SustainaWeekly

The impact of climate change on the neutral rate of interest

- **Strategist: Climate change and the response to it will generate multiple countervailing influences on r*, which is the neutral or equilibrium rate of interest. Theory shows that r* is determined by three factors - GDP/productivity growth, demographics and the preference for safe assets. Rising temperatures will result in more frequent and intense extreme weather events that will raise the demand for safe assets and a consequence of that is lower r*. The outlook for r* depends on the size of the transition and physical shocks.**

- **Economist: This is the second of a set of three notes on the electricity sector. In the first note, we highlighted the divergence in electricity demand in OECD and emerging market economies. Going forward, under different scenarios, the demand for electricity is expected to rise in both OECD and emerging economies because of decarbonisation and energy security. This marks a shift from the past 10 years in the OECD where electricity demand was flat.**

- **ESG Bonds: Ms. Isabel Schnabel indicated that the ECB is looking into potentially decarbonising (or greening) its covered bond portfolio. It seems therefore likely that the ECB is now working on a framework that it can use for that purpose. In this piece, we discuss how such a framework could look like.**

- **Sector: Within many of the economic sectors of the Dutch economy, the transition to low or zero carbon is well underway. But some sectors still face a heavy emission reduction path, while for a small number of others, the emission reduction pathway toward 2030 is a viable option. The sectors responsible for most greenhouse gas (GHG) emissions face a major challenge to decarbonise their processes and products. The transition is often complex and also faces many obstacles.**

- **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 with the impact of climate change on the neutral rate of interest. We go on with the second of a set of three notes on the electricity sector, where we discuss how different scenarios look at electricity demand growth for the upcoming years. We then discuss how a possible framework for the ECB to decarbonise it covered bond holdings could potentially look like. Finally, we show that the carbon-free transition in key sectors of the Dutch economy still faces enough obstacles.

Enjoy the read and, as always, let us know if you have any feedback!
Nick Kounis, Head Financial Markets and Sustainability Research | nick.kounis@nl.abnamro.com

The impact of climate change on r*

Amit Kara – Senior Climate Economist | amit.kara@nl.abnamro.com

- **This note discusses the impact of climate change on the neutral or equilibrium rate of interest (r*). r* is of profound importance for monetary policy, asset prices and fiscal policy**
- **r* is a theoretical concept and the measure evolves over time. Theory shows that r* is determined by three factors - GDP/productivity growth, demographics and the preference for safe assets. r* also helps balance savings with investment**
- **The outlook for r* depends on the size of the transition and physical shocks. There is a trade-off between physical and transition shocks; the physical shocks will be smaller (bigger) if governments make a meaningful (poor) effort to reduce greenhouse gas emissions. The uncertainty around policy could exert downward pressure on r***
- **Rising temperatures will result in more frequent and intense extreme weather events that will raise the demand for safe assets and a consequence of that is lower r*. The prospect of more frequent and intense weather events could also deter investment spending altogether, again lowering r* and further amplifying the search for safe assets**
- **A carbon tax will lower the demand for and the price of fossil fuels. This adjustment will be particularly painful for fossil fuel exporters who will face an adverse terms-of-trade shock during the transition. The shock will be favourable for importing countries. Global r* will represent a balance of these two effects**
- **r* balances desired investment with desired savings. Investment on mitigation and adaptation is forecast to rise by around 1-2% of GDP annually for the next 20-30 years under a net zero scenario. This will raise the demand for savings with upside pressure on r***

> *The humans of the future will surely understand, knowing what they presumably will know about the history of their forebears on earth, that only in one, very brief era, lasting less than three centuries, did a significant number of their kins believe that planets and asteroids are inert. My ancestors were ecological refugees long before the term was invented.*
> Amitav Ghosh in The Great Derangement. Climate Change and the Unthinkable

In this note we discuss the impact of climate change on the neutral or equilibrium interest rate. The equilibrium rate is the level of the real short interest rate when the economy is in equilibrium i.e. when the economic activity is at potential and inflation is on target. It is also the level at which savings are equal to investment. Economists refer to equilibrium rate as r*. The equilibrium rate is of profound importance to central banks, governments and investors. Monetary policy makers at central banks continuously calibrate monetary policy to r*. The policy stance is said to be expansionary when the official policy rate is below the equilibrium rate and restrictive when the policy rate is above the equilibrium rate. r* is important for government policy, especially when the central bank interest rate is at the lower bound and the government needs to step in with structural reform to raise potential economic growth or with a fiscal stimulus, as has been the case recently. And finally, r* is fundamentally important for asset returns because, ultimately, all asset prices are benchmarked against the risk-free interest rate.

What drives r*?

r* is a theoretical concept and the precise level is unknown. In fact, not only is the precise level of r* unknown, it also thought to vary over time. For example, the equilibrium rate has been on secular downtrend in advanced economies since the 1980s.

There are many explanations for this downtrend and in line with economic theory, they can be grouped into three buckets – economic growth, demographics and the rising preference for safe assets. These drivers are structural in that they evolve gradually over time. For example, one important reason for the decline in advanced economy real interest rates since the 1980s is slower economic growth caused by lower productivity growth over this period. Low economic growth requires less

investment and that in turn requires less savings, resulting in a reduction in r* because the equilibrium rate helps balance savings and investment.

r* is not only influenced by the average rate of economic growth, it is also impacted by the volatility of that growth and the skewness around that growth. To be clear, it is the growth in productivity/GDP rather than the level of productivity/GDP that matters for r*. By way of intuition, economic agents prefer safety and agents are prepared to pay a premium for assets that offer the same safe payoff in all outcomes and especially in periods when the economic outlook is volatile.

For that same reason, agents are prepared to pay a premium when the skew in the distribution of outcomes is negative i.e. the chances of a bad outcome exceeds the likelihood of a good outcome.

Climate change and r*

Climate change and climate change policy are important for productivity growth and investment spending. High investment spending will boost GDP in the short run and support the long run productive capacity of the economy. GDP will also be less volatile. Higher GDP growth and lower GDP volatility will result in higher r*.

Physical shocks

One way to frame the discussion is through the prism of physical and transition shocks. Physical shocks relate to direct and indirect risks to the economy that are caused by global warming. These risks can be chronic or acute. The chronic impact stems from the effect that rising temperatures have on labour productivity, labour supply, total factor productivity and capital accumulation. The majority of recent climate literature appears to suggest that global warming will lower the level of productivity and GDP rather than the growth in productivity and GDP. The impact of chronic physical shocks on r* will be relatively small if, as studies suggest, the effect on the growth rate of GDP is marginal.

Acute physical risk is also closely associated with temperature. GDP is expected to be more volatile, especially in small, low income economies that are densely populated and prone to extreme weather events. Low-income economies are also more vulnerable because they are less able to access the technology and finance that will be necessary to build resistance and to rebuild the economy after an extreme weather event. The quote from Amitav Ghosh above highlights the fragility of the economy in one such country, Bangladesh. In fact, studies show that global warming of 1.1 degrees has already doubled the global land area and population that is exposed to extreme weather events such as flood, crop failure, heatwaves and droughts. These events will only multiply and potentially bring with them increased migration and conflict, resulting in more volatile GDP. The preference for safe assets will rise, exerting downward pressure on r*.

Extreme weather events could also raise the demand for investment which will support r*, but equally, a scenario can be painted where the increased frequency of extreme weather events deters investment spending and in that case, r* could fall. Low-income countries with limited access to finance and technology are most vulnerable. The corollary of low mitigation and adaption investment spending could be an increase in demand for risk free assets.

