# SustainaWeekly

## Positive tipping points could supercharge rise of renewables

- **Economist: Past assessments have underestimated the speed of capacity increase of renewable energy. One reason is the existence of positive tipping points, the point at which new solutions cross a threshold of affordability, attractiveness or accessibility leading to mass adoption. There are solutions that are not only close to a tipping point, but also have cascading effects on other solutions by bringing their tipping points forward in time as well.**

- **Strategy: A final text regarding regulation of the EU Green Bond Standard has been agreed and could become effective in the second half 2024 or early 2025. The EU GBS is likely to result in more fragmentation than harmonisation at the start. But over time, fragmentation is likely to diminish, as EU GBS should support investments in taxonomy-aligned activities, while we see larger greeniums for green bonds aligned with the EU GBS.**

- **Sector: One of the key measures to achieve the EU's emissions target is to end new sales of internal combustion cars and vans by 2035. However, the vote at the European Council was delayed because some countries proposed an exemption for cars with internal combustion engines fuelled by synthetic fuels. Synthetic fuels are not currently the most viable or efficient solution for cars, though there are some advantages as well.**

- **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 discuss how developments in transition technologies are non-linear. Based on a new report, we discuss the existence of tipping points, the point at which new solutions cross a threshold of affordability, attractiveness or accessibility leading to mass adoption. What is more, a tipping point for one solution can have cascading effects on other solutions by bringing their tipping points closer as well. This may explain the structural underestimation in the rise of renewables. We dig in to one example of these cascading effects. We then go on to review the new EU Green Bond Standard, where a final text was recently agreed. We assess the main features of the regulation and the implications for green bond markets. Finally, we assess the push by some EU countries to exempt cars with internal combustion engines fuelled by synthetic fuels from the 2035 new sale ban. We zoom into the pros and cons of synthetic fuels.

Enjoy the read and, as always, let us know if you have any feedback!

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# Underestimating the impact of tipping points

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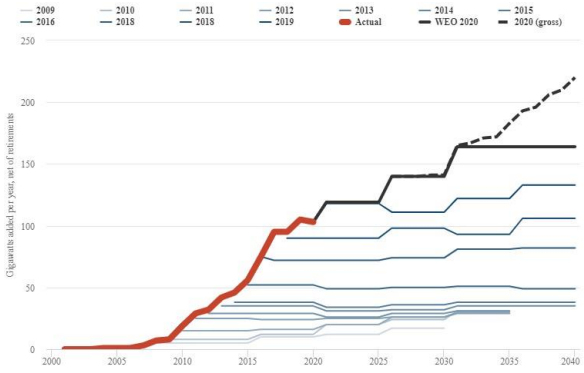
- **The IEAs annual assessment is that renewable energy growth will be strong but insufficient for a net zero scenario**
- **However, earlier assessments of the speed of capacity increase of renewable energy shows that there is a material underestimation of the actual growth of renewable energy capacity**
- **One reason for this is the existence of positive tipping points, the point at which new solutions cross a threshold of affordability, attractiveness or accessibility leading to mass adoption**
- **There are solutions that are not only close to a tipping point for mass adoption, but also have cascading effects on other solutions by bringing their tipping points forward in time as well**

When trying to assess the speed of the energy transition, the IEAs annual assessment of renewable energy growth for the coming decade is an important variable. Unfortunately the projection shows that the growth in renewables is unlikely to be sufficient to get us to the pathway of IEAs Net Zero scenario. Even the latest projections of 2022, which shows the largest ever increase in renewable energy growth projection, is insufficient for a net zero pathway. Should we worry? Maybe not. Earlier 6-year assessments of the speed of capacity increase of renewable energy shows that there is a massive underestimation of the actual growth of renewable energy capacity. Particularly for Solar energy, the annual 20 year ahead estimation fails to capture the remarkable growth in solar energy capacity every year since 2009.

**Global solar capacity growth**

Adjustment main IEA-scenario after each year




Source: Carbon brief – *Solar is now 'cheapest electricity in history', confirms IEA*, 13 October 2020

What may partly be driving this underestimation is the existence of positive tipping points that are notoriously hard to predict. A positive tipping point is a point in time at which new solutions cross a threshold of affordability, attractiveness or accessibility in comparison with incumbents. What follows is mass adoption through self-enforcing feedback loops of learning, leading to cost decrease and quality improvements which again create more adoption. When close to such a tipping point, relatively small interventions can push the new solutions into the self-enforcing dynamics. In this week's Sustainaweekly we look at a recent study in tipping points per sector. We discuss how these tipping points work, what the nearest and most probable tipping point is and what signals to look out for to confirm that a tipping point is near. For this assessment we mainly rely on a **recent study** by Systems Change Lab, a collective of researchers from academia and consulting.

