SustainaWeekly

How far is the world from a net zero trajectory?

- **Economist: A recent IRENA report shows that the world is way off track relative to a pathway to net zero. A whole host of energy transition indicators demonstrate that the gap is wide. For instance, annual renewable power capacity additions would need to more than triple to 2030. The energy intensity improvement rate would need to accelerate more than fivefold. Clean energy investment needs to almost quadruple to USD 4.4 trillion.**

- **Sectors: We have defined a list of eleven key technologies to help to decarbonize the world by 2050. We explain each of the technologies and what they are used for. As technologies are continuously evolving because of limitations and challenges this list is not complete and will also change over time.**

- **Strategy: The ECB has published its first climate disclosure report on its EUR 344bn corporate bond holdings purchased under the CSPP and PEPP. Emission intensity has been declining since 2018, through good luck as well as good management. In addition, it has a greater share of holdings in issuers with reduction pathways than its eligible universe.**

- **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 first review the International Renewable Energy Agency's recently published energy transition indicators, which tell us where we are and where we need to be through to 2030 and beyond to achieve a net zero scenario. In addition, what is necessary on the policy and investment side going forward. We then go on to identify eleven crucial net zero technologies. We explain each of the technologies and what they are used for. Finally, we report on the conclusions of the ECB's first climate disclosure report on its corporate bond holdings.

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

What is needed by 2030 for net zero

Nick Kounis – Head Financial Markets & Sustainability Research | nick.kounis@nl.abnamro.com

- **A recent IRENA report shows that the world is way off track relative to a pathway to net zero**
- **A whole host of energy transition indicators demonstrate that the gap is wide**
- **For instance, annual renewable power capacity additions would need to more than triple to 2030**
- **The energy intensity improvement rate would need to accelerate more than fivefold**
- **Clean energy investment needs to almost quadruple to USD 4.4 trillion**

The International Renewable Energy Agency (IRENA) recently published a sneak preview of its World Energy Transitions Outlook 2023 (see here). The headline message in the report pulled no punches: 'the energy transition is off-track' and that 'every year, the gap between what is required and what is implemented continues to grow'. This conclusion is not contentious. There is not much in the way of disagreement from similar studies, for instance from the IEA and IPCC. In this note, we review IRENA's energy transition indicators, which tell us where we are and where we need to be through to 2030 and beyond to achieve a net zero scenario. In addition, what is necessary on the policy and investment side to close the gap.

Energy transition indicators tell us that the gap is wide

IRENA presents a range of transition indicators to compare where we are now and where would need to be through to 2030 to leave the world on track for a 1.5°C trajectory. We have summarised these indicators in the table below, spanning the different energy sectors and technologies. As can be seen, the gap across all areas between recent levels and the step up needed is large. Good examples can be found in two key focus areas for the next years: electrification and efficiency. The annual renewable power capacity added in 2020-2022 was almost double that seen in 2014-2018. At the same time, last year, 83% of all capacity additions in the power sector were renewable, compared to 57% in 2018. So significant steps have been take. Still, the absolute level of renewable additions would need to more than triple to 2030.

A similar story holds when looking at energy efficiency. One way to measure progress is the energy intensity improvement rate, which is defined as the percentage decrease in the ratio of global total energy supply per unit of GDP. The recent rate has been estimated at around 0.6% per annum, so there is an improving trend. However, according to IRENA this has to accelerate to 3.5%, while in the IEA's Net Zero scenario, this metric needs to be in excess of 4%. Yet, the improvement in energy intensity has actually been slowing. Between 2015 and 2020 improvement averaged 1.4% per year, down from 2.1% per year over the period 2010-2015.

Selected Transition Indicators

	Recent	2030		Recent	2030
Electrification with renewables			**Renewables in end-uses**		
Share of renewabes in power generation (%)	28	67	Renewables in final energy consumption (%)	19	34
Renewable power capacity additions (GW/yr)	295	975	Solar thermal collector area (mn m2 per yr)	746	1700
Solar PV additions (GW/yr)	191	551	Bioenergy direct use (EJ)	1.5	44
Wind energy additions (GW/yr)	75	329	Geothermal consumption direct use (EJ)	0.4	1.3
			District heat generation (EJ)	0.9	4.3
Electrification and energy efficiency			**Hydrogen and carbon capture**		
Energy intensity improvement rate (%/yr)	0.6	3.5	Clean hydrogen production (Mt/yr)	0.7	21.4
Electricity in energy consumption (%)	22	29	Electrolyser capacity (GW)	0.5	233
Passenger electric cars on the road (mn)	10.5	355	Clean hydrogen consumption (EJ)	0.04	2.4
			CCS/CCU industry (GtCO2 captured/yr)	0.01	1.0

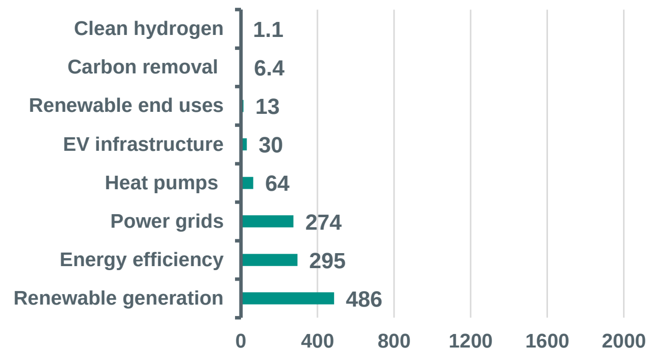
Source: IRENA

It is worth noting that IRENA's 2030 net zero milestones are even sometimes on the lower end of the range. For instance, the IEA's analysis (see **here**), estimates that 1020 GW of annual wind and solar capacity additions would be necessary, compared to IRENA's 880 GW and last year's additions of 266 GW.