Impact of physical and transition risk on r* over the next 20-30 years

Driving factor	Impact on r*	Impact on r* from physical risk	Impact on r* of transition risk
GDP growth	Positive relationship. High growth, high r*	Downwards, if global warming results in a reduction in GDP/productivity growth.	Investment spending on mitigation, adaptation and reconstruction could rise. This lifts r*. The transition to net zero is negative/positive for fossil-fuel exporters/importers who suffer an adverse/favourable term-of-trade shock. r* falls/rises
Risk			
Volatility	Negative relationship. High volatility, low r*.	r*likely to fall because of more frequent and more intense extreme weather events.	Higher spending on adaptation and mitigation lowers economic volatility, resulting in higher r* r* likely to fall because the mitigation policy path is unknown
Negative skew	Negative relationship. Bigger skew, lower r*	r* likely to fall especially in low-income economies with limited access to technology and finance.	Higher spending on adaptation and mitigation lowers the chances of a negative skew resulting in higher r* r* likely to fall because the mitigation policy path is unknown

Source: ABN AMRO Group Economics

Transition shocks

Transition shock is the impact on the economy of changes in climate policy and technology. The literature on transition shocks is centered around price-based policies such as carbon taxes and non-price based policies such as regulation, public investment and incentives for green investments. Carbon tax will raise the effective price of carbon-intensive fuels such as coal, oil and gas relative to nuclear and renewables. As a result, demand will shift away from fuels, especially high-carbon fuels, and towards low carbon fuels. The production process will also switch towards capital and labour and away from energy. The underlying price of fossil fuels will fall because of lower demand. Lower fossil fuel prices and demand will act as an adverse terms-of-trade shock for fuel exporters such as countries in the Middle East, Canada, Norway, and Russia. On the flip side, fossil fuel importers such as the EU, Japan, China and India will benefit from the lower price.

As discussed previously, the equilibrium rate of interest also serves to balance savings with investment. The power sector sits at the centre of this transition and investment will have to rise substantially over the next 15 years in this sector to achieve net zero. The Energy Transition Commission believes that a complete transformation of the energy system is required to achieve net zero by 2050 and that will cost 1-2% of GDP per annum. This is the total estimate of investment to replace/retrofit the existing fossil fuel-based infrastructure with clean energy, but what matters for this analysis is the incremental investment that needs to occur over and above regular fossil fuel investment that would have been undertaken under a no climate change scenario. McKinsey, the management consultant, estimates that the net investment required is in the region of 1% of GDP. This amount of investment is unaffordable for most governments and as a result, the private sector will have to play an important role in funding and building the required infrastructure.

To this we need to add the cost of adaptation projects to guard against the physical effects of climate change. This includes upgrading public infrastructure such as irrigation systems, roads, bridges, buildings and developing early warning systems. Spending on transition and adaptation must be matched by additional savings and r* will need to rise to encourage the private and public sector to channel savings into these investment projects.

Conclusion

Climate change and the response to it will generate multiple countervailing influences on r*. Theory states that r* will be influenced by economic growth and the uncertainty around that growth r* also acts to balance savings with investment. The overall impact will depend on the balance of these forces. Higher mitigation and adaptation investment spending will raise r* and in these circumstances we expect the demand for safe assets to ease which, in turn, will also support r*. The converse is also possible – investment spending could be low and the risk to the economy will rise. Both forces will act to dampen r*. Fossil fuel exporting countries will suffer a loss in income because of adverse terms-of-trade shocks, meanwhile the purchasing power of fossil fuel importers will improve because of the favourable terms-of-trade shock. Global r* will reflect a balance of these two factors.

Electricity demand at turning point

Aggie van Huisseling – Economist | aggie.van.huisseling@nl.abnamro.com
Amit Kara – Senior Climate Economist | amit.kara@nl.abnamro.com
Jeannine van Reeken – Economist/Data Scientist | jeannine.van.reeken@nl.abnamro.com

- **Electricity demand was flat in OECD countries in the last 10 years**
- **The demand for electricity will expand in the coming years due to decarbonization and prioritizing energy security**
- **In all IEA and NGFS scenarios, but particularly in the Net-Zero by 2050, electricity demand rises**

This is the second of a set of three notes on the electricity sector. In the first note (find it here), we compared electricity demand over the last 10 years in OECD countries and emerging markets and highlighted the divergent demand trends in electricity demand in OECD and emerging countries. Electricity demand was flat in OECD over the past 10 years but it rose by around 25% in emerging economies over the same period. There are two main reasons for the divergence: efficiency gains in OECD countries and the transfer of heavy industries to emerging economies. In this note we look at future electricity demand prospects and compare the assumptions embedded in two well-known net zero scenario's: by the NGFS and the IEA.

Demand for electricity to expand by decarbonization and energy security

Electricity sector reform is pivotal for decarbonization. As discussed below, through the IEA and NGFS scenarios, this means, amongst others, an increase in electricity demand and a switch in the underlying sources used to produce it. The EU, for instance, set a goal of reducing GHG emissions by 55% by 2030 in its Fit for 55 package. Not only governments set goals for GHG emission reduction, but also large companies made high-profile pledges to limit their impact on the environment.

In addition to that and in the face of potential deglobalization, energy security has also become a priority in many regions. For the EU this momentum is amplified by the recent energy crisis, leading to the new REPowerEU plan which supports the block's overall clean energy transition and simultaneously reducing its energy import dependence (to switch away from Russian gas, for instance). The new initiative not only targets the gas sector, it also aims to transform the electricity sector – via accelerated roll-out of renewable energies, electrification of end uses and renewable hydrogen. The electrification of end uses will result in higher demand for de-carbonized electricity (read our publication here).

Although the current energy crisis has stressed the importance of energy security, there are limits to direct electrification in the short term, especially for some industries such as long-distance transport, including aviation and shipping. These barriers could be overcome by suitable technologies that are under development. Thus, although the energy crisis has not enabled a sudden switch to fossil fuel-free alternative energy sources, it has set in motion a number of medium to longer term shifts that will accelerate the transition (see our publication here). When these physical limitations are overcome, the sectors that are reducing their dependence on fossil fuels will spark an increase in electricity demand.

The electrification of sectors such as transport will raise electricity demand but energy demand will be moderated by energy efficiency gains that will be driven by new and improved technology. A good example of energy efficiency is the response of European manufacturers to the recent gas crisis. Industrial output has proven remarkably resilient in spite of a large reduction in gas supply, but going forward, similar gains in energy efficiency cannot be expected. In other words, there are (short term) limits to energy efficiency gains. All in all, going forward, we expect the increased demand from electrification to outweigh the reduction in electricity demand from efficiency, resulting in higher overall electricity demand.

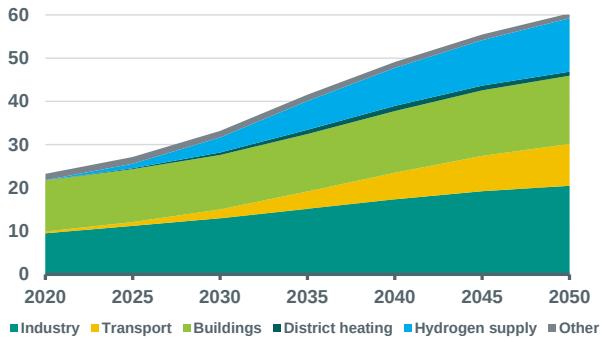
Net-zero by 2050 scenario's to quantify electricity demand increases

In this section we discuss the implications and assumptions for electricity demand that are embedded in two well-known net-zero by 2050 emissions (NZE) scenarios, which are designed to model how the world can achieve net-zero energy-related and industrial process CO_2 emissions by 2050. The scenarios require substantial emissions reductions by 2030 to be in line with the Paris stretched target of 1.5°C scenario's (as defined by the IEA).

Electricity demand is set to rise sharply in both scenarios. In the figures below we have visualized the electricity use for various sectors. All denote final electricity use, except hydrogen supply which is a secondary source. As visualized in the graphs, electricity used in hydrogen production differs significantly between the two scenarios; the assumptions for hydrogen supply are provided in the table below. The main implication is that the IEA assumes almost all hydrogen production to be low-carbon and expect almost double the yearly production capacity for hydrogen than the NGFS does.

IEA: world electricity demand rises to 60,377 TWh

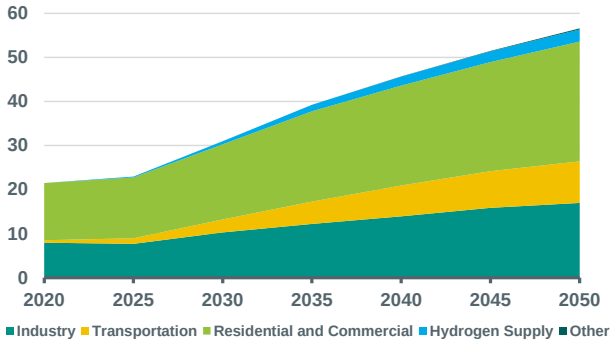
World. Demand in Thousand TWh



Source: IEA Net Zero by 2050, ABN AMRO Group Economics

NGFS: world electricity demand rises to 56,577 TWh

World. Demand in Thousand TWh



Source: NGFS Phase 3 REMIND-MAgPIE 3.0-4.4, ABN AMRO Group Economics

To illustrate the methodological differences and assumptions of the scenarios, we contrast these in the table below.