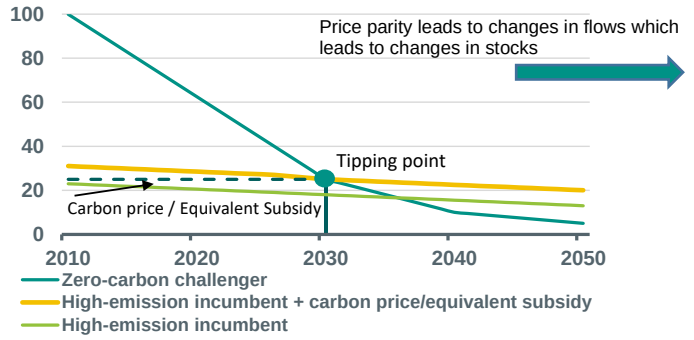
**Conditions for positive tipping points**

Affordability is the most important criteria for a new solution to reach a tipping point. As costs fall as a function of cumulative production, the easy of producing large quantities is a key element of a new solution. As such rather small simple products or services with short lifetimes are more likely to speed up production and learn to improve the production process with every new product produced. The tipping point is reached in terms of affordability when price parity is reached between the new solution (price including subsidies) and the incumbent solution (price including carbon tax) as shown in the left picture

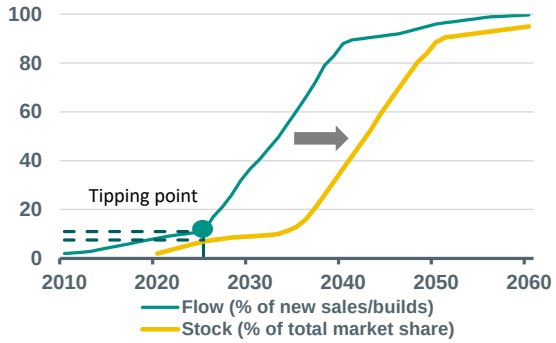
below. Besides affordability, attractiveness in relation to the existing solution is also important. During the energy crisis, the installing of solar panel and heat pump installation for households was not only financially attractive but it also was a way to refuse gas consumption from a regime that had initiated the war in the Ukraine. For many, the principle of 'we do not want to make Putin earn money from me to finance the war' became an attractive argument besides the cost reduction potential. Finally, adoption also depends on accessibility. What good is a solution if it is affordable and attractive if it is not accessible? Often it is the infrastructure that creates accessibility but also labour shortages or other capacity constrains in execution could hamper or enable accessibility and hence adoption.

**Tipping points process**

Enabling conditions for tipping points – affordability, USD/kg H2




Tipping points in adoption – Flow to stock, % of adoption




Source: Systemiq, *The breakthrough effect: how to trigger a cascade of tipping points to accelerate the net zero transition*, January 2023, ABN AMRO Group Economics

**Fight for dominance: reinforcing versus balancing feedback loops.**

Once the conditions mentioned above are in place, the reinforcing dynamic starts (right hand picture). Deploying an innovation creates learning effects and scale effects. As such, the product and the production processes improve, the fixed costs are spread over more products and as the product becomes cheaper and better, the demand increases further. Entrepreneurs observe opportunities for complementary products or new applications for the initial product and this creates more use cases, and greater dependence through network effects. Market participants that are following this development start expecting the pace of adoption to continue and investments start flowing towards the solution enabling even more deployment.

While these reinforcing effects take place, incumbents start getting worried as they see their product declining at the margin. They pull their strength through lobbying, standard setting, and network effects to slow down the speed of the adoption of the new solution. Particularly the network effects of consumer practises, business models and investments that have formed around the incumbent technologies can create powerful slowing of adoption, known as a system lock-in. The Dutch coal mines are a famous example of an incumbent energy that had penetrated into the economic and social fabric of the Limburg region[1]. It took a deliberate and active phase out strategy by the government together with stakeholders to open up to the new energy solution of natural gas at the end of the sixties.

**Cliff edge moment for incumbents**

Once incumbents output goes from slower growth from falling demand into decline of output through production cuts, diseconomies of scale also become self-enforcing. As a result, the price disadvantage grows larger and financial devaluations occur as investors move elsewhere and capital costs increase. When incumbents start slowing their R&D investments, their patent applications and their spending on lobbying, together with higher price volatility and lower ability to recover from setbacks, strong decline may be on the cards[2]

[1] Geels, et al, 2017 Sociotechnical transitions for deep decarbonization
Accelerating innovation is as important as climate policy. In: Science, climate and innovation policy.
[2] Scheffer et al. 2009 Early-warning signals for critical transitions. In: Nature.

**Most likely and most impactful tipping point**

According to the Systems change lab study, there are solutions that are not only close to a tipping point for mass adoption, but also have cascading effects on other solutions by bringing their tipping points forward in time as well. We discuss one example, but the **full report** has many more highly relevant tipping points for many sectors.

**Making emission free vehicles mandatory**

Mandating emission free vehicles brings certainty to car producers about their future zero emission vehicle market (ZEV). This triggers rising production volumes which in turn drives down costs and increases demand. Public expenditures need to warrant that sufficient accessible EV charging stations are present. The scale up in the EV market for light duty vehicles triggers at least two new accelerations:

- Battery deployment: By 2030, 70 percent of installed battery capacity will come from electric vehicles. If EVs adoption reaches 60 percent of the global passenger vehicle sales (not stock) by 2030, the demand for batteries will be the ten-fold of current levels. Even with learning rates constant (which is a conservative assumption) battery costs would have come down with 60 percent in 2030.
- Total costs of wind and solar: As battery costs make up around 30 percent of the total costs of solar and wind, the total costs of these power solutions compared to the costs of coal or gas comes down faster.
- Smart grid solutions: Furthermore, the better performing and cheaper batteries provide flexibility for smart grid solutions that could trigger many use cases for dynamic electricity pricing solutions for home owners.
- Heavy road transport: Trucks powered by better performing and cheaper batteries start to get closer to the point where they can outcompete petrol or diesel trucks.

