
LNG	50	23.4	1	-162
Methanol	19.9	15.8	1	20
Liquid ammonia	18.6	12.7	1	-34
			8.6	20
Liquid H_2	120	8.5	1	-253
Compressed H_2	120	7.5	700	20

Source: IRENA (2019a)

Methanol

Methanol has one of the lowest carbon and highest hydrogen (H2) contents compared to other fuels. Furthermore, methanol reduces emissions of sulphur oxide (SOx), and nitrogen oxide (NOx) by up to 60% in comparison to heavy fuel oil (ITF, 2018), including reductions in particulate matter emissions of 95%. Currently, most methanol is produced from coal or natural gas, but methanol can also be produced from lignocellulosic feedstocks such as agricultural waste, from biomass (preferably) collected from sustainable managed forests to produce bio-methanol. Methanol can be used today as a ship fuel in an internal combustion engine (ICE). Despite the success of using methanol fuel in ship engines and its commercial availability, the technology is still in development, and existing vessels are required to replace fuel injectors and the fuel supply system. Methanol's storage temperature varies between -93°C to 65°C, making it significantly cheaper to store and transport than other fuels such as H2, ammonia and LNG. Methanol can be stored in integral fuel tanks for liquid fuels if modifications are made to accommodate its low flashpoint properties. Energy density is a main concern with methanol. This means that the tanks take up much more storage compared to marine gas oil (IRENA).

Ammonia

One of the most promising alternative shipping fuels is carbon-free ammonia ("green ammonia"), as a means to achieve IMO's GHG emission goals. According to IRENA it is estimated that reductions of life cycle GHG emission would be between 83.71 and 92.1%. Ammonia-fuelled ships need pilot fuels to trigger combustion in an internal combustion engine, although H2 can play this role. Ammonia has various advantages compared to other alternative fuels. These include an existing logistical infrastructure with no need for cryogenic storage. It is easier to store and to transport because ammonia becomes liquid at more ambient temperature than H2 fuel. In addition, as the table above shows ammonia has a significantly higher energy density than hydrogen. Ammonia seems to be the preferred alternative for the shipping sector as it has more similarity to conventional fossil fuel sources in terms of physical characteristics, is simple to store and transport, and as opposed to e-methanol, the production cost of e-ammonia does not depend on the costs associated with carbon capture and removal technology because it has a no-carbon content in its molecular structure. The ammonia engine is expected to be ready in 2023 and this will be a key milestone in unlocking the use of renewable ammonia.

But there are also cons to ammonia as the future shipping fuel. First ammonia-fuelled ships would require between 1.6 and 2.3 times the volume of fuel compared to conventional heavy fuel oil ships. So compared to heavy fuel oil, ammonia weighs twice as much and requires three time more space to contain the same amount of energy. This needs to be taken into account when designing new vessels. Second, ammonia is currently produced via natural gas so the life cycle greenhouse gas emissions are high. If these are taken into account ammonia may not be a good alternative. Third as with hydrogen (see below), there are two ways of utilising ammonia as a fuel, in a fuel cell and in an internal combustion engine (DNV GL, 2019c). But current technology for both ammonia fuel applications, fuel cells and internal combustion engines, are still in the development and research stages, with few real-world applications in the shipping industry at present. Fourth, using ammonia comes with safety challenges – such low flammability, corrosion and toxicity (**IRENA**) and nitrous oxide (N2O) and potential ammonia slip (**DNV**). Ammonia slip refers to the unreacted ammonia that goes into the atmosphere. Due to its toxicity, the introduction of ammonia as fuel creates new challenges related to safe bunkering, storage, supply and consumption. Last but not least, there is limited to no ammonia bunkering infrastructure (**DNV**).

Hydrogen (H2):

The cleanest marine fuel with zero carbon emission is green hydrogen, which is produced by using renewable energy. It can be produced in many ways such as by electrolysis of renewable matter and by reforming natural gas. Hydrogen is the lightest of all gas molecules, thus offering the best energy-to-weight storage ratio among all fuels (**KPMG**). H2 as a shipping fuel can be stored either as compressed gas or as a cryogenic liquid, or it can be used to produce e-fuels, e.g. e-ammonia or e-methanol.

Current barriers to using hydrogen as marine fuel include lack of safety requirements; low maturity of technology; onboard storage space required (because of low energy density); and, the high investment cost. Hydrogen is not transported as a marine cargo, and the experiences as a marine fuel are currently limited to small-scale R&D projects. The safety implications of storing and distributing hydrogen on board ships are not clear. For hydrogen the potential explosion risk related to the low ignition energy and the wide flammability range requires special attention. The very low boiling temperature for hydrogen makes it more challenging to store in its liquefied form (**DNV**). The main issues with using H2 as a fuel for ships are the costs associated with engine retrofits, storage on ships and bunkering of H2.