Variable	IEA	NGFS
GDP growth	World GDP: 45% larger in 2030 than in 2020 More than twice as large by 2050	In the counterfactual case without damage, world GDP would increase from 77003.11 bn US$2010/yr in 2020, to 143051.09 bn US$2010/yr in 2050.That is, an 86% increase. GDP deviation mostly follows from transition, chronic and acute risks. GDP deviation from these is -3% in 2030 and -4.2% in 2050.
World population	7.8 bn people in 2020 Increase to 8.55 bn in 2030 And to 9.8 bn in 2050	7.8 bn people in 2020 Increase to 8.5 bn in 2030 And to 9.4 bn in 2050.
Total energy consumption	Between 2025 and 2050 total final energy consumption falls by just under 1% each year. In 2050 assumed at 340 EJ	Total energy consumption assumed at: 427.32 EJ/yr in 2020; 396.9 EJ/yr in 2030; 367.77 EJ/yr in 2050.
Share of electricity in total energy consumption	Share of total final energy consumption: 20% in 2020 26% in 2030 50% in 2050.	Electricity consumption assumed at: 77.33 EJ/yr in 2020, share of 18%; 108.93 EJ/yr in 2030, share of 27.5%; 193.73 EJ/yr in 2050, share of 53%.
Hydrogen	2050 production realized of 528 MT H_2 520 MT H_2 of this is low-carbon Requires 14,500 TWh electricity. In EJ, this is a production capacity of 75.43 EJ	Expects production of 36.83 EJ/yr in 2050.
Investments	Between 2016-2020, annual investment in energy was on average 2 trillion USD. Expected to be: 5 trillion USD by 2030 4.5 trillion USD by 2050 In total annual capital investment terms: 2.5% of global GDP between 2016-2020 4.5% in 2030 2.5% in 2050	Investment in the energy sector: 1.2 trillion US$2010/yr for 2020; 3.4 trillion US$2010/yr for 2030; 2.4 trillion US$2010/yr for 2050.
Emissions	CO_2 emissions go to 21 Gt CO_2 in 2030 and to net-zero in 2050	CO_2 emissions go down from 42.5 in 2020, to 23.4 Gt in 2030, to 2.4 Gt CO_2 /year in 2050
CO_2 prices	For advanced economies, on average, USD 130 per tonne (tCO_2) in 2030 and USD 250/ tCO_2 in 2050. For BRICS USD 200/tCO_2 in 2050. And for other emerging and developing USD 55/tCO_2 in 2050.	The carbon price stands at 9.73 US$2010/t CO_2 in 2020 and 451.24 US$2010/t CO_2 in 2050.

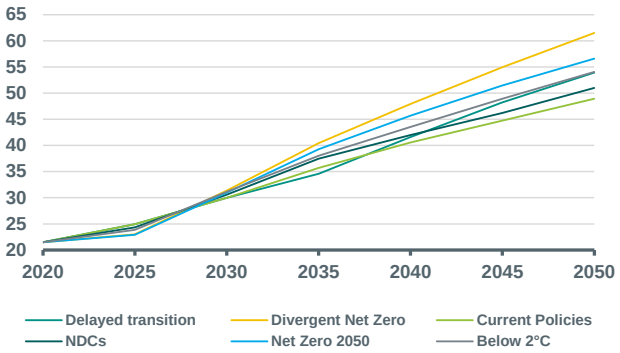
* Sources: IEA and NGFS

Electricity demand will rise in all scenarios

Since the NZE scenarios are ambitious pathways, in this section we illustrate that worldwide electricity demand will also rise in the other scenarios that the NGFS has set out in their third phase scenarios. Electricity demand will rise significantly in all scenarios as shown in the figure below. The data represents the sum of final electricity demand and electricity use in hydrogen production (which is a secondary step).

Electricity demand rises in all NGFS scenarios

World. Demand in Thousand TWh[1]



Source: NGFS Phase 3 REMIND-MAgPIE 3.0-4.4, ABN AMRO Group Economics

This illustrates that even in the scenario with the lowest ambition (i.e. the current policy scenario), electricity demand rises from 21,503 TWh in 2020 to 48,927 TWh in 2050. The divergent net zero, which is the scenario with the highest ambition, shows a rise of electricity demand to 61,488 TWh in 2050. Note that this is still less global electricity demand than the IEA set out in their NZE scenario.

Greening of electricity generation and obstacles to electrification

As we have set out above, electricity demand will grow under all scenarios. This marks a shift from the past 10 years in the OECD where electricity demand was flat. For the electrification process to decrease the CO_2 emission intensity, the sources used in electricity generation need to be de-carbonised alongside switching from fossil fuel use to electricity. The IEA, for instance, expects the two major sources in 2050 to be solar PV (33%) and wind (35%). To enable this transition, large investments in the energy sector are needed. According to the assumptions in the IEA Net-Zero scenario, annual investment will rise to 5 trillion USD in 2030 and to 4.5 trillion USD by 2050. The NGFS Net-Zero scenario assumes investment in the energy sector to be 3.4 trillion US$2010/yr for 2030 and 2.4 trillion US$2010/yr for 2050

This decarbonization of electricity production in combination with the growing electricity demand will lead to intermittency problems. These problems and their solutions will be discussed in the third and final part of our three-piece publication on electricity.

[1] NDCs denotes Nationally Determined Contributions

A blueprint for greening CBPP3

Joost Beaumont – Head of Bank Research | joost.beaumont@nl.abnamro.com

- **ECB Executive Board member Isabel Schnabel has set out the central bank's intention to also decarbonise its CBPP3 portfolio (currently greening is focussed only on corporate bonds)**
- **The central bank has not yet set out a framework to do so, so we think about such a blueprint in this note**
- **It will likely resemble the framework it uses for corporate bonds, which includes backward and forward-looking pillars as well as one on data disclosures**
- **The recent publication by the ECB of climate-related indicators is likely to support the setup of a covered bond framework, as it provides information about carbon-intensity of bank loan books**
- **However, there are still many data gaps, so we expect that the ECB will place weight on climate-related strategies of banks as well as publicly available data disclosures**
- **It will be interesting to see whether the ECB will add a pillar related to cover pools, although this also is exposed to a risk of green washing**
- **The ECB might start actively decarbonising its CBPP3 portfolio in H2 of this year**

Earlier this month, ECB Executive Board member Isabel Schnabel mentioned in a **speech** that the ECB wants to step up its efforts to accelerate the green transition and its own contribution to it as well. Currently, the central bank already has a framework in place to gradually green (or decarbonise) its corporate bond portfolio (CSPP). As such, it tilts reinvestments to 'green' companies (so-called flow-based approach). However, to further decarbonise this portfolio once the central bank stops reinvesting maturing principles, it must start actively reshuffling its portfolio (so-called stock-based approach). This implies substituting bonds from 'non-green' companies with bonds from greener companies. The important message for the covered bond market was that Ms. Schnabel also indicated that the ECB wants to decarbonise (or green) its covered bond portfolio, which currently has an outstanding amount of EUR 304bn. But it first needs a framework to do so. Therefore, it seems likely that the ECB is now working on a framework that it can use to decarbonise its CBPP3 portfolio. In this note, we will discuss how such a framework might look like.

The framework that the ECB uses to decarbonise its corporate bond holdings consists of three pillars (see **here**): (1) backward-looking emission performance of corporates; (2) forward-looking emission targets, and (3) the quality of climate disclosures. The backward-looking emission performance includes a time series of a company's carbon emissions, based on scope 1, 2 and 3 emissions (with the latter assessment using sector-level data), while the forward-looking measure assesses the level of ambition of companies' climate strategies. The final pillar judges the quality of climate-related data that companies publish and whether these are, for example, checked by third parties. Hence, the best scores are for companies with the lowest emissions, the clearest and most ambitious decarbonization strategies as well as those that provide the most transparent climate-related insights in their reporting.