**What evidence to look out for in the coming years?**

Indicators to look out for that provide more certainty of the tipping points approaching are the following:
Obviously the first thing to look out for is the sticker price of EV passenger cars to go below combustion engine vehicle. Expectations are that this is set to happen in 2025 -2026 in EU US and China. With the inflation reduction Act in the US subsidizing the gap to reach price parity, this is rather likely. More doubtful is the presence of sufficient charging stations. In 2021 1.8 million charging stations have been installed globally, and this needs to increase to 5 million stations to support deployment that moves EV adoptions to its tipping point.

For the battery deployment to reach the tipping point such that solar and wind power become stand alone power sources, the levelized costs of electricity generated (and stored) from wind and solar needs to become below the levelized costs of electricity generated from coals or gas fired power plants. Already today, battery costs have come down massively (90% compared to 2010) and are expected to reach 110 dollar/kWh this year. The levelized costs of solar plus storage is currently below 50 dollars /kWh and is expected to be cheaper that the levelized costs of gas power in the US this year.

Also, at least 500 billion dollar investments annually in transmission and distribution of power needs to be put in place to reach the tipping point by 2030. Here are the main uncertainties. In 2022 around 300 billion dollar has been invested in transmission and distribution and this needs to have reached 500 billion in the next few years. Also the planning and permitting timelines are mainly in Europe around 5 times longer than legally established limits.

# Milestone reached for the EU Green Bond Standard

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- **EU regulators have agreed on a final text regarding regulation of the EU Green Bond Standard**
- **This paves the way for standards to become effective in the second half 2024 or early 2025**
- **Final agreement includes 15% flexibility pocket to finance activities not yet fully aligned with EU Taxonomy**
- **It also contains a 7y grandfathering period and establishes a registration system and supervisory framework for external reviewers**
- **EU GBS is likely to result in more fragmentation than harmonisation at the start, as limited share of green bonds as well as eligible economic activities comply with taxonomy**
- **But over time, fragmentation is likely to diminish, as EU GBS should support investments in taxonomy-aligned activities, while we see larger greeniums for green bonds aligned with the EU GBS**

The EU authorities have reached a provisional agreement on the final text regarding the regulation of the EU Green Bond Standard (EU GBS). This marks a new milestone on the road to get to the first official piece of legislation/regulation on how to define green bonds. The journey started in 2018 when the establishment of green bond standards was part of the European Commission's (EC) 2018 action plan on sustainable growth (here). The first milestone was the publication of the EC's legislative proposal on EU GBS in July 2021 (here), which then had to be agreed by the EC, the European Parliament, and the EU Council during their trilogue discussion. On 28 February, an agreement was reached (here), although the agreed text still needs to be confirmed by the Council and Parliament. Once adopted, the EU GBS will set a golden standard for what green bonds can be deemed in the EU (called European green bonds or EuGB). It will offer clarity to both issuers as well as to investors, as it will provide a strong quality label. Meanwhile, it should support transparency and comparability of green bonds, also preventing greenwashing.

The EU GBS key ingredients are based on four requirements, of which the first is that the proceeds of the green bonds are used to (re)finance projects/activities that are aligned with the EU Taxonomy. The others include regulations related to transparency (i.e., reporting requirements), external reviewers (second party opinion providers), and supervision of external reviewers by the European Securities Markets Authority (ESMA). We have previously reported (see here) what the main discussion points between the European Commission, the Parliament and the Council were. Below, we have therefore analysed what discussion points were left out and which ones were agreed upon.

**Flexibility pocket of 15%**

The Council, led by the Slovenian Presidency (SI PCY), had previously proposed that the EU GBS would have a flexibility pocket - that is, that a certain share of the proceeds raised under EU green bonds that would not necessarily need to be invested in activities that are fully aligned with the EU taxonomy. While SI PCY had proposed a 20% flexibility pocket, the final agreement was to have a 15% threshold. Furthermore, the final text includes flexibility only towards economic activities that comply with the EU taxonomy requirements but for which no criteria would have yet been established to determine if that activity contributes to a green objective (technical screening criteria). That is mainly because the EU Taxonomy for four out of the six environmental objectives is still under development. On top of this, the 15% pocket can be used to finance certain very specific activities outside the scope of the EU Taxonomy (but no further details were released). The use and need of a flexibility pocket will be re-valuated over time, which was also previously proposed by some member states such as Austria and the Netherlands.

**Financing of gas and nuclear energy**

The Parliament, led by rapporteur Paul Tang (S&D, NL), had previously proposed that European green bonds should not fund fossil gas- or nuclear-powered energy plants, despite those activities already being included in the Complementary Delegated Act for the EU taxonomy. This was however not included in the final agreements, meaning that a European green bond could still finance those transitional activities. There are also no additional disclosure requirements for European green bonds financing gas/nuclear, which was initially proposed by the Parliament.

**Disclosure on transition plans**

Still, in order to increase transparency and allow investors to judge themselves whether they would like to invest in European green bonds, the final proposal of the EU GBS includes mandatory requirements for detailed disclosure on how bond proceeds are used. Furthermore, the final agreement obliges companies "to show how those investments feed into the transition plans of the company as a whole". This would allow the EU GBS to be used by companies that engage also in transitional activities (mainly gas/nuclear) and offers investors more insights in whether they would like to invest in these bonds.