Clearly, across a whole range of areas, an incredible – and perhaps improbable – acceleration in the pace of transition is necessary according to IRENA's indicators. So what is needed to close the gap? The report does not recommend a focus on re-inventing the wheel, at least for the progress necessary this decade. Rather it asserts that a 'significant scale up of existing solutions is paramount. For instance, for the power sector as well as transport and buildings advancing efficiency and electrification based on renewables, which will also require grid expansion and flexibility measures should be the focus. Meanwhile, clean hydrogen and sustainable biomass solutions also offer end-user solutions.

Current clean energy investment level

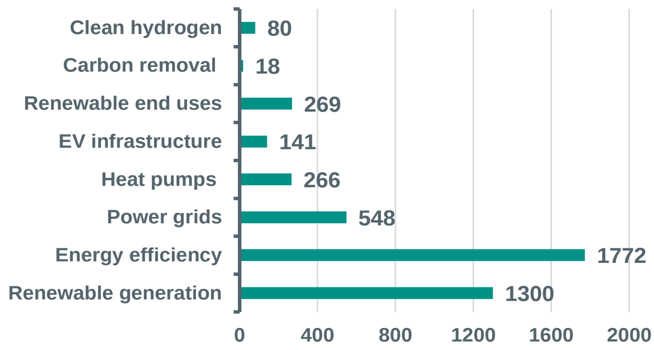
EUR bn per annum



Source: IRENA, ABN AMRO Group Economics

Investment needed through to 2030 for Net Zero

EUR bn per annum



Source: IRENA, ABN AMRO Group Economics.

Net zero gap is also reflected in a large investment gap

Of course the large gap across the range of transition indicators is mirrored by a large investment gap (see charts above). Currently, clean energy investment is running at around USD 1.2 trillion per annum, with the largest amounts flowing into renewable energy generation, energy conservation and efficiency and for power grids and flexibility. This overall amount is a record high. Despite this, it is no time for celebration. In fact, leave the champagne on ice.

The pace of investment is still well short of what is needed to leave the world on track for a 1.5°C trajectory. This annual amount would need to almost quadruple to roughly USD 4.4 trillion to be in line with a net zero trajectory (this is also broadly in line with the IEA's estimates). Furthermore, even the current investment levels are highly concentrated in terms of geography and technologies. IRENA estimates that in 2022, 85% of global renewable energy investment benefitted less than 50% of the world's population and Africa accounted for only 1% of additional capacity. This underlines the need for climate solidarity for a successful transition.

The report also provides a Planned Energy scenario, which projects the outlook based on government's energy plans and other planned targets and policies. Under that scenario, total annual energy investment is seen at around USD 3.6 trillion per annum through to 2030. However, that includes a significant investment in fossil fuels. Indeed, an important conclusion of the report is that 'around USD 1 trillion of annual investments in fossil fuel based technologies currently envisaged in the Planned Energy Scenario must therefore be redirected towards energy transition technologies and infrastructure'. This echoes the IEA's conclusion that 'there is no need for investment in new fossil fuel supply in our net zero pathway'.

The eleven crucial net zero technologies

Georgette Boele – Senior Economist Sustainability | georgette.boele@nl.abnamro.com

- **We have defined a list of eleven key technologies to help to decarbonize the world by 2050**
- **Below we explain each of the technologies and what they are used for**
- **As technologies are continuously evolving because of limitations and challenges this list is not complete and will also change over time**

Introduction

What is technology? Technology is the application of scientific knowledge to the practical aims of human life or to the change and manipulation of the human environment. Technology is constantly evolving and innovating driven by curiosity, creativity and problem-solving. Technology can be classified into different types such as electrical, digital, nanotechnology depending on the tools and methods used. Technology has enabled humans to achieve remarkable feats. And technology is key to decarbonize the world. In this report we identify eleven technologies that look set to be crucial if the world is to achieve net zero by 2050. This is a list of important technologies today and it is unlikely complete. As technology is constantly evolving and innovating, the list of today could differ substantially from this in five or ten years' time. The important technologies mentioned below will by themselves also trigger new technologies. This is because the current crucial technologies also have challenges such as shortage of critical metals.

Crucial technologies to bring down emissions

We have defined 11 technologies/groups of technologies that are currently crucial in the transition to a net-zero world. The table below there is an overview of these. For each technology, we indicate how it is or could be used. For example a heat pump is used in the heating of homes but also in electric vehicles.