Biofuels

Biofuels are considered unlikely to be the dominant future fuel for shipping. This is because the sector would need huge volumes, and other sectors such as aviation and road transport are likely to be more able to pay the cost (**Shell**). Biomethane production costs are highly dependent on feedstock availability and feedstock market price, leading to wide cost rages. Biogas produced via anaerobic digestion for the subsequent production of liquid biogas and compressed biogas has high technological maturity, making it an attractive option for displacing LNG. However, due to scalability and logistical issues, the role of renewable gaseous fuel may be limited. Biogas may be more effective in end-use applications other than for fuelling the shipping sector. Renewable methanol, i.e. bio-methanol and renewable e-methanol, requires little to no engine modification and can provide significant carbon emission reductions in comparison to conventional fuels (**IRENA**).

Design of the ship

Choosing the right fuel strategy is one of the most important decisions an owner will have to make for a current newbuild. The key will be to optimize the fuel storage and propulsion system of the ship to accommodate current and future fuel requirements. The question is how their potential to reduce greenhouse gas emissions can be maximized. A vessel built now faces a significant risk that the most competitive fuel type in the ship's early life will not be the same at a later stage (**DNV**). As a result it could become a stranded asset in the future.

Apart from the right fuel strategy there are other ways to improve the efficiency of the ship. A ship should be designed to allow for the needed upgrades or fuel changes later in its lifetime. Fuel Ready refers to a new DNV Class Notation and indicates that a conversion to an alternative fuel has been accommodated and verified in the newbuild design such as Fuel Ready LPG, LNG, ammonia and/or methanol/ethanol. There are mono fuel internal combustion engines (ICEs) or dual fuel ICEs using LNG, LPG or methanol as fuel (**DNV**) and then ammonia ready. All designs must have a steadily increasing blend-in of carbon-neutral fuels as the ship follows the diminishing carbon-intensity trajectory. From a design point of view, the main challenge with ammonia and other less carbon-intensive fuels is in most cases to find space to store a suitable amount of fuel without affecting the cargo capacity of the ship to an unacceptable degree. Safely managing fuel properties like high flammability and toxicity is also a challenge, both for design and in operation. From a volumetric energy density perspective, ammonia will require significantly more space than marine gas oil to store the same amount of energy. strengthening the support structure below the tank(s) and, in some cases, reinforcement of the hull girder (**DNV**).

To design the ship more lightweight materials could be used, a more slender hull design, hull-form optimization and improvement in propulsion, advanced hull coatings and an air lubrication system (**UNCTAD**). The change in design could result in a reduction of greenhouse gas emissions of 5-15% (**DNV**).

Voyage optimization

Voyage optimization is how to get from A to B using the least energy and to be the most efficient. The easiest and cheapest way to reduce emissions is to reduce ship speed (**UNCTAD**). Slow steaming is a very efficient way to save fuel, as a speed reduction of 3% causes a reduction in fuel use of 10%. However, slow steaming also carries safety risks, as it provides less propulsive power and therefore less manoeuvrability (DTU). Moreover, transporting the same cargo volumes at slower speeds will also require more ships. The report estimates that the IMO short-term measures will require 13 per cent more vessel capacity. Drewry estimates that global shipbuilding capacity is equivalent to 7 per cent of the global fleet and that, while maintaining also normal fleet replacement and growth, increasing vessel capacity by 13 per cent would require a ramp-up period of around five years (**UNCTAD, 2021b**). Next to reduce ship speed, a higher percentage of the fleet could be used or be used more efficiently.

Machinery

Currently combustion engines (diesel) continue to dominate the fleet. Going forward these engines need to able to operate on two or more fuels and be ready for a future fuel such as ammonia. Moreover, marine fuel cells are expected to be integrated in power systems over the next years (**DNV**). Fuel cells are just like batteries — they produce electricity with a high frequency through an electrochemical process. They offer higher electric efficiencies with lower noise. Fuel cells need hydrogen-rich fuel such as natural gas, methanol and diesel using chemical reactors for the cells, apart from pure hydrogen (**KPMG**). Today fuel cells are more expensive than internal combustions engines on a $/KW basis. The solid state nature of fuel cell technology lends itself to lower operating costs, less need for intervention from crew and high reliability (**Shell**).

Next to fuel cells, a battery is also an option for smaller ships that travel short range. Batteries provide abilities to store electricity critical for the use of ship propulsion. Recent technologies in batteries such as lithium-ion have made it possible for battery-powered propulsion systems to be engineered for smaller ships. The lower power density and greater weight limit the usage for many applications. Hence, for larger vessels, engine manufacturers are focused on the hybrid electric solutions. However, using batteries as a standalone solution is not possible in the current technology status; it may be combined with other renewable sources of energy such as solar and wind (**KPMG**).