The big question is how the central bank will apply such a framework to covered bond issuers. Complicating factors in this respect is that covered bonds are backed by collateral (mostly mortgages, but also public sector loans and shipping loans), which could be included within the framework as well. As a starting point, we expect that it is likely that the central bank will look at the issuer level. Most banks already report scope 1 and 2 emissions, and have emission targets as well. However, the quality of reporting varies widely. Moreover, scope 3 emissions from their lending portfolios (i.e., the carbon emissions of companies that banks lends to) are the most important element in assessing how carbon-intensive banks are within their lending operations. Currently, several banks only report scope 3 emissions restricted to their indirect business operations (e.g., business travels).

Still, the ECB's recent publication of climate-related data could provide insights in a methodology that it will probably use to measure the carbon footprint of banks. Indeed, the ECB has published a set of climate-related statistical indicators, which offers insights in issuance and holdings of sustainable bonds as well as exposures of the financial sector to physical climate risks and transition risks (see **here** and **here**). Transition risks are mainly captured by the ECB's indicators about carbon

emissions, which are based on two indicators. The first focusses on capturing the banks' financing towards carbon-intensive activities, and includes for example, the total amount of carbon emissions from companies financed by the bank (absolute emissions). The second focusses on more directly capturing exposures to transition risks through relative metrics, and includes for example, the weighted average of the carbon-intensity of bank loan portfolios.

This information is something the central bank could use in its calculations of the first pillar, which would imply that the more carbon-intense the loan book, the lower the score. However, the central bank acknowledges that there are still quite some challenges related to the quality of the data, which is why the recently published data on the carbon intensity of banks' portfolios is based on data from non-financial counterparties., Furthermore, the ECB acknowledges that the data is subject to various methodological and data-related limitations, including limited data coverage over time and across regions. For example, emissions and balance sheet information are jointly available for only about 47% of outstanding debt, which gives therefore only a partial view over the emissions of banks' portfolios. As a result, it could be that the central bank will give this pillar a lower weight in its framework initially, given a higher weight to, for example, the third pillar, which is related to the quality of the disclosures. This would incentivise banks to be more transparent on the carbon footprint of their portfolio. Once data quality improves over the years, the central bank could put more focus into this pillar.

The second pillar is likely to be assessed on an issuer level as well. To do so, the ECB needs to look at whether banks have climate strategies in place, and if so, what the level of ambition is compared to peers. We think that this pillar will likely mirror the approach it will use to assess targets and decarbonization strategies of the companies that issue the securities in its corporate bond portfolio. To assist with this assessment, it could for example consider whether the strategies have been published and whether they have been incorporated in banks operations as well. A starting point could be whether banks are member of the Net Zero Banking Alliance (NZBA), which also keeps track if banks have in place decarbonisation strategies (see **here**). Signatory banks of the NZBA are required to set intermediate targets to reduce emissions of their lending and investments portfolio for 2030 or sooner using robust, science-based guidelines, and must commit to net-zero emissions by 2050. A quick look shows that most large eurozone banks that issue covered bonds are indeed part of the NZBA, but also that covered bond issuers from some euro area countries are missing (e.g., Belgium, Slovakia). Currently, the below euro (benchmark) covered bond issuers are members of the NZBA:

AT	Erste Group
DE	Commerzbank, Deutsche Bank
ES	ABANCA, Banco Sabadell, Banco Santander, Bankinter, BBVA, Caixabank
FI	Nordea Bank
FR	BNP Paribas, Credit Argricole, Credit Mutuel, Credit Mutuel Arkea, Group BPCE, La Banque Postale, Societe Generale
IE	AIB Group
IT	Banca Monte dei Paschi di Siena, BPER Banca, Intesa Sanpaolo, Mediobanca, Unicredit
NL	ABN AMRO, Rabobank, ING
PT	Caixa Geral de Depósitos

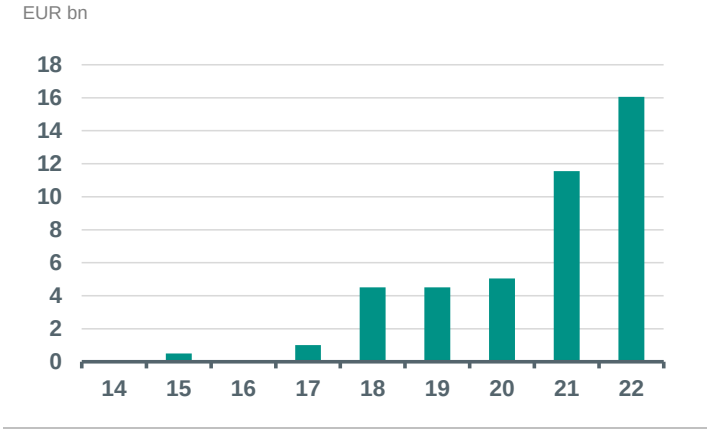
Unsurprisingly, banks that have clear strategies in place, with targets aligned with the Paris Agreement, which are verified by a third-party will likely be the ones that score best for this pillar.

The third pillar is about the quality of climate-related disclosures, which is somewhat related to the first pillar. The ECB will check what level of data banks are reporting when it comes to their carbon emissions, so banks that currently do not report emissions of their lending portfolios will likely score lower on this pillar. A big difference in this respect is that the ECB already has access to a lot of information because it is the bank regulator. As such, it demands from banks that they are taking steps in terms of climate strategy, governance, risk management, etc. and that banks also provide it with information about these. Furthermore, the ECB already uses data for its climate indicators, which it can use. Having said that, this pilar (data disclosures) will likely be more related to the data that banks make publicly available and whether this data is being checked by third parties. In this case, the higher the quality and level of detail of publicly available data, the better the score.

This brings us to the question of whether the central bank will also consider climate-related information on cover pools backing the covered bonds that banks issue. The new Covered Bond Directive that came into force on 8 July 2022 does include reporting requirements for covered bond issuers, although these do not (yet) include data disclosures related to climate (risks). The ECB indicated last year in a speech (see **here**) that it would appreciate banks to start disclosing more climate-related data on all covered bonds and not only sustainable covered bonds. This likely implies that the central bank prefers to see banks reporting climate-related data on all assets included in cover pools. For mortgages, this could, for instance, consist of information about carbon emissions of the properties and/or energy labels. This, however, could lead to some 'greenwashing' as banks could reserve mortgages on most energy-efficient buildings for their cover pools, keeping least-energy performing mortgages out. As such, it would be better if the ECB would look at the total mortgage portfolio of covered bond issuers rather than only the cover pool (hence also an issuer-level analysis). This, in turn, would be rather closely related the first pillar (i.e., the carbon-intensity of a bank's loan book). It therefore remains to be seen whether the ECB will add a fourth pillar to covered bonds, although it might separate carbon emissions related to banks' mortgage lending and that related to other lending. Having said that, data issues are likely to pop up among countries in this respect as well.

Finally, as with the corporate bond holdings, the ECB could favour green covered bonds over regular covered bonds, as these have already the green label being also subject to reporting requirements. However, the universe of eligible green covered bonds remains limited, implying that the central bank needs a broader framework to materially decarbonise its covered bond portfolio. Indeed, currently, the share of green covered bonds in the euro benchmark index is roughly only 5% (EUR 39bn).

Issuance of green covered bonds



Source: Bloomberg, ABN AMRO

Overall, we expect the ECB to establish a framework for greening its CBPP3 portfolio that would be roughly similar to the framework it uses for corporate bonds, with the difference being that there are still some considerable data issues that need to be solved. Having said that, the central bank as regulator has already access to quite some data, while it also has started to compile climate-related statistics, which it is likely to use for this framework. Therefore, the central bank will probably publish such a framework sooner rather than later. The end of APP reinvestments, which we expect in July, might be a good starting point to start actively decarbonising its CBPP3 portfolio.