Technologies to bring down emissions

		Mobility					Storage	Heating	Industry	Electricity	Agri
Technology	**Product**	Road	Aviation D	Aviation I	Navigation D	Deep sea shipping					
Lithium ion battery	**Electricity**	x	x		x		x				
Heat pumps	**Heat**	x						x	x		x
Permanent magnets	**Motor EV**	x									
	Generator wind turbine									x	
Electrolysis & fuel cells	**Hydrogen, electricty, heat**	x	x	x	x	x	x	x	x	x	x
Photovoltaics (PV)	**Electricity**	x							x	x	x
Concentrated solar power (CSP)	**Electricity, heat**						x	x		x	
Wind energy using the aerodynamic force	**Electricity**									x	x
Technologies to produce synthetic fuels *Power-to-gas technologies* *Power-to-liquid technologies* - Electrolysis - CCS - Reverse Water Gas Shift -Synthesis of Methanol - DME - Fischer-Tropsch *Biomass-to-liquid technologies* - Hydrocracking/Hydrogenation *Sun-to-liquid technologies* - Thermochemical redox cycle	**Synthetic fuels** e-methane e-methanol, e-kerosine HVO hydrogen, ammonia	x	x	x	x	x	x	x	x	x	x
Carbon capture and storage (CCS) DACCS BECCS	**CO2**					x			x	x	x
Combined Heat and Power (CHP)	**Electricity, heat**							x	x		x
Digital technologies	**Monitor use of heat and electricity**							x	x	x	x
	Manage use of heat and electricity							x	x	x	x
	Smart grid									x	
	Internet of Waste								x		x

Source: ABN AMRO Group Economics, Aviation D = Domestic aviation, Aviation I = International aviation, Navigation D = Domestic navigation

Lithium-ion batteries

A lithium-ion battery is a family of rechargeable battery types. During a discharge cycle, lithium atoms in the anode are ionized and separated from their electrons. The lithium ions move from the anode and pass through the electrolyte until they reach the cathode, where they recombine with their electrons and electrically neutralise. Lithium-ion batteries are used in vehicles, portable electrical devices and in storage. The battery's capacity and voltage are determined based on what type of active material is used in the cathode. There is a drive to increase the energy density of the battery. This is the measure of how much energy a battery contains in proportion to its weight. It is typically presented in Watt-hours per kilogram. A higher energy density means that vehicles can travel further without the need to recharge. Safety and durability are also important to take into account. Each battery chemistry has a specific energy density, stability, safety and durability and one chemistry could be better suited for storage than for electric vehicle.

Heat Pumps

A heat pump works like a refrigerator. It uses electricity to extract heat from the air, the ground, or from water, amplifies that heat, and then transfers heat to where it is needed, which in the case of a home is for space heating and hot water. Homes can install a heat pump but many energy-inefficient homes will also have to invest in energy efficiencies such as double-glazing, wall cavity insulation, and even new radiators. The primary function of heat pumps is space heating through radiators, underfloor heating systems, or warm air convectors, they can also be used to heat water for use in a home or business. In an electric vehicle, a heat pump can be used to both warm the battery and cool it. When cooling it, the excess heat from the battery can be sent to the cabin heater.

Permanent magnets

Permanent magnets are magnets that can maintain their magnetism for a long time. Permanent means that the magnet is rotating even with no electrical current applied, magnetic flux will still be present. Magnets have a high efficiency. Neodymium is the primary Rare Earth Element present in these magnets in an alloy of Neodymium-Iron-Boron (NdFeB). The alloy is then doped with other rare earth elements such as Praseodymium and Dysprosium to improve the operating characteristics of the magnet like to increase the operating temperature of the magnet without becoming demagnetised. The majority of electric vehicles have these permanent magnets in their motors. In addition, the rotating shaft of a wind turbine is connected to one or more strong magnets, usually neodymium magnets. These magnets turn relative to an assembly of coiled wire, generating voltage in the coil. Next to the neodymium magnets there are also other types of permanent magnets. Permanent magnets are used in hard drives, motors, cars, generators, televisions, phones, headphones, speakers, transducers and sensors.

Electrolysis & fuel cells

Electrolysis is a technique that uses a direct electric current (DC) to drive an otherwise non-spontaneous chemical reaction. Electrolysis is the process of using electricity to split water into hydrogen and oxygen. This reaction takes place in a unit called an electrolyser. Electrolysis is a technique and a fuel cell is a cell producing an electric current direct from a chemical reaction. Fuel cells work like batteries, but they do not run down or need recharging. They produce electricity and heat as long as fuel (such as hydrogen) is supplied. Fuel cells are unique in terms of the variety of their potential applications; they can use a wide range of fuels and feedstocks and can provide power for systems as large as a utility power station, a car and as small as a laptop computer. A fuel cell consists of two electrodes—a negative electrode (or anode) and a positive electrode (or cathode)—sandwiched around an electrolyte. In a hydrogen fuel cell, a catalyst at the anode separates hydrogen molecules into protons and electrons, which take different paths to the cathode. The electrons go through an external circuit, creating a flow of electricity. The protons migrate through the electrolyte to the cathode, where they unite with oxygen and the electrons to produce water and heat (source **energy.gov**). There are different types of fuel cells and every type has its own application. We would like to highlight one type though. This is the polymer electrolyte membrane fuel cell or proton exchange membrane fuel cell. In vehicles this fuel cell is mostly used. The fuel is hydrogen and operates at relatively low temperatures.