Another way to reduce the carbon footprint is a waste heat recovery. When the fuel is burnt in the engine, the heat released could be used to heat the water and generate steam. This reduces the carbon footprint as only the main engine is consuming the fuel.

CCS

Onboard carbon capture and storage (CCS) is a potential option for decarbonizing the deep-sea portion of the world fleet. However, there has not yet been any largescale demonstration or implementation of onboard CCS systems on merchant ships for substantial recovery rate (**DNV**).

Conclusion

Overall, the change in energy carrier will be responsible for the largest reduction in greenhouse gas emissions in international shipping. But with that comes major challenges. But at this point in time, it is uncertain which fuel will be the future shipping fuel. All alternative fuels have lower energy densities that marine gas oil and this means that there is a need to have larger tanks on the ships resulting in lower storage capacity and or the refortification of the structure of the ship. Moreover, different safety measures are needed dependent on the future fuel. Next to this, the ship design could be further modified to increase the efficiency and the engine could be adjusted. DNV estimates that hydrogen and ammonia technologies are ready for commercial use in four to eight years. Fuel cells are far less mature than internal combustion engines, for all fuels. Ammonia, hydrogen and methanol can with internal combustion engines ICE (now methanol, in 2027 hydrogen and ammonia) and with Fuel cell in 2030 (**DNV**). The uncertainty about the future shipping fuel of choice could make shipping owners more reluctant to replace old vessels and to invest in new design and vessels. Because they would like to avoid that their new ships become stranded assets in 10 to 15 years from now.

EU Parliament rejects the EU ETS reform plans…for now

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- **The European Parliament voted against the proposed plans of the EC to reform the ETS**
- **Despite the rejection the impact on the ETS price was rather limited**
- **It has been sent back to the Environmental Committee to renegotiate the proposal**
- **A further delay to implementing the reforms to the EU ETS as a part of the Fit-for-55 plans likely**

On Wednesday the European Parliament voted against the proposed plans of the European Commission to reform the Emission Trading Scheme (EU ETS). The bill was turned down by 340 to 265 votes. The proposal of the reform of the EU ETS included the extension towards other sectors, like commercial transport and buildings next to the existing sectors (industry, utilities and aviation - within the EU). Furthermore, the European Parliament has postponed the votes on other plans like the implementation of a Carbon Border Adjustment Mechanism (CBAM) and the introduction of a social climate fund, which are linked to the ETS reform.

The reason for the rejection is that last month the Environmental Commission proposed an increase in the ambition for the carbon reduction of the EU ETS to 67%. This is significantly higher than the original target of 61% of the European Commission. And although the ambition was already softened somewhat last week (to 63%), the opposition still remained. As a result of this, the Social Democrats and the Greens indicated that the proposal was not ambitious enough and therefore they voted against. At the same time, the far-right parties thought the plans were still too ambitious and also voted against the proposal. With the rejection by the European Parliament, the topic has now been sent back to the Environmental Committee to renegotiate the proposal and to see whether a compromise can be found. Either way, a further delay to implementing the reforms to the EU ETS as a part of the Fit-for-55 plans is very likely.

Despite the current rejection of the EU ETS reform plans, the impact on EU ETS prices was rather limited. We think that the main reason for that is that most of the speculative positions has been closed in recent weeks after the Russian invasion of Ukraine. Due to the higher margin calls, many hedge funds have closed their positions in highly speculative markets like the EU ETS, leaving it to the market participants who actually need the emission rights for their businesses. These participants are less driven by news headlines and simply buy and sell EU ETS emission rights depending on their expected activities, rather than on expected EU ETS price levels. The news of the reform rejection can be seen as a negative driver for EU ETS prices. Still, this effect is balanced out by the fact that demand for the emission rights is rising due to the higher usage of coal fired power plants as a result of high gas prices balances. So far, EU ETS have continued to trade around EUR 80/ton.

EU ETS prices continue to hover around EUR 80/ton

Source: Bloomberg

Low carbon breakthrough technologies are essential in the steel sector

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- **The steel industry is responsible for about 4-5% of total global CO2 emissions**
- **The structure of the steel production process largely determines the amount of CO2 emission**
- **The more polluting *Blast Oxygen Furnace*-route of steel making has a global share of 71% in total steel production**
- **To further reduce greenhouse gas emissions in the steel sector, many opportunities are already available, but the further development of breakthrough technologies remains essential.**

A lot of CO2 is released during the production of steel. In 2021, more than 1.9 billion tonnes of steel were produced worldwide. This is 4.2% more than the total production in 2020. Each tonne of steel produced results, however, in an average of about 1.5 tonnes of CO2 emissions, depending on the production process chosen. That is about 3.5 billion tonnes of CO2 yearly. According to the *International Energy Agency* (IEA), the steel industry is thus responsible for about 4-5% of total global CO2 emissions. To make the steel sector carbon neutral, there is still a long way to go, and for the pace of emission reductions, investment in low carbon technologies and the choice of production process can be decisive.