Carbon-free transition in sectors still faces enough obstacles

Casper Burgering – Economic Transition Economist | casper.burgering@nl.abnamro.com

- **Most sectors need to reduce more than half of GHGs from current levels**
- **Decarbonisation techniques are widely available, but require a lot of (public & private) investments**
- **The decarbonisation challenge requires efficiency gains, innovativeness and positive public policy**

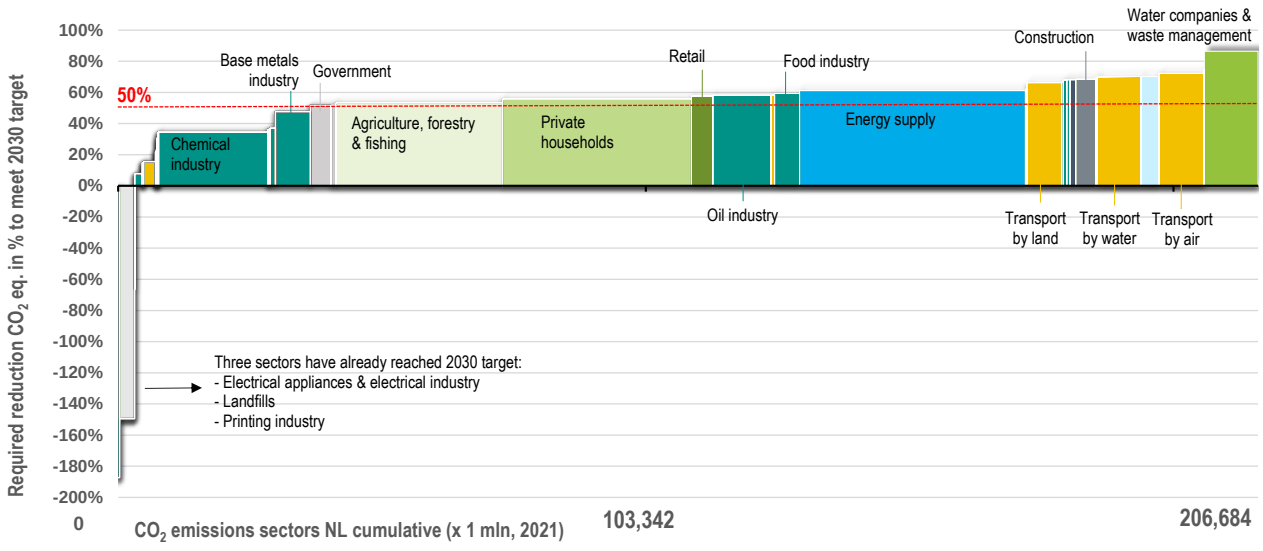
Within many of the economic sectors of the Dutch economy, the transition to low or zero carbon is well underway. But some sectors still face a heavy emission reduction path, while for a small number of others, the emission reduction pathway toward 2030 is a viable option. The sectors responsible for most greenhouse gas (GHG) emissions face a major challenge to decarbonise their processes and products. The transition is often complex and also faces many obstacles.

Decarbonisation-curve 2030

Decarbonisation is a term used for removing or reducing emissions of carbon dioxide (CO2) in particular. Decarbonisation of processes and activities applies to almost all sectors in the Dutch economy. To gain emissions sector insight into how the Dutch economy, we created a decarbonisation curve. The decarbonisation curve not only shows how much CO2 an individual sector is responsible for (horizontal axis in the figure below), but also shows the minimum amount of CO2 that must still be reduced until 2030 by those sectors, compared to the current level (vertical axis in the figure below).

Decarbonisation curve 2030: most sectors need to reduce more than half of GHGs

(width of a block is the amount of GHG emissions, height of a block is the minimum GHG reduction% to meet 2030 target)



Source: CBS, ABN AMRO Group Economics
Dark green blocks are industrial sectors, orange blocks refer to transportation sectors, light gray blocks refer to government and utilities; the other colors refer to individual sectors

In some sectors, separate sector agreements have been made on the emission reduction path toward 2030 and 2050. For the sake of simplicity and comparability, in this analysis we have taken into account a GHG reduction of 60% of 1990 levels (here referred to as the 2030 target). This is in line with the ambitions and climate goal of Cabinet Rutte IV. Because ultimately the entire Dutch economy should aim for this level, we have therefore given all economic sectors this same reduction target.

The figure reveals a few striking things. For example, four major subsectors are responsible for the largest share of GHG emissions. These are successively: energy supply, agriculture, industry and transportation. Private households also contribute significantly with about 15% of total GHG emissions. Furthermore, about three sectors have already more than reached the 2030 target and about five sectors only need to reduce less than 25% of the current level of GHG emissions until 2030. This seems like a viable option, but may still prove to be quite a complex process at times. Furthermore, most sectors (>60%) still face the immense task of reducing more than 50% of the current level of GHG emissions.

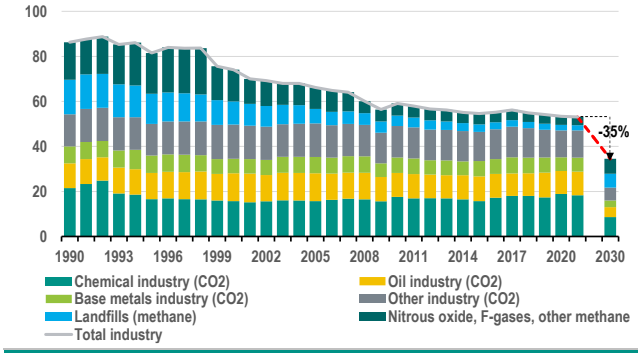
In the 2019 Climate Accord, five different climate sectors are distinguished, capturing the total GHG emissions of the Netherlands. The climate sectors are successively (with the share in total GHG emissions in brackets): industry (32%), electricity (19%), mobility (18%, including domestic traffic and transport), agriculture (16%) and built environment (15%, due to natural gas consumption).

In industry, three subsectors have a significant share: the chemical industry, the petroleum (or oil) industry and the base metals industry. These three subsectors collectively account for over 65% of total industrial emissions in 2021 (according to IPCC data). Total industry still needs to reduce about 35% of the current level of GHG emissions until 2030. This is about 4% per year. At first glance, this does not seem like a nearly impossible task. On balance, however, in some cases it is still complex to make a good business case for emissions reductions. Accurate data on lead times, the necessary investments (both private and public), maintenance and operational costs, payback periods and possible subsidy schemes are indispensable in building a sound business case.

In the built environment, from the 2021 level of GHG emissions, some 51% minimum reductions must be achieved to reach the 2030 target. In the total emissions of the built environment, homes have a share of about 70%. Public and commercial services account for 30%. Virtually every energy-saving measure in the built environment affects every sector of the Dutch economy. The bulk of the emission reduction must be achieved with climate-neutral measures in existing buildings, and this makes the transition to low-carbon buildings slow. The challenge here is mainly to convince existing building owners, users and occupants of the need for more energy efficiency.

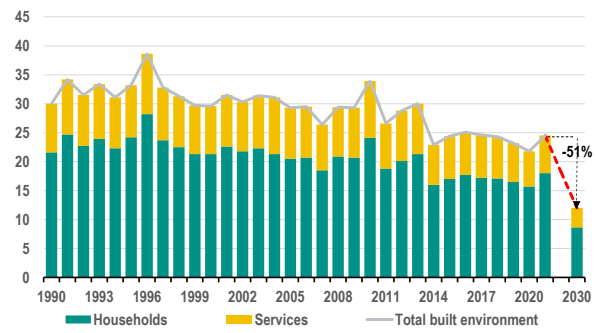
Dutch emissions GHG industry and 2030 target

billion kg CO2-equivalents



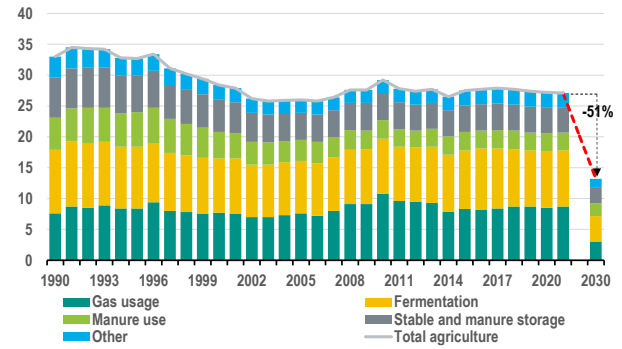
Dutch emissions GHG buildings and 2030 target