**Grandfathering**

The initial legislative proposal by the Commission included a five year grandfathering period – that is, European green bond issuers would have five years to re-allocate proceeds if there would be changes in the EU taxonomy. Later, the Parliament had proposed excluding this clause, with the justification that 'this would provide greater certainty and financial stability for issuers making medium and long-term investments in the real economy and for investors in green bonds issued on the basis of criteria predefined in the Taxonomy'. However, the final proposal includes now a seven year grandfathering period. There will also be an additional clause included, which stipulates that the Commission will publish a report by the end of 2024 and every three years to inform issuers on the review conducted.

**External reviewers**

There were also disagreements between the three parties about the external reviewers of European green bonds. The Council had previously argued that there needed to be a "binary choice" between whether European Securities Market Authority (ESMA) or National Competent Authorities (NCA) would act as supervisors of external reviewers. The final proposal however has stipulated that the NCA "of the home member state designated (in line with the Prospectus Regulation) shall supervise that issuers comply with their obligations under the new standard." ESMA will, on the other hand, have the role of supervising external reviewers, ultimately making sure that "potential conflicts of interest are properly identified, eliminated or managed, and disclosed in a transparent manner."

**No mandatory disclosure requirements for all green bonds**

The Parliament had previously proposed to introduce mandatory disclosure requirements for all green bond issuers, whether they are considered European green bonds or not. This however has not been included in the final proposal. Nevertheless, both the Parliament and the Council have highlighted in their press releases that the disclosure requirements are also open to be used by companies that cannot fulfil the requirements to qualify for the EU GBS, that is, on a voluntary basis. This should, according to the Parliament, help companies to 'subject themselves to ambitious transparency requirements and, as a result benefit from better trust among investors'.

**Next steps**

The provisional agreement still needs to be put in the form of a final text, which will also provide more clarity with regards to other details on the EU GBS (read our previous piece on some of these discussion details **here**). The final text needs then to be voted on by EU regulators, after which it will become effective 12 months later. Some media reports suggest that the final approval is likely to take place by the summer, which would imply that the EU GBS will become effective in the second half of 2024. However, we do not rule out that this can be delayed to the start of 2025. Furthermore, authorities still need to develop technical standards addressing conflicts of interest for external reviewers. ESMA has also previously stated that it would require some time until the accreditation scheme for external reviewers is fully in place. Finally, we understand that the EC will publish a legislative proposal about sustainability-linked bonds within three years of the EU GBS becoming effective.

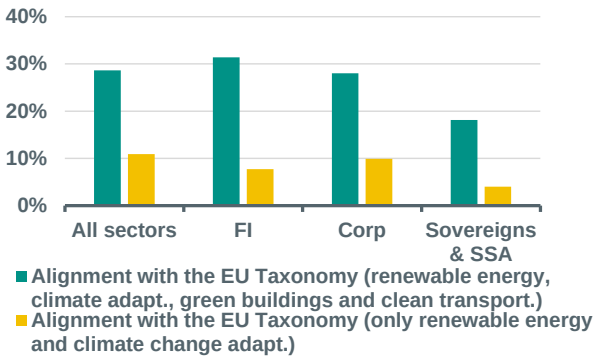
**Verdict**

We welcome the final agreement on the EU GBS, as it will set a clear standard for issuers as well as investors in green bonds. However, at first, the EU GBS is likely to result in a fragmented market, given that only a small share of green bonds will qualify the EU GBS. We estimate that only 10-30% of the outstanding green bonds fully comply with the EU Taxonomy. As shown in the chart below, there also seems to be a natural skew towards Financials and Corporates, with only a very small share of sovereigns & SSA green bonds that would potentially align with the proposed EU GBS. Moreover, less than

3% of global economic activity is aligned with the taxonomy, according to a report last October by the EU's Platform on Sustainable Finance. Hence, for now, the EU GBS applicability also remains an issue, keeping the size of the market limited.

**Small share of green bonds align with EU Taxonomy**

Share of total green bonds (all currencies)




Source: Bloomberg, ABN AMRO Group Economics. Note: EU Taxonomy alignment based on ICMA Green Bond Principles categories

The fragmentation will likely consist of three layers of green bonds once the regulation will be effective: European green bonds, green bonds that use the disclosure requirements of the EU GBS but that do not (yet) comply fully with the standards, and green bonds issued under the Green Bond Principles of the ICMA. This is likely to create quite some confusion for investors, leading to fragmentation rather than harmonisation (which in the end is also one of the final aims of the EU GBS). Still, this issue will probably be solved in the medium term, as the EU GBS is likely to support investment towards EU taxonomy-aligned activities to foster (among others) the energy transition (which is of course a key objective of the regulation). This will increase the available amount of loans to projects aligned with the EU GBS, which will result in growth of the European green bonds market.

Furthermore, we expect demand for European green bonds to be relatively large, as the quality label will provide some security towards investors with disclosure requirements under the SFDR, in particular those with funds classified as Article 8 or 9. European green bonds should naturally be classified as sustainable investments, and will therefore alleviate any fears of greenwashing (several Article 9 funds have recently been downgraded to Article 8 given opaque definitions of what sustainable investments entail). As a result, we think that European green bonds will likely benefit from a larger 'greenium' than green bonds not carrying the label. This, in turn, will be an incentive for issuers to align with the EU GBS. Finally, the EU GBS can be used as a blueprint for other countries that would like to establish regulations for green bonds.