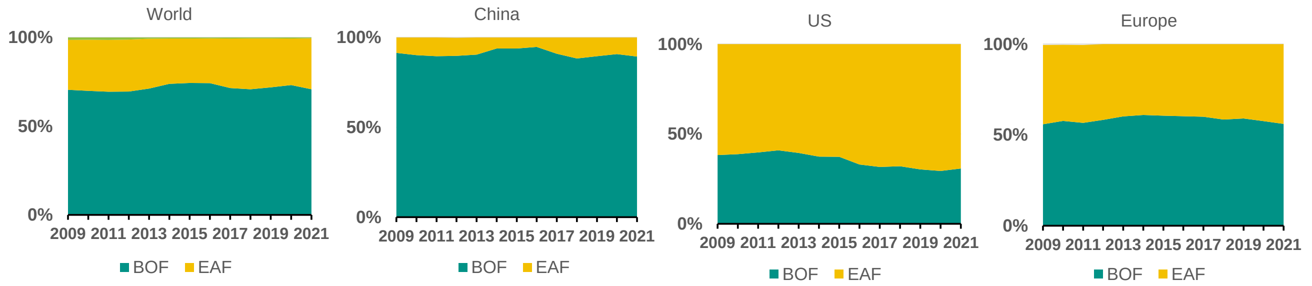
Difference in steel production process

The design of the production process for making steel largely determines the amount of greenhouse gas emissions. Crude steel can be produced either via the *Electric Arc Furnace* (EAF)-route or via the *Blast Oxygen Furnace* (BOF)-route.

The EAF-route mainly uses steel scrap, which is melted with electricity. It is also a flexible process. This means that shutting down and starting up this furnace is relatively easy, in contrast to the BOF-route. This route mainly consumes iron ore, coking coal and a small amount of scrap. Shutting down the production process via the BOF-route takes a long time, because it takes a long time for the furnace to get back up to temperature. The choice of the type of production process depends on a number of factors. For example, China has large deposits of coking coal, which makes the choice for the BOF-route a no-brainer. Moreover, this makes the cost of making steel much less dependent on price volatility in international markets. In 2021, 89.4% of the total Chinese steel production went via the BOF-route.

Steel production by process

BOF = Blast Oxygen Furnace; EAF = Electric Arc Furnace



Source: World Steel Association, ABN AMRO Group Economics

In the US, the ratio is almost the opposite. There, most steel is produced via the EAF-route. Here too, the raw material supply and availability has been an important reason in the choice of production process. The growth of domestic scrap reserves has been substantial in the past and has made the choice for the EAF-route much easier, as steel could be produced at lower cost. In Europe, the split is currently close to 50-50.

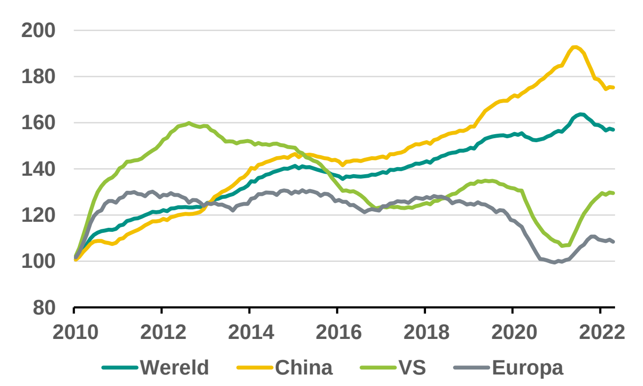
Emissions steel sector

The various routes of steel production have different implications for CO2 emissions. Producing one tonne of steel via the BOF-route releases approximately 2.3 tonnes of CO2, according to the *Net-zero Steel Initiative* (Oct. 2021). When producing a tonne of steel via the EAF-route, the CO2 emissions are much lower, at 0.6 tonnes. Based on these emission figures per tonne per route and the ratio in production process per region, we can monitor the emission path of the global steel sector on a monthly basis.

Since China produces almost 55% of the world's steel output, the CO2 emissions from the Chinese steel industry are relatively high. And they have been rising almost continuously since 2010. The ongoing Covid-19 crisis in late 2021 and early 2022 has caused a sharp decline in emissions as business activity was much lower. In Europe and the US, Covid-19 also caused a sharp decline in 2020-2021, but the recovery in emissions after the crisis has also been strong. In the US, the level of emissions returned almost to pre-Covid-19 levels, while in Europe the recovery in emissions was relatively low.