Photovoltaics (PV)

Photovoltaics is the science of turning light into electricity using special materials that absorb photons and release electrons. A photovoltaic system consists of solar panels, which are made of many connected solar cells, and a solar inverter, which converts the direct current into alternating current for use. Photovoltaic technologies vary in the type and efficiency of the semiconducting materials used, such as silicon, thin film, or organic compounds. Solar-cell efficiency refers to the portion of energy in the form of sunlight that can be converted via photovoltaics into electricity by the solar cell. Solar panels efficiency levels are relatively low (between 14%-25%), most home solar panels have efficiency ratings between 19% and 21% (source: **SolarReviews**). For a continuous supply of electric power, especially for on-grid connections, photovoltaic panels require not only inverters but also storage batteries.

Concentrated solar power (CSP)

Concentrated solar power (CSP) is an approach to generating electricity through mirrors. This technology uses mirrors to reflect and focus sunlight onto a thermal receiver. The intense CSP energy heats up the fluid (heat-transfer fluid or HFT) in the receiver to high temperatures. This heat or thermal energy is used to turn a turbine and thus generate electricity (source: **energysystems.com**). Unlike the solar energy generated by photovoltaic panels, the thermal energy contained in the fluid can be stored for later use. CSP energy also has direct industrial applications in water desalination and food processing. Concentrated solar power also has a high energy output, which makes it suitable for large-scale electricity generation. One of the main drawbacks is its high capital and maintenance costs. CSP installations require significant upfront investments, Additionally, the technology is still relatively new, and there's a lack of experienced professionals in the field.

Wind energy using the aerodynamic force

Wind turbines use wind to make electricity. Wind turns the propeller-like blades of a turbine around a rotor, which spins a generator, which creates electricity. A wind turbine turns wind energy into electricity using the aerodynamic force from the rotor blades, which work like an airplane wing or helicopter rotor blade. When wind flows across the blade, the air pressure on one side of the blade decreases. The difference in air pressure across the two sides of the blade creates both lift and drag. The force of the lift is stronger than the drag and this causes the rotor to spin. The rotor connects to the generator that speed up the rotation and allow for a physically smaller generator. This translation of aerodynamic force to rotation of a generator creates electricity (source **energy.gov**). The permanent magnets are in the generator of the largest wind turbines to reduce costs, improve reliability and reduce the need for maintenance (source: **windsystemsmag**).

Technologies to produce synthetic fuels

Synthetic fuels are liquid fuels that have the same properties as fossil fuels but are produced artificially. Synthetic fuels can be blended with fossil fuels or replace the fossil fuel in internal combustion engines in vehicles, planes or ships. For the production of synthetic fuels CO2 is captured from the atmosphere through Direct Air Capture system (see below). Burning the synthetic fuel does release CO2 back into the air. This is the CO2 that was used in the production of the synthetic fuel. As a result, there are no-net CO2 emissions. There are four types of synthetic fuels and the way they are produced makes the difference (source **Synhelion**).

- Biomass-to-liquid produces biofuels (any fuel that is derived from biomass) such as renewable diesel/hydrotreated vegetable oil (HVO)
- Power-to-liquid produces e-fuels such as e-kerosine and e-methanol
- Power-to-gas produces e-methane
- Sun-to-liquid produces solar fuels such as hydrogen, ammonia (source **energy.gov**)

Power-to-gas is a technology that uses electric power to produce a gaseous fuel. The hydrogen that is produced via electrolysis is converted to methane together with carbon dioxide. For mobility if synthetic fuels are mentioned they often refer to e-fuels or electrofuels. These fuels are produced via the power-to-liquid method. First, renewable electricity is generated, which then drives an electrolyser that splits water into hydrogen and oxygen. Next, the hydrogen is mixed with carbon dioxide and turned into syngas via the reverse water gas shift (RWGS) reaction – a process that is conducted at high temperatures and driven by electricity.

There are low carbon fuels, carbon neutral fuels and zero-carbon fuels. Low carbon fuels emit less carbon than fossil fuels. Renewable diesel, biodiesel hydrogen/methanol/ammonia when produced using fossil fuels with carbon capture and storage are examples of low carbon fuels. Renewable diesel's CO2 emissions are highly dependent on the feedstock used. Often, this results in life-cycle emissions above zero. Carbon neutral fuels are fuels that do not increase or decrease the amount of carbon in the atmosphere through their life cycle. Power-to-liquid fuels e-methanol and e-kerosine are carbon neutral fuels. They are considered carbon neutral if renewable resources are used in the production process and the carbon captured from the atmosphere is later released back into the air. Zero-carbon fuels are fuels that do not release carbon at the time of usage. For example hydrogen when produced by electrolysis and renewable electricity and ammonia when produced by renewable electricity and green hydrogen as the source are zero-carbon fuels (source **Cummins**).