billion kg CO2-equivalents



Dutch emissions GHG agriculture and 2030 target

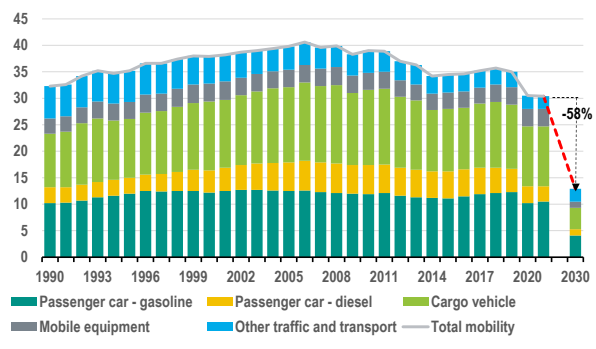
billion kg CO2-equivalents



Source: CBS, ABN AMRO Group Economics

Dutch emissions GHG mobility and 2030 target

billion kg CO2-equivalents



Source: CBS, ABN AMRO Group Economics

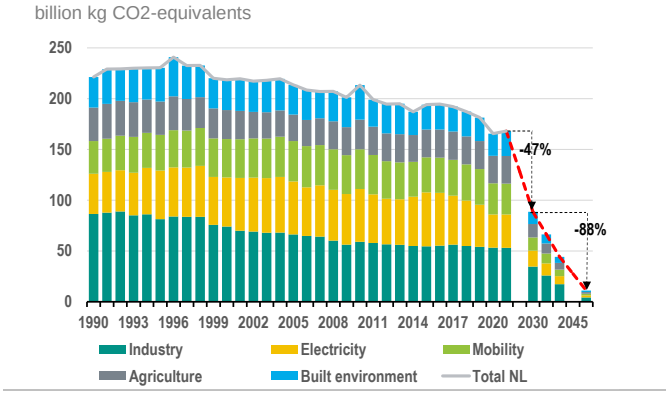
Agriculture also has yet to reduce 51% of the 2021 level of GHG emissions. It is the sector most exposed to and directly affected by climate change. This primary production sector is highly dependent on the natural environment with its activities. Changes in average temperature and precipitation patterns, as well as more intense and extreme weather events, pose a major challenge to the sector. In agriculture, the bulk of GHG emissions come from gas consumption and fermentation. Natural gas consumption accounts for 32% of agricultural GHG emissions (mainly CO2), with greenhouse heating accounting for a relatively high share in particular. Fermentation mainly involves methane emissions, which come mainly

from the digestion process of grass in cows. Agriculture is becoming more sustainable. Currently, the sector is already a leader in the deployment of techniques for sustainable energy production such as solar panels, geothermal energy, biomass plants, windmills, residual heat utilization and manure digesters on a larger scale.

The mobility sector has the longest way to go in emissions reductions until 2030. In this emission reduction path, gasoline cars and cargo vehicles have a large share. Targeted government policies will shape this transition. For example, from 2030, all new passenger cars must be zero-emission vehicles. With this, investing in a covering charging infrastructure (battery or fuel cell) on roads and in ports will become crucial in the coming years.

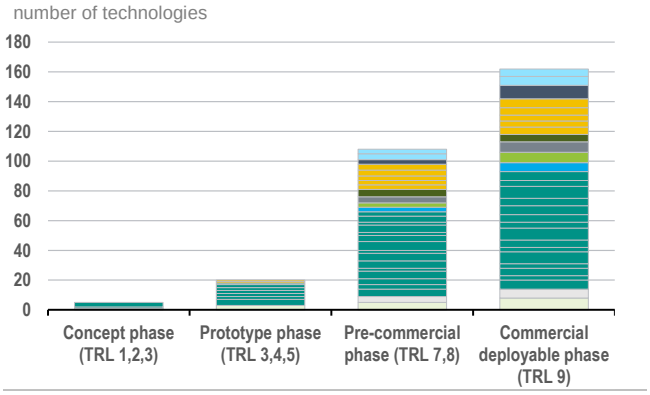
So until 2050, the Dutch economy still has a long GHG-reduction road ahead. Currently, many decarbonisation techniques are widely available in many sectors (**see also our publication with decarbonisation techniques**). Some of these techniques require a lot of investment. Not only in the technique itself, but also in the infrastructure. For example, a good connection to the electricity network with sufficient capacity is a precondition. Here the government has an important role.

GHG emissions by climate sectors (IPCC) and targets



Source: CBS, ABN AMRO Group Economics

Decarbonisation options by TRL



Source: CBS, ABN AMRO Group Economics

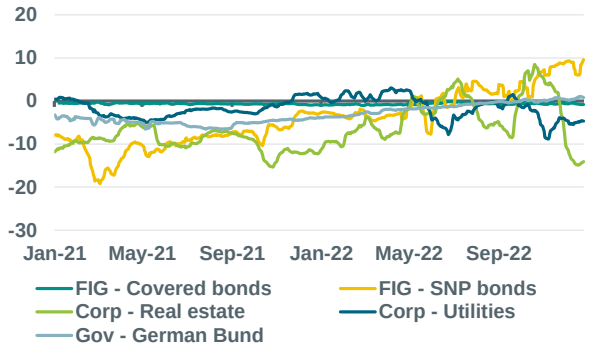
Decarbonising processes and activities generally have four benefits (after Changwoo Chung et al, in Energy Research & Social Science, February 2023). It brings energy and carbon savings (1) while also bringing cost savings (2). In addition, decarbonisation brings other environmental benefits (3) and decarbonisation in one sector has positive impacts on other sectors (4). For example, an energy efficiency measure can reduce the energy and fuel consumption of many processes. It often provides cost and financial savings. In addition, many decarbonisation options can provide other positive environmental benefits, such as water conservation, raw material and resource savings, and improved air quality. Finally, low-carbon ambitions in one sector impact other sectors. For example, ammonia - made in the chemical industry - is widely used to produce fertilizers that are in turn used by agriculture. Thus, decarbonising the production of ammonia has in part also a positive impact decarbonizing agriculture.

Decarbonisation can be achieved in several ways, and the best practice decarbonisation technique varies greatly by sector. For companies in one sector, switching to renewable energy sources or fuel substitution is most promising, while companies in other sectors achieve more ecological gains through electrification and efficiency measures. Using the "Technical Readiness Level," we gain insight into which technologies are still in the concept phase and which have reached maturity. The scales in the TRL system represent the stage that a new decarbonisation or emission reduction technique is in. Here, stage 1 represents the start of development and discovery. And stage 9 represents the commercial readiness of the technology. Interestingly, the commercially deployable phase has ample techniques plotted, while the pipeline of new techniques from phase 1 is little filled. The bottom line is that the decarbonisation challenge can only be met with enough efficiency gains in sectors, sufficient innovativeness and stimulating government policies.

ESG in figures

ABN AMRO Secondary Greenium Indicator

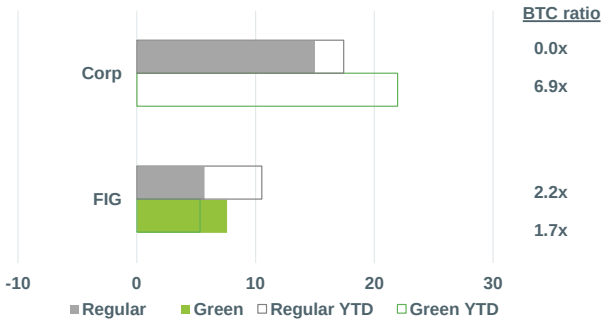
Delta (green I-spread – regular I-spread)



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

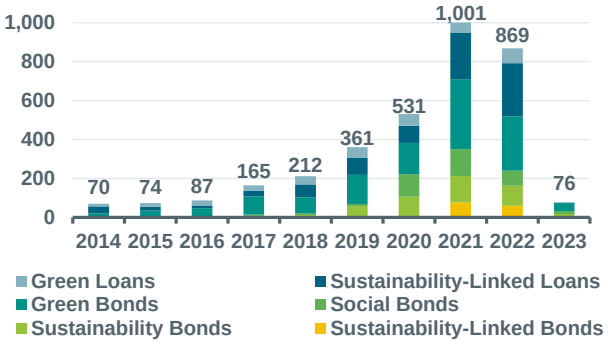
NIP in bps



Note: Data until 26-1-23. BTC = Bid-to-cover orderbook ratio. Source: Bloomberg, ABN AMRO Group Economics