# Are synthetic fuels the solution for cars?

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- **The EU aims to reduce GHG emissions by 55% by 2030 and to be net-zero in 2050**
- **One of the key measures to achieve this is to end new sales of internal combustion cars and vans by 2035**
- **However, the vote at the European Council has been delayed because some countries proposed an exemption for cars with internal combustion engines fuelled by synthetic fuels**
- **Synthetic fuels are a solution but currently not the most viable or efficient solution for cars**
- **Still, there are also some important advantages of using e-fuels for road transport**

**Introduction**

According to Eurostat, the mobility sector accounted for 21% of total EU emissions in 2020. Road transport is the biggest emitter in the mobility sector. It is responsible for around 95% of the total emissions of the mobility sector. The table below shows the greenhouse gas emissions of EU 27 in 2020 of the mobility sector in Megaton and as percentage of the total of mobility. Passenger cars account for 57% of emissions of the mobility sector. Commercial vehicles account for around 38% of the GHG emissions. This is the sum of emissions and percentages of heavy duty and light duty vehicles. In 2021 nearly 250 million cars were on the road in total. 29.5 million vans (up to 3.5 tonnes) were in circulation throughout the European Union and 6.4 million medium and heavy commercial vehicles and 714,000 buses.

**Shares of GHG emissions mobility EU 27**

In % and Mton

| EU 27 | Emissions GHG in % | GHG end 2020 in Mton |
|---|---|---|
| Cars | 57% | 409.9 |
| Heavy duty | 27% | 195.2 |
| Light duty | 11% | 75.9 |
| Motorcycles | 1% | 8.8 |
| Other road transporation | 0% | 0.1 |
| Railways | 1% | 3.7 |
| Domestic navigation | 2% | 15.1 |
| Domestic aviation | 1% | 8.0 |
| Other transporation | 1% | 4.6 |
| **Mobility total** | **100%** | **721.3** |

Source: Eurostat, ABN AMRO Group Economics

**Ban on new sales of cars and vans with internal combustion engines by 2035?**

The EU has set the goal to reduce emissions of greenhouse gasses (GHG) by at least 55% and make the EU climate neutral by 2050. To reduce GHG emissions by the mobility sector the EU has set ambitious targets for this sector. A key policy is the ban on sales of new cars and vans with internal combustion engines by 2035. In June 2022, the European Parliament backed the European Commission's proposal of zero emissions from new cars and vans by 2035. Intermediate emissions reduction targets for 2030 would be set at 55% for cars and 50% for vans. Members of the European Parliament voted to ban the sale of new combustions engine cars by 2035. The Environment Ministers at the European Council agreed to this ban from 2035. But the European Council left the door open to CO2 neutral fuels as decarbonization alternatives to electrification. The ban was approved by Parliament in February 2023 by a tight margin. But it had to be formally endorsed by the Council. A few days ago the Swedish Presidency of the Council decided to postpone the formal signoff of new CO2 emission standards for cars and vans including the ban. The vote was previously scheduled for 7 March 2023. Germany, Italy, Poland and Bulgaria have expressed concerns about the ban of cars with internal combustion engines by 2035. Some countries had asked for a delay of five years but this was overruled. At the end of February, Germany asked the European Union for an exemption to this ban. The exemption would be for internal combustion cars using synthetic fuel.

What happens now? There is no new date set for the vote. A proposal is adopted if a qualified majority is reached. This is the case if two conditions are simultaneously met: 55% of member states vote in favour and the proposal is supported by member states representing at least 65% of the total EU population. This is called the double majority rule. The blocking minority must include at least four member states.

**What are synthetic fuels?**

The discussion is centred around the notion that cars with internal combustion engines fuelled by synthetic fuels should be exempted from the ban. What are 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. For the production of synthetic fuels CO2 is captured from the atmosphere through a Direct Air Capture system. Burning the synthetic fuel does release CO2 back into the air. So 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 three 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)
- Power-to-liquid produces e-fuels such as e-methane, e-kerosine and e-methanol
- Sun-to-liquid produces solar fuels such as hydrogen, ammonia (source **energy.gov**)

For mobility if synthetic fuels are mentioned they often refer to is e-fuels or electro fuels. 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 with electricity (source **Synhelion**). Are synthetic fuels carbon-neutral fuels? Carbon-neutral fuels are fuels which produce no net-CO2 emissions. So synthetic fuels are considered carbon neutral if renewable resources are used in the production process.

**Are synthetic fuels a viable solution for road transport?**

The aim of the EU to be net zero by 2050 is an enormous challenge. There are several technologies and solutions that are crucial in the transition. Lithium-ion batteries, fuel cells that use hydrogen and zero-carbon synthetic fuels are technologies for the mobility sector to reduce greenhouse gases. The choice of technology or technologies for each subsector in mobility depends on availability of a technology, the efficiency, the cost and infrastructure. Which technology is viable or suitable for which subsector in mobility? Lithium-ion batteries are a viable solution for personal cars, vans and city buses but less so for heavy duty vehicles (because of weight, range, infrastructure and grid adjustments) and no viable solution for long-distance aviation (weight and range) and international shipping (range).

Fuel cells fuelled with hydrogen are a viable solution for heavy duty vehicles and could also be a viable solution for domestic aviation and domestic navigation. But the infrastructure is the main challenge. Meanwhile synthetic fuels can be used in all subsectors of mobility. It is blended or replaces fossil fuels. Then the existing infrastructure and engines of fossil fuels can be used, but synthetic fuels need to be produced from renewable energy in order to qualify as green. However these fuels are expensive to produce and are available in limited quantities. For example the production of green hydrogen on sufficiently large scale is still not established and there almost no plants that produce e-fuels.