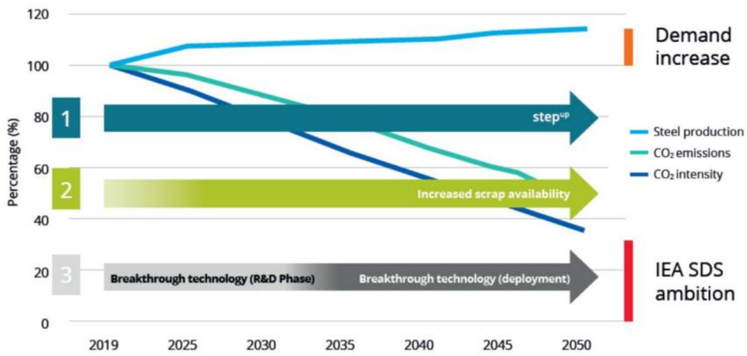
Indication of emissions steel sector by location

index (2009-100), 12-month moving average



Source: World Steel Association, ABN AMRO Group Economics

Low carbon strategies and technologies for steel sector



Source: World Steel Association, IEA

Demand for steel will of course continue in the years ahead. The various scenarios for the future demand for metals hint on strong growth in the coming decades. If we take the IEA *Sustainable Development Scenario* (SDS) - with climate stabilisation 'well below' global temperature increase of 2°C - this will result in a fourfold increase in metals and mineral requirements by 2040. And if the 2050 'net zero' emissions target is taken into account, six times more metals and minerals will be needed in 2040 than today.

However, the steel sector needs to reduce its greenhouse gas emissions. After all, the steel sector committed to the emission reduction targets of the European Commission (EC). The EC has indicated that the construction of pathways towards ‘net zero’ in 2050 must take place within the steel sector itself. The *World Steel Association* (WSA), for example, published an approach that maps out the strategic and technological possibilities for the sector.

In the first phase of the transition, the industry programme called 'step up' is intended to support improvements in plant operations across the sector to efficiency levels that are in line with the top performers in the steel industry. The programme has four pillars that need to be addressed in the short term:

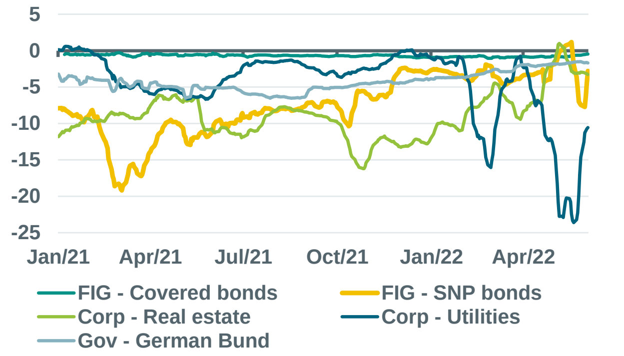
- Optimal selection and use of high-quality raw materials
- Increase energy efficiency and minimize waste
- Improve revenue and return
- Improving process reliability

In addition to encouraging the use of steel scrap and also promoting the availability of scrap in the medium term, there are several other low-carbon breakthrough technologies that can reduce the use of iron ore on a large scale. These are the long term options. For example, carbon can be used as a reducing agent while avoiding fossil CO2 emissions, for example by using carbon capture and reuse (CCUS) and/or sustainable biomass. Carbon can also be replaced by hydrogen as a reducing agent, generating H2O (water) instead of CO2. And finally, electrical energy can also be used via an electrolysis-based process. These are all promising breakthrough technologies, but they are still in the pilot phase and are therefore not yet being deployed on a larger scale. Investment in research and development remains therefor essential. Because only with these kind of breakthrough technologies the 2050 target for the steel sector remains in sight. Next to that, the EC’s focus on steel scrap in the near future favours the EAF-route. But transforming a steel plant with a BOF-route to an EAF-route will cost a lot of time and money, which will be especially challenging in this low margin industry.