Sustainable debt market overview

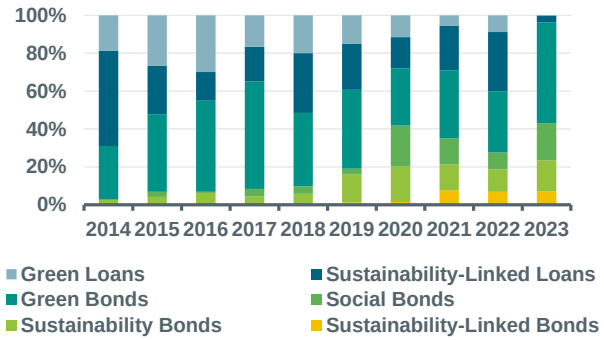
EUR bn



Source: Bloomberg, ABN AMRO Group Economics

Breakdown of sustainable debt by type

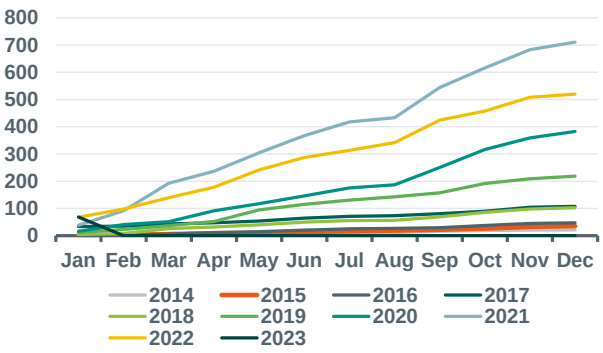
% of total



Source: Bloomberg, ABN AMRO Group Economics

YTD ESG bond issuance

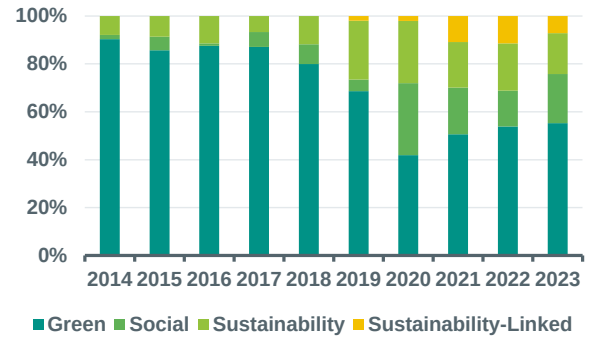
EUR bn (cumulative)



Source: Bloomberg, ABN AMRO Group Economics

Breakdown of ESG bond issuance by type

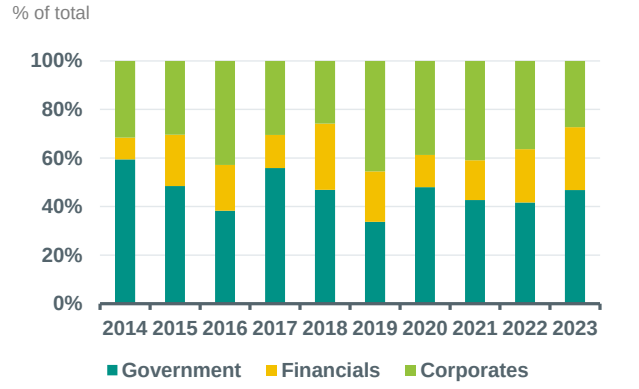
% of total



Source: Bloomberg, ABN AMRO Group Economics

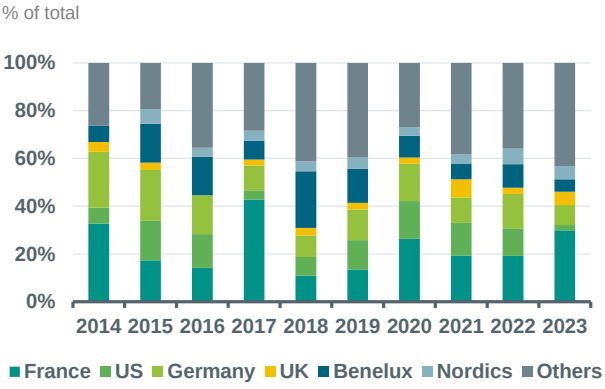
Figures hereby presented take into account only issuances larger than EUR 250m and in the following currencies: EUR, USD and GBP.

Breakdown of ESG bond issuance by sector



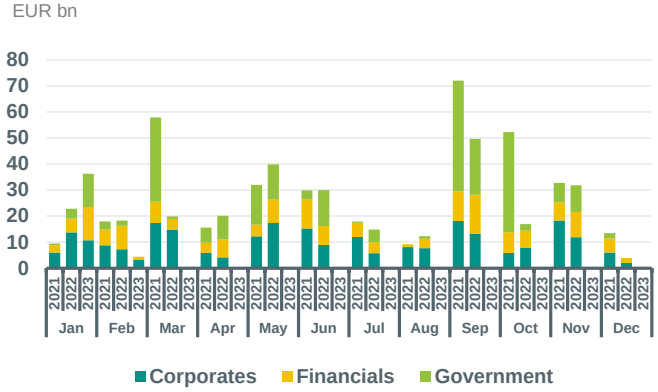
Source: Bloomberg, ABN AMRO Group Economics

Breakdown of ESG bond issuance by country



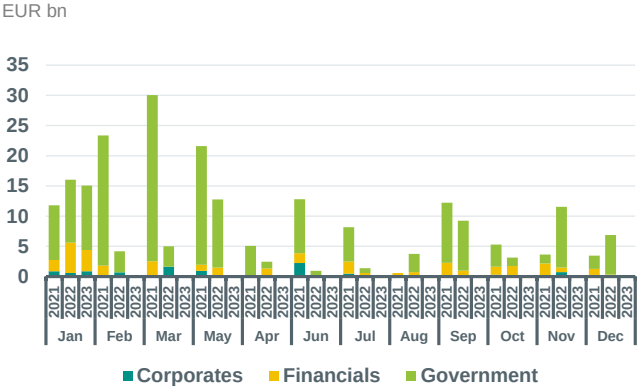
Source: Bloomberg, ABN AMRO Group Economics

Monthly Green Bonds issuance by sector



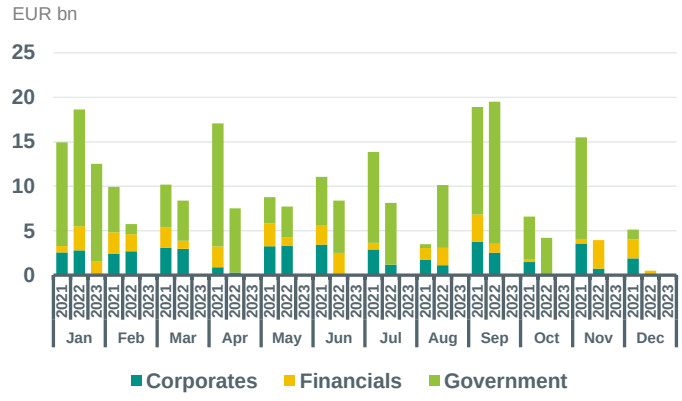
Source: Bloomberg, ABN AMRO Group Economics

Monthly Social Bonds issuance by sector



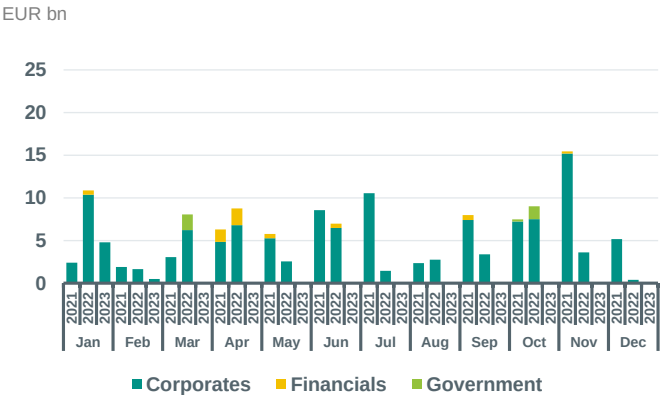
Source: Bloomberg, ABN AMRO Group Economics

Monthly Sustainability Bonds issuance by sector



Source: Bloomberg, ABN AMRO Group Economics

Monthly Sust.-Linked Bonds issuance by sector



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.