Are synthetic fuels a viable solution for road transport? We think that they are currently not the most viable solution for the following reasons. First, due to the limited availability of e-fuels, the aim is to use them only for the hard to decarbonize (sub)sectors such as aviation and international shipping. Second, battery-electric vehicles are the most efficient solution for personal cars, vans and city-buses. This technology is more efficient than fuel cells fuelled by hydrogen.

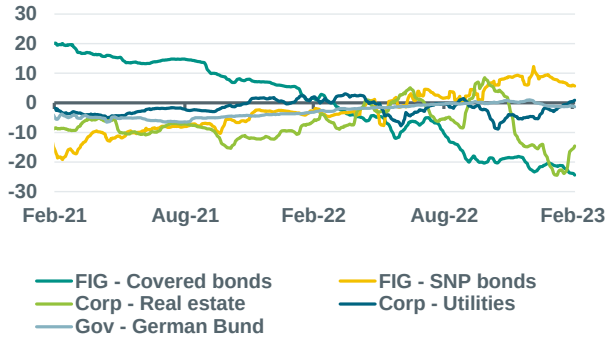
E-fuels are the least efficient technology for road transport right now. According to ICCT 48% of the energy from renewable electricity is lost in the conversion to liquid fuels. To compound the problem, according to various studies 70% of the energy in those fuels will be lost when they are combusted in internal combustion engines. All together the total efficiency for the e-fuels pathway for road transport is around 16%. This compares to a 72% efficiency for a battery electric car where the battery is charged by solar panels (source **ICCT**). Third, manufacturing e-fuels is very expensive and energy-intensive. Using e-fuels in an internal combustion car requires about five times more renewable electricity that running a battery-electric vehicle, according to a paper in the Nature Climate Change journal.

But there are also some important advantages of using e-fuels for road transport. With the use of e-fuels the internal combustion engine and the current refuelling infrastructure could continue to be used. In addition there will be lower pressure to build charging infrastructure for electric vehicles, the refuelling infrastructure of fuel cell vehicles, to make the grid adjustments, and lower demand for critical metals (except metals used as catalyst in the production of synthetic fuels). If future technological developments result in a less expensive, less energy-intensive mass-production of e-fuels and improve the efficiency of e-fuels, e-fuels could be used on a wider scale and also in cars.

# ESG in figures

## ABN AMRO Secondary Greenium Indicator

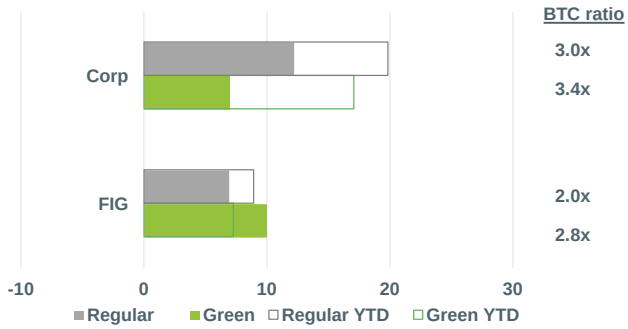
Delta (green I-spread – regular I-spread)




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

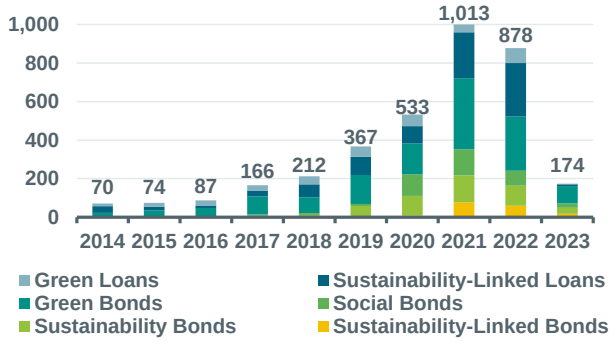
NIP in bps




Note: Data until 09-3-23. BTC = Bid-to-cover orderbook ratio. Source: Bloomberg, ABN AMRO Group Economics