Carbon capture and storage

The idea behind CCS is to capture the CO2 generated by burning fossil fuels before it is released into the atmosphere. Most current CCS strategies involve the injection of CO2 deep underground. This forms a "closed loop", where the carbon is extracted from the Earth as fossil fuels and then is returned to the Earth as CO2. There has also been considerable interest recently in using CCS technologies to remove CO2 from the atmosphere. One option is bioenergy with CCS (BECCS), where biomass (like wood or grasses) removes CO2 from the air through photosynthesis. The biomass is then harvested and burned in a power plant to produce energy, with the CO2 being captured and stored. This creates what is called "negative emissions" because it takes CO2 from the atmosphere and stores it. Another negative emission option is called direct air capture (DAC), where CO2 is removed from the air using a chemical process. However, the concentration of CO2 in the air is about 300 times less than in the smokestacks of power plants or industrial plants, making it much less efficient to capture. Because of this, DAC is quite an expensive option today (source **MIT Climate portal**).

Combined heat and power

Cogeneration or combined heat and power (CHP) is the use of a heat engine or power station to generate electricity and useful heat at the same time. Cogeneration is a more efficient use of fuel or heat, because otherwise-wasted heat from electricity generation is put to some productive use. This involves the concurrent production of electricity or mechanical power and useful thermal energy (heating and/or cooling) from a single source of energy (source: **energy.gov**). Combined heat and power (CHP) is a highly efficient process (over 80%) that captures and utilises the heat that is a by-product of the electricity generation process. The electricity could be generated from renewables as well. By generating heat and power simultaneously, CHP can reduce carbon emissions by up to 30% compared to the separate means of conventional generation via a boiler and power station. The heat generated during this process is supplied to an appropriately matched heat demand that would otherwise be met by a conventional boiler.

Digital technologies

The are several digital technologies that improve efficiency and reduce demand for heat and or electricity. For example smart technologies that monitor and manage the demand/use of heat and electricity. A smart grid is an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end users (source: **IEA**). Another technology is the Internet-of-Waste (IoT). IoT-enabled waste management and recycling significantly reduce the inefficiencies in waste logistics. From fill-level sensors to smart bins and material quality assessing sensors, the recycling industry is leveraging the internet of waste to streamline operations.

Conclusion

We have defined eleven technologies/group of technologies that help to decarbonize the world by 2050 namely: lithium-ion batteries, heat pumps, permanent magnets, electrolysis & fuel cells, photovoltaics, concentrated solar power, wind energy using aerodynamic force, technologies that produce synthetic fuels, carbon capture and storage and combined heat and power and digital technologies. But as technologies are continuously evolving because of limitations and challenges this list is not complete and will also change over time. So it is by no means a list with technologies that is fixed for the future. Companies in many sectors have a lot of low-hanging fruit when it comes to decarbonisation technologies. For further analysis on how this manifests itself in sectors, see the publication **'Decarbonisation strategies in Dutch sectors'**.

The ECB starts disclosing the climate impact of its portfolio

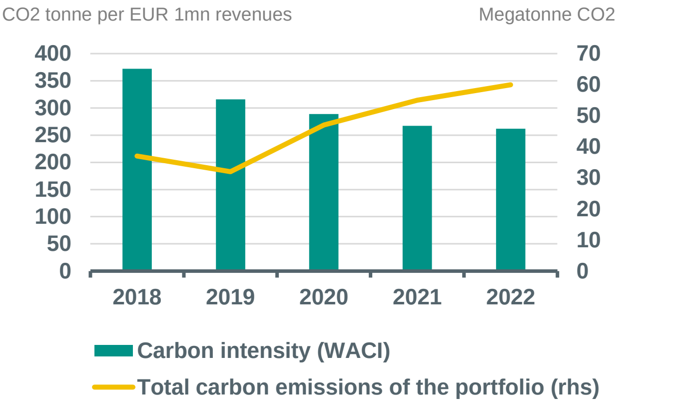
Shanawaz Bhimji – Head of Corporate Bond Research | shanawaz.bhimji@nl.abnamro.com

- **The ECB published its first climate disclosure report on its corporate bond holdings**
- **Emission intensity has been declining since 2018, through luck and management**
- **It has a greater share of holdings in issuers with reduction pathways than its eligible universe**

Two weeks ago the ECB reached a milestone on its large holdings of corporate bond securities worth EUR 344bn purchased under the CSPP and PEPP. For the first time it published the carbon impact of the portfolio as this was also part of its earlier climate action to improve climate disclosures to the public. Earlier the central bank had already decided to tilt the reinvestments of bond purchases, which we expect to end in the second half of the year when it comes to the CSPP, towards issuers with better climate performance based on 3 pillars being their existing emissions, their ambition to reduce emissions and the quality of their climate disclosures (see our previous notes here and here).

In the disclosure, the ECB weighs the carbon intensity of each issuer (limited to scope 1 & 2 emissions divided by revenues) and then calculates a weighted average based on each issuer's share in the corporate bond portfolio. This is also known as the WACI approach. It also has calculated a non-intensity based total portfolio emission, which relates total emissions to the size of ECB holdings divided by the issuer enterprise value. Due to significant growth in the size of holdings over the past few years this absolute measure has risen considerably. Limited historical data reliability precluded the years before 2018 in the historical comparison (remember the ECB started purchasing corporate bonds back in early 2016) and due to reporting time limitation the 2022 numbers actually reflect 2021 emission and financial data re-arranged for the latest holdings. The chart below shows the WACI and the absolute portfolio emissions.