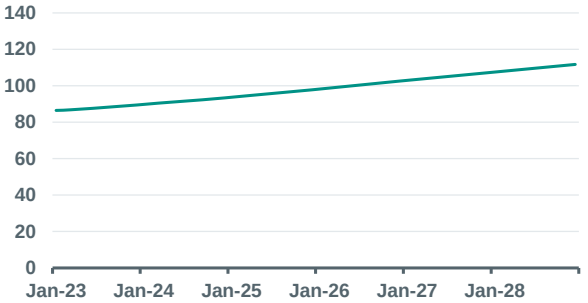
Carbon contract current prices (EU Allowance)

EUR/MT

Source: Bloomberg, ABN AMRO Group Economics

Carbon contract future prices (EU Allowance)

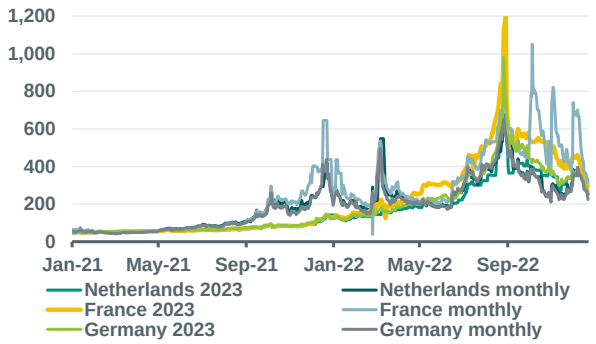
EUR/MT



Source: Bloomberg, ABN AMRO Group Economics

Electricity power prices (monthly & cal+1 contracts)

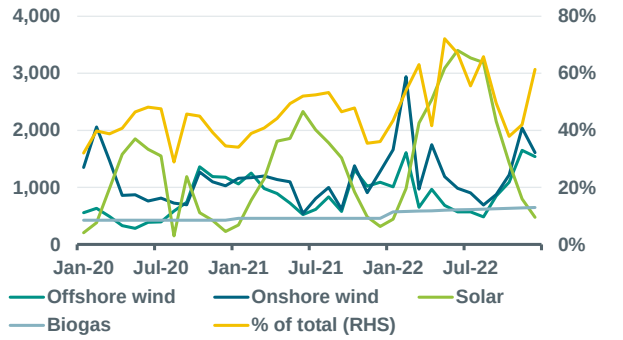
EUR/MWh



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

Electricity generation from renewable sources (NL)

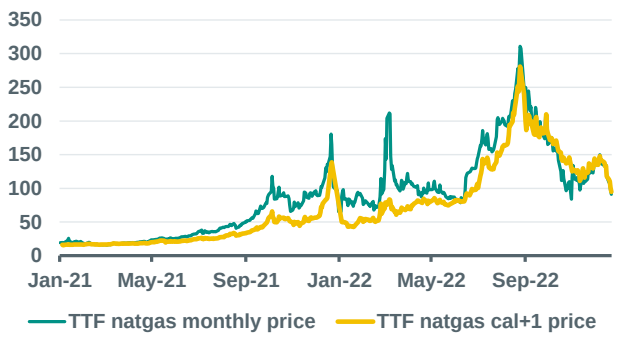
GW % of total



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

TTF Natgas prices

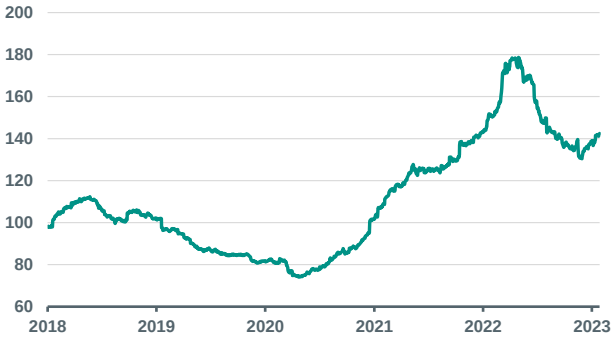
EUR/MWh



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

DISCLAIMER

ABN AMRO Bank
Gustav Mahlerlaan 10 (visiting address)
P.O. Box 283
1000 EA Amsterdam
The Netherlands

This material has been generated and produced by a Fixed Income Strategist ("Strategists"). Strategists prepare and produce trade commentary, trade ideas, and other analysis to support the Fixed Income sales and trading desks. The information in these reports has been obtained or derived from public available sources; ABN AMRO Bank NV makes no representations as to its accuracy or completeness. The analysis of the Strategists is subject to change and subsequent analysis may be inconsistent with information previously provided to you. Strategists are not part of any department conducting 'Investment Research' and do not have a direct reporting line to the Head of Fixed Income Trading or the Head of Fixed Income Sales. The view of the Strategists may differ (materially) from the views of the Fixed Income Trading and sales desks or from the view of the Departments conducting 'Investment Research' or other divisions

This marketing communication has been prepared by ABN AMRO Bank N.V. or an affiliated company ('ABN AMRO') and for the purposes of Directive 2004/39/EC has not been prepared in accordance with the legal and regulatory requirements designed to promote the independence of research. As such regulatory restrictions on ABN AMRO dealing in any financial instruments mentioned in this marketing communication at any time before it is distributed to you do not apply.

This marketing communication is for your private information only and does not constitute an analysis of all potentially material issues nor does it constitute an offer to buy or sell any investment. Prior to entering into any transaction with ABN AMRO, you should consider the relevance of the information contained herein to your decision given your own investment objectives, experience, financial and operational resources and any other relevant circumstances. Views expressed herein are not intended to be and should not be viewed as advice or as a recommendation. You should take independent advice on issues that are of concern to you.

Neither ABN AMRO nor other persons shall be liable for any direct, indirect, special, incidental, consequential, punitive or exemplary damages, including lost profits arising in any way from the information contained in this communication.
Any views or opinions expressed herein might conflict with investment research produced by ABN AMRO.
ABN AMRO and its affiliated companies may from time to time have long or short positions in, buy or sell (on a principal basis or otherwise), make markets in the securities or derivatives of, and provide or have provided, investment banking, commercial banking or other services to any company or issuer named herein.

Any price(s) or value(s) are provided as of the date or time indicated and no representation is made that any trade can be executed at these prices or values. In addition, ABN AMRO has no obligation to update any information contained herein.
This marketing communication is not intended for distribution to retail clients under any circumstances.
This presentation is not intended for distribution to, or use by any person or entity in any jurisdiction where such distribution or use would be contrary to local law or regulation. In particular, this presentation must not be distributed to any person in the United States or to or for the account of any "US persons" as defined in Regulation S of the United States Securities Act of 1933, as amended.

CONFLICTS OF INTEREST/ DISCLOSURES
This report contains the views, opinions and recommendations of ABN AMRO (AA) strategists. Strategists routinely consult with AA sales and trading desk personnel regarding market information including, but not limited to, pricing, spread levels and trading activity of a specific fixed income security or financial instrument, sector or other asset class. AA is a primary dealer for the Dutch state and is a recognized dealer for the German state. To the extent that this report contains trade ideas based on macro views of economic market conditions or relative value, it may differ from the fundamental credit opinions and recommendations contained in credit sector or company research reports and from the views and opinions of other departments of AA and its affiliates. Trading desks may trade, or have traded, as principal on the basis of the research analyst(s) views and reports. In addition, strategists receive compensation based, in part, on the quality and accuracy of their analysis, client feedback, trading desk and firm revenues and competitive factors. As a general matter, AA and/or its affiliates normally make a market and trade as principal in securities discussed in marketing communications.

ABN AMRO is authorised by De Nederlandsche Bank and regulated by the Financial Services Authority; regulated by the AFM for the conduct of business in the Netherlands and the Financial Services Authority for the conduct of UK business.