## Sustainable debt market overview

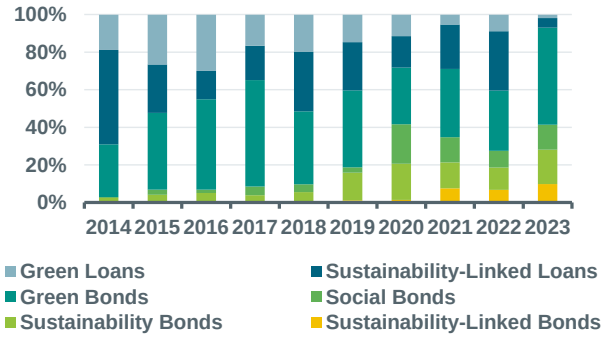
EUR bn




Source: Bloomberg, ABN AMRO Group Economics

## Breakdown of sustainable debt by type

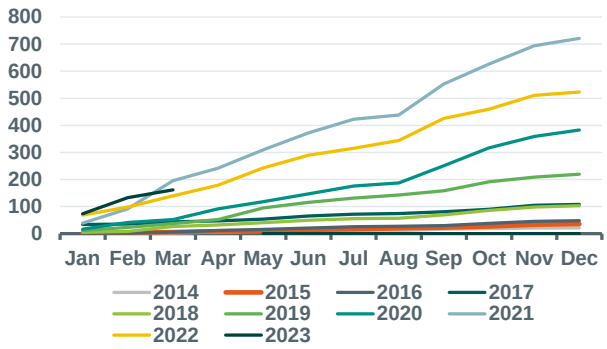
% of total




Source: Bloomberg, ABN AMRO Group Economics

## YTD ESG bond issuance

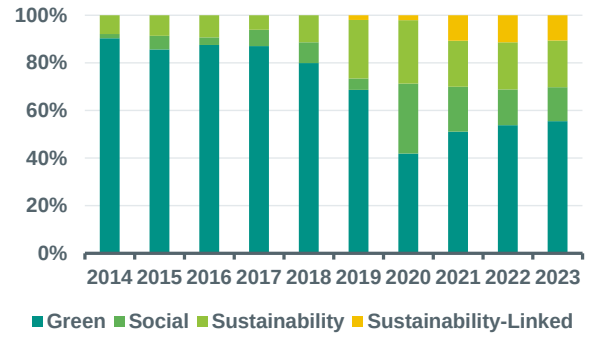
EUR bn (cumulative)




Source: Bloomberg, ABN AMRO Group Economics

## Breakdown of ESG bond issuance by type

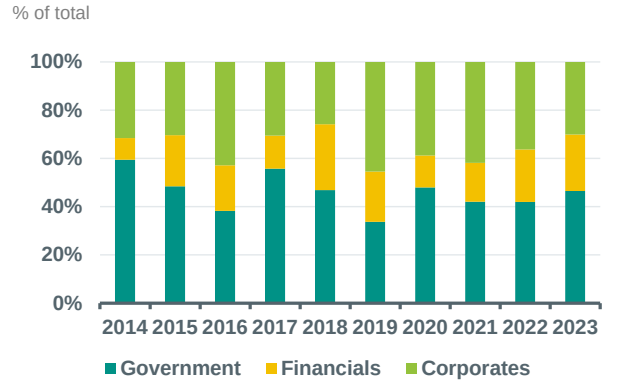
% of total




Source: Bloomberg, ABN AMRO Group Economics

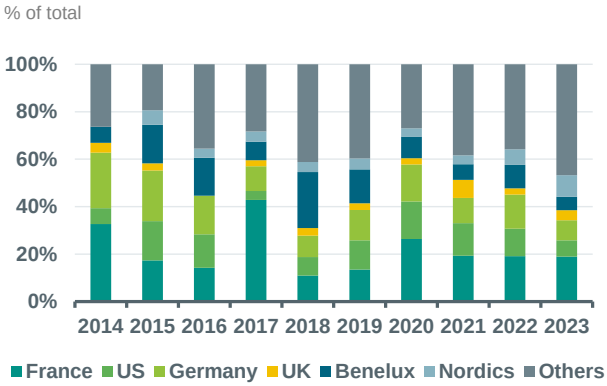
Figures hereby presented take into account only issuances larger than EUR 250m and in the following currencies: EUR, USD and GBP.