ESG in figures

ABN AMRO Secondary Greenium Indicator

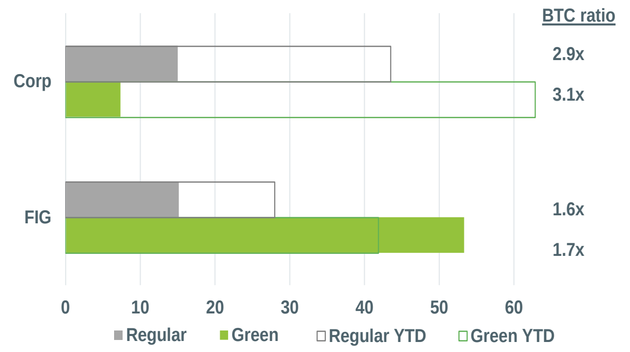
Delta (green I-spread – regular I-spread)



Note: Secondary Greenium indicator for Corp and FIG considers at least five pairs of bonds from the same issuer and same maturity year (except for Corp real estate, where only 3 pairs were identified). German Bund takes into account the 2030s and 2031s green and regular bonds. Delta refers to the 5-day moving average between green and regular I-spread. Source: Bloomberg, ABN AMRO Group Economics

ABN AMRO Weekly Primary Greenium Indicator

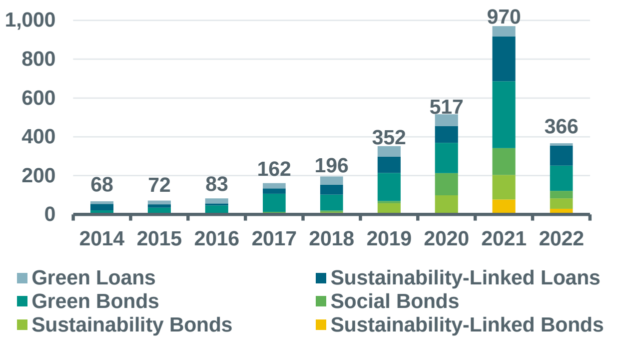
NIP in bps



Note: Data until 08-06-22. BTC = Bid-to-cover orderbook ratio. Source: Bloomberg, ABN AMRO Group Economics.

Sustainable debt market overview

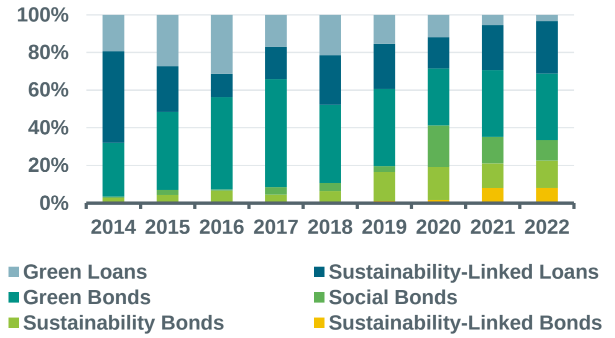
EUR bn



Source: Bloomberg, ABN AMRO Group Economics

Breakdown of sustainable debt by type

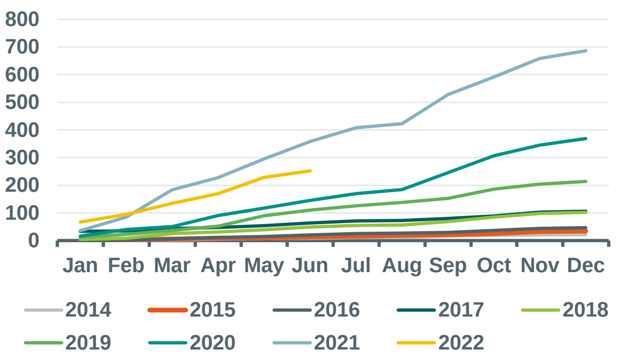
% of total



Source: Bloomberg, ABN AMRO Group Economics

YTD ESG bond issuance

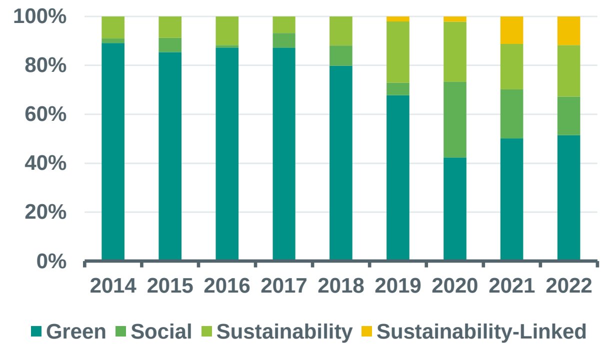
EUR bn



Source: Bloomberg, ABN AMRO Group Economics

Breakdown of ESG bond issuance by type

% of total

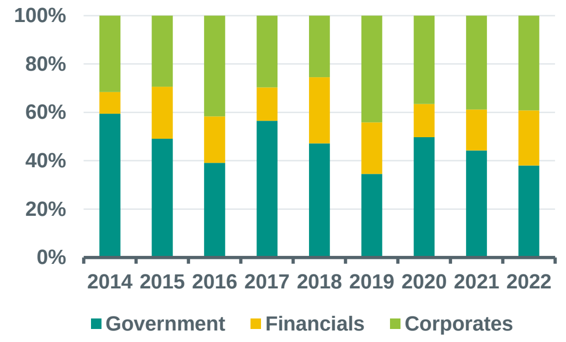


Source: Bloomberg, ABN AMRO Group Economics

Figures hereby presented take into account only issuances larger than EUR 250m and in the following currencies: EUR, USD and GBP.