ECB's emission disclosure on corporate APP



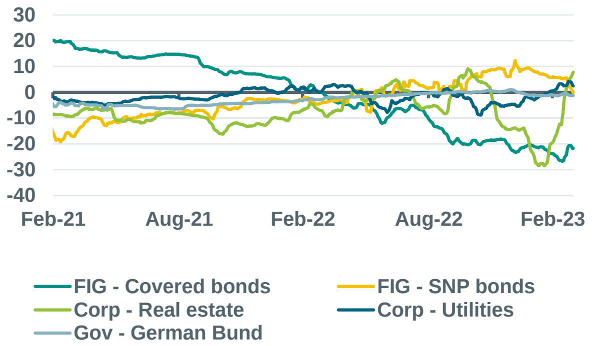
Source: ECB, ABN AMRO Group Economics, only relates to scope 1 & 2 emissions

The WACI has been on a clear downward trend from when recording started. For 2019 the ECB states that greater decarbonization efforts by issuers were the main driver behind this improvement. During 2020, the collapse in revenues at pandemic affected sectors (such as transport and utilities) would have led to higher intensity, but the ECB steered a larger share of its purchases to less carbon intensive (but also less revenue affected) sectors during this year, which kept the WACI on a descent. The reductions in intensity during 2021 and 2022 were purely because issuers were able to raise revenues fast in the pandemic recovery, since primary issuance from carbon intensive sectors was large. In the final quarter of 2022, when the ECB implemented climate change considerations in their mandate, the WACI on purchases fell considerably, but given the large stock of debt held by the ECB the portfolio impact was very limited. It seems that the decline in WACI seems to be a combination of luck and active management by the ECB.
Finally on future emission targets, which is the second pilar of the ECB's issuer climate criteria, 59% of the holdings relate to issuers which have certified science based carbon reduction targets. This contrasts against only 42% of all eligible issuers having some form of carbon reduction targets, confirming that the ECB is taking serious steps already to green its portfolio.

ESG in figures

ABN AMRO Secondary Greenium Indicator

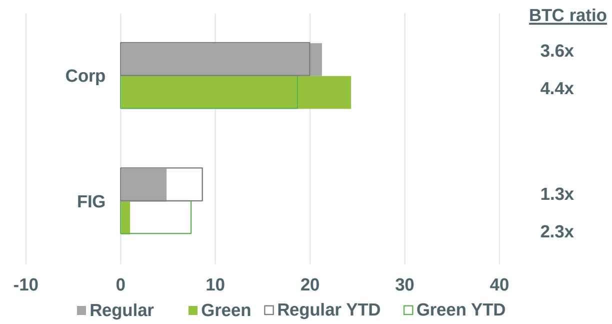
Delta (green I-spread – regular I-spread)



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

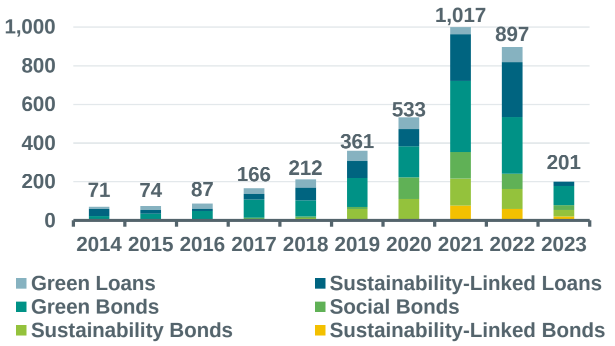
NIP in bps



Note: Data until 30-03-23. BTC = Bid-to-cover orderbook ratio. Source: Bloomberg, ABN AMRO Group Economics

Sustainable debt market overview

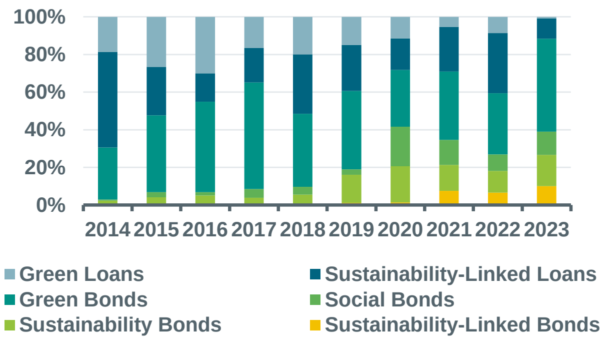
EUR bn



Source: Bloomberg, ABN AMRO Group Economics

Breakdown of sustainable debt by type

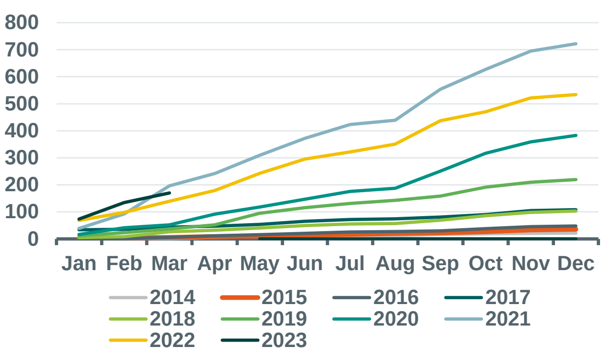
% of total



Source: Bloomberg, ABN AMRO Group Economics

YTD ESG bond issuance

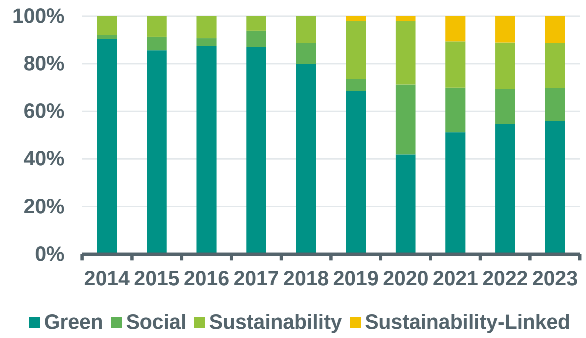
EUR bn (cumulative)