## Breakdown of ESG bond issuance by sector



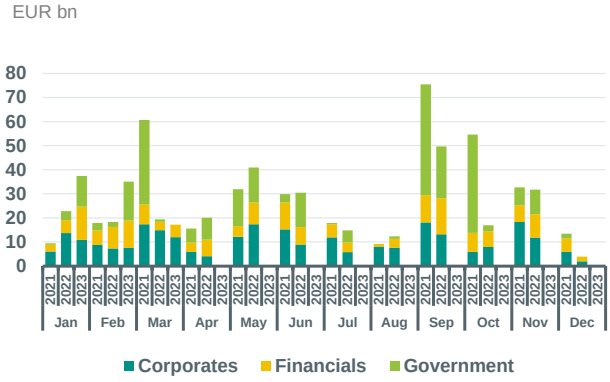

Source: Bloomberg, ABN AMRO Group Economics

## Breakdown of ESG bond issuance by country



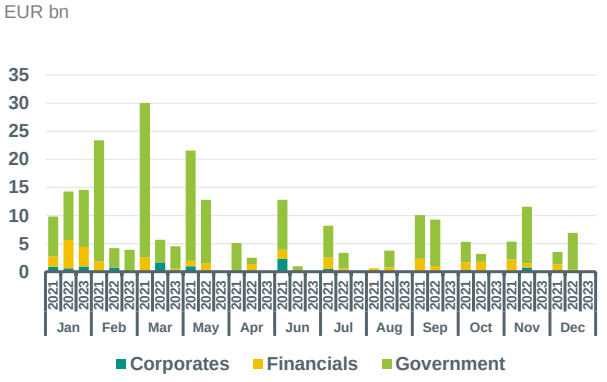

Source: Bloomberg, ABN AMRO Group Economics

## Monthly Green Bonds issuance by sector



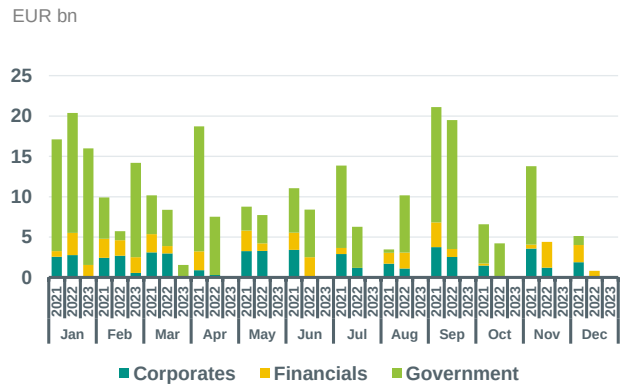

Source: Bloomberg, ABN AMRO Group Economics

## Monthly Social Bonds issuance by sector



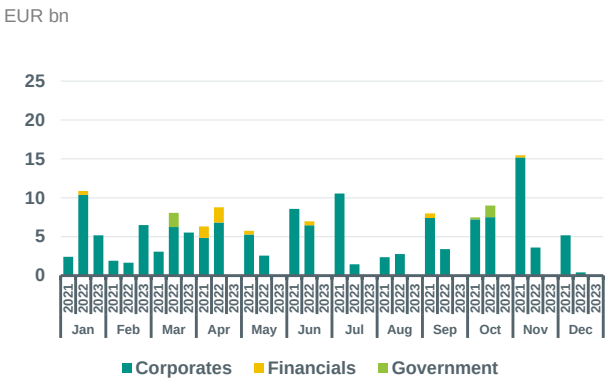

Source: Bloomberg, ABN AMRO Group Economics

## 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.

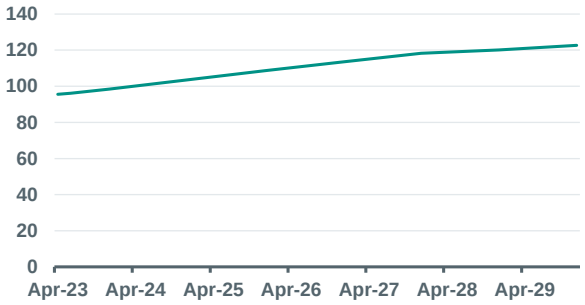
## Carbon contract current prices (EU Allowance)

EUR/MT


Source: Bloomberg, ABN AMRO Group Economics

## Carbon contract futures curve (EU Allowance)

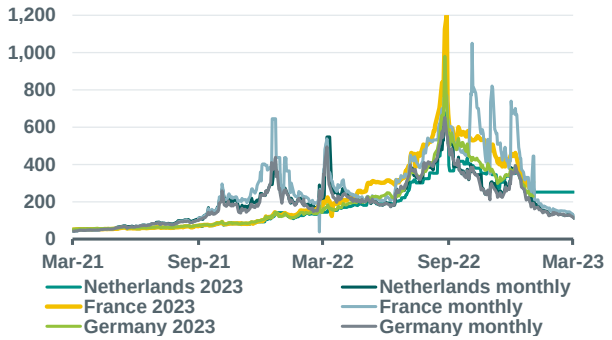
EUR/MT




Source: Bloomberg, ABN AMRO Group Economics

## Electricity power prices (monthly & cal+1 contracts)

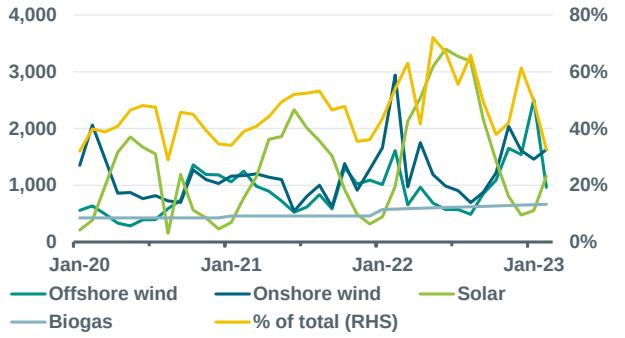
EUR/MWh




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

## Electricity generation from renewable sources (NL)

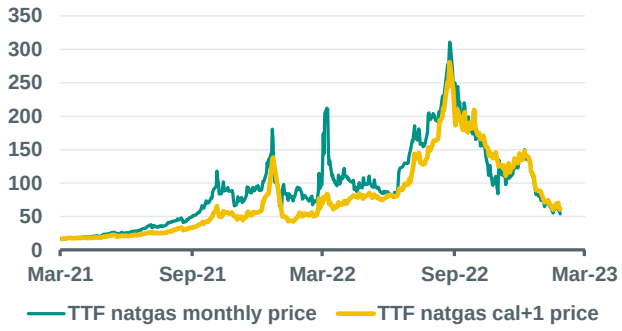
GW % of total




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

## TTF Natgas prices

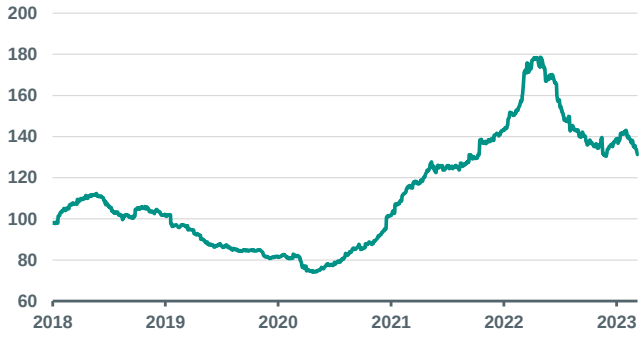
EUR/MWh




Source: Bloomberg, ABN AMRO Group Economics

## Transition Commodities Price Index

Index (Jan. 2018=100)




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

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