Breakdown of ESG bond issuance by sector

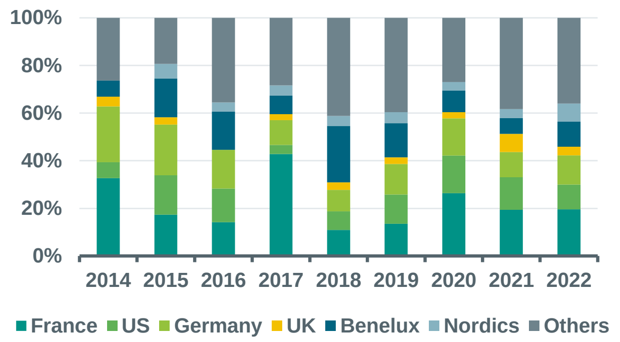
% of total



Source: Bloomberg, ABN AMRO Group Economics

Breakdown of ESG bond issuance by country

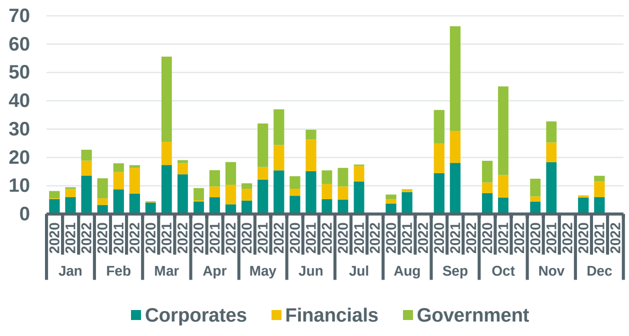
% of total



Source: Bloomberg, ABN AMRO Group Economics

Monthly Green Bonds issuance by sector

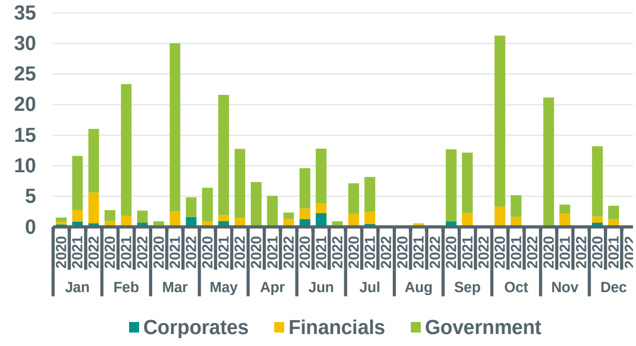
EUR bn



Source: Bloomberg, ABN AMRO Group Economics

Monthly Social Bonds issuance by sector

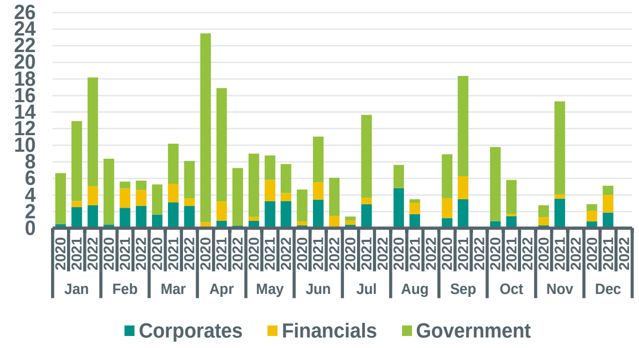
EUR bn



Source: Bloomberg, ABN AMRO Group Economics

Monthly Sustainability Bonds issuance by sector

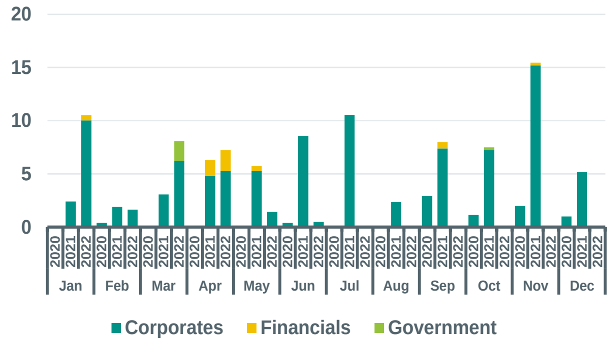
EUR bn



Source: Bloomberg, ABN AMRO Group Economics

Monthly Sust.-Linked Bonds issuance by sector

EUR bn



Source: Bloomberg, ABN AMRO Group Economics

Figures hereby presented take into account only issuances larger than EUR 250m and in the following currencies: EUR, USD and GBP.