Source: Bloomberg, ABN AMRO Group Economics

Breakdown of ESG bond issuance by type

% of total

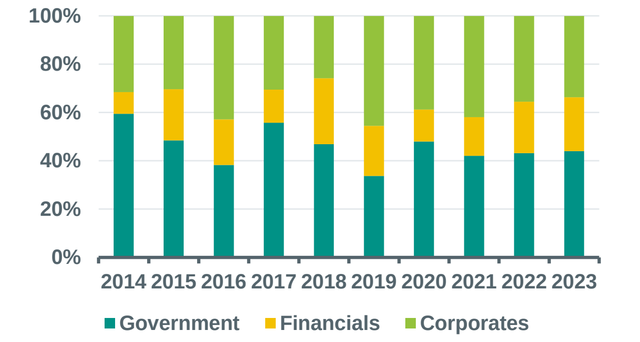


Source: Bloomberg, ABN AMRO Group Economics

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

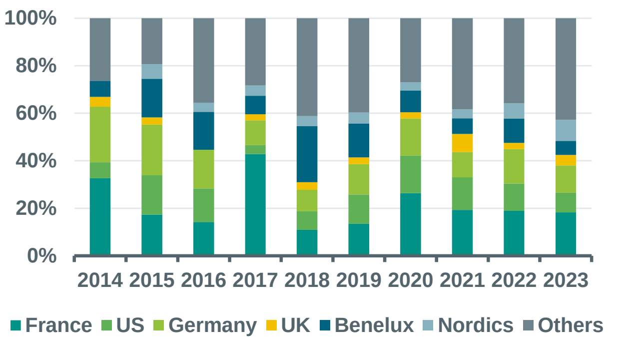
% of total



Source: Bloomberg, ABN AMRO Group Economics

Breakdown of ESG bond issuance by country

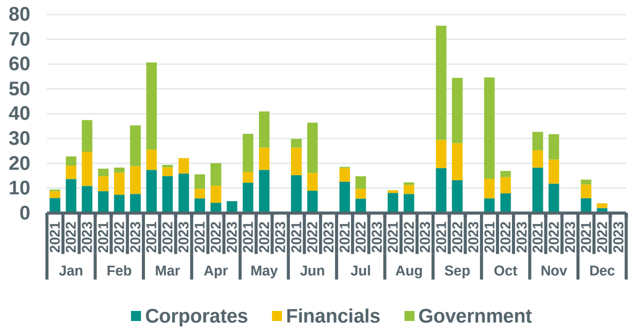
% of total



Source: Bloomberg, ABN AMRO Group Economics

Monthly Green Bonds issuance by sector

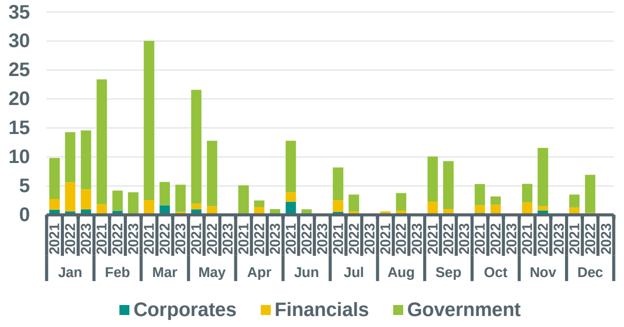
EUR bn



Source: Bloomberg, ABN AMRO Group Economics

Monthly Social Bonds issuance by sector

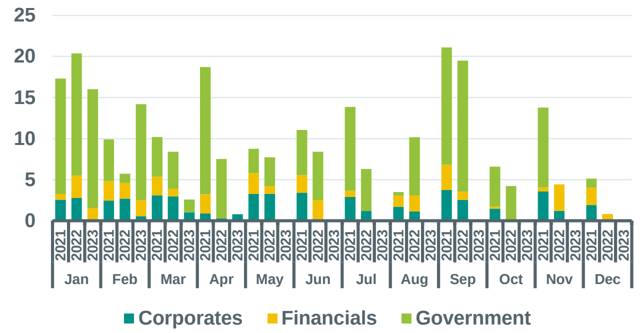
EUR bn



Source: Bloomberg, ABN AMRO Group Economics

Monthly Sustainability Bonds issuance by sector

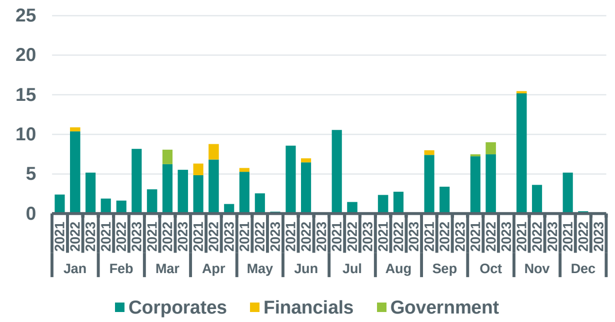
EUR bn



Source: Bloomberg, ABN AMRO Group Economics

Monthly Sust.-Linked Bonds issuance by sector

EUR bn



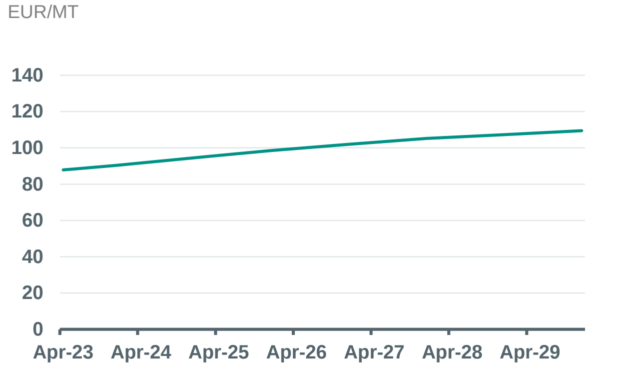
Source: Bloomberg, ABN AMRO Group Economics

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)

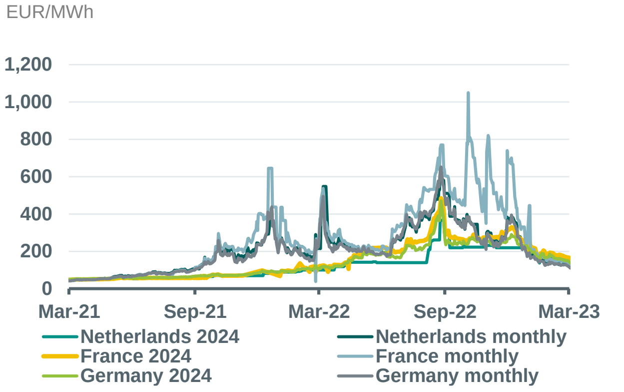
Source: Bloomberg, ABN AMRO Group Economics

Carbon contract futures curve (EU Allowance)



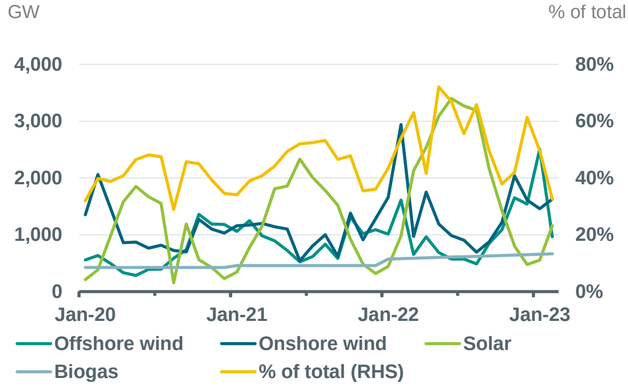
Source: Bloomberg, ABN AMRO Group Economics

Electricity power prices (monthly & cal+1 contracts)



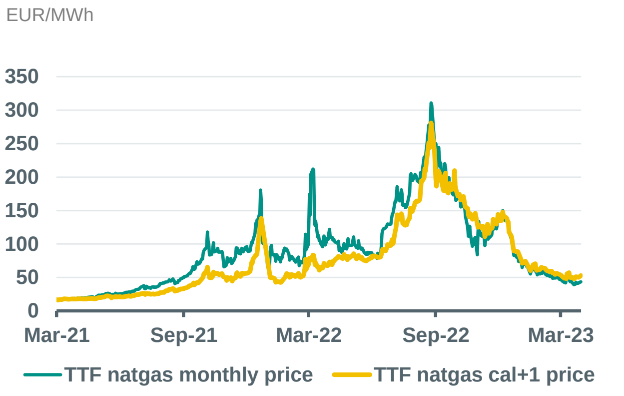
Source: Bloomberg, ABN AMRO Group Economics. Note: 2024 contracts refer to cal+1

Electricity generation from renewable sources (NL)



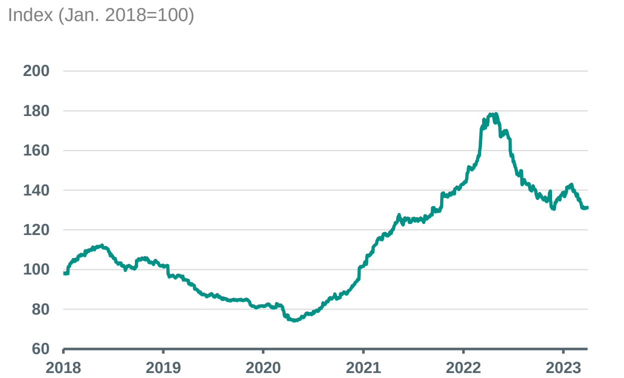
Source: Energieopwek (Klimaat-akkoord), ABN AMRO Group Economics

TTF Natgas prices



Source: Bloomberg, ABN AMRO Group Economics

Transition Commodities Price Index



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.