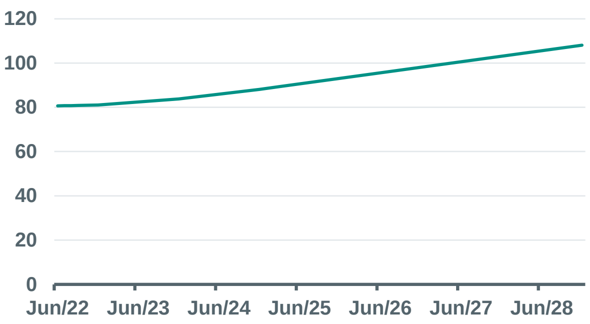
Carbon contract current prices (EU Allowance)

EUR/MT

Source: Bloomberg, ABN AMRO Group Economics

Carbon contract future prices (EU Allowance)

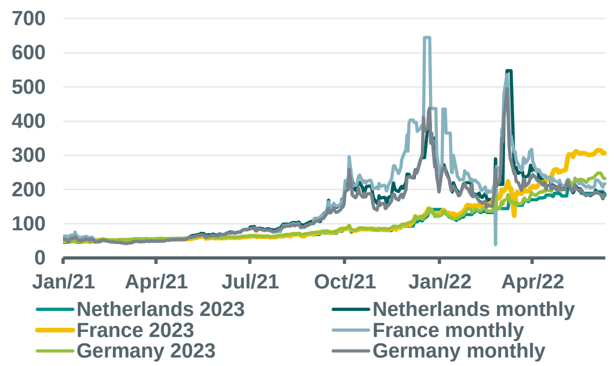
EUR/MT



Source: Bloomberg, ABN AMRO Group Economics

Electricity power prices (monthly & cal+1 contracts)

EUR/MWh

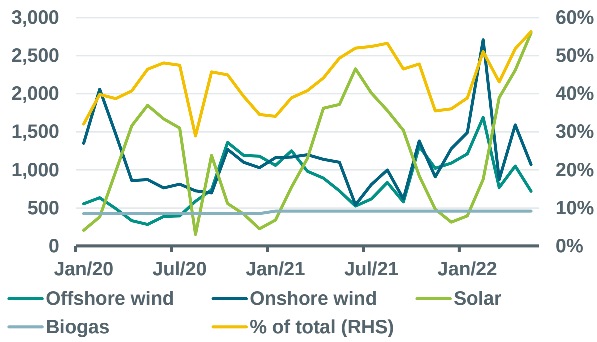


Source: Bloomberg, ABN AMRO Group Economics. Note: 2023 contracts refer to cal+1

Electricity generation from renewable sources (NL)

GW

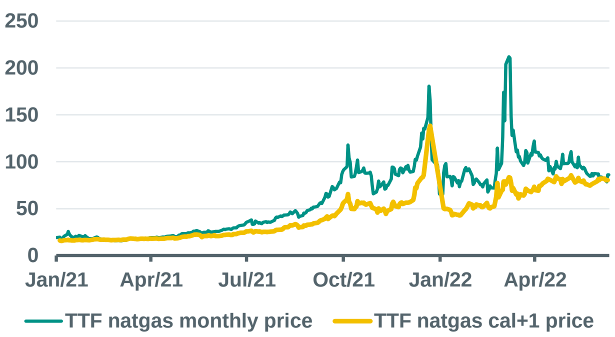
% of total



Source: Energieopwek (Klimaat-akkoord), ABN AMRO Group Economics

TTF Natgas prices

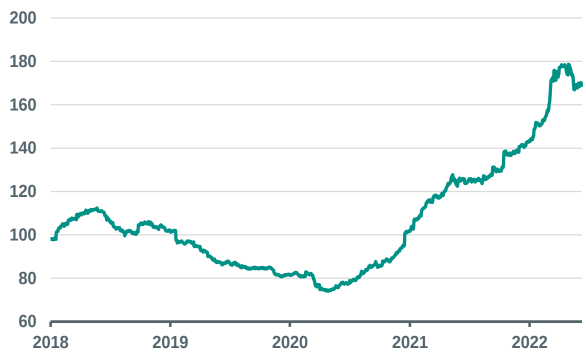
EUR/MWh



Source: Bloomberg, ABN AMRO Group Economics

Transition Commodities Price Index

Index (Jan. 2018=100)



Note: Average price trend of 'transition' commodities, such as: corn, sugar, aluminium, copper, nickel, zinc, cobalt, lead, lithium, manganese, gallium, indium, tellurium, steel, steel scrap, chromium, vanadium, molybdenum, silver and titanium. Source: Refinitiv, ABN AMRO Group Economics

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