The Green Bond

Your insight into sustainable finance

18 June 2024

Can AI support the sustainability transition?

SEB

In this issue

Can AI support the sustainability transition?

Letter to the reader

Dear reader,

In addition to our regular updates on the transition, sustainable finance markets, and regulations, in this issue we have decided to explore the impact of Artificial Intelligence (AI) on the future of sustainability.

The green bond market continues to perform well, supported by strong corporate issuance and a robust sovereign, supranational, and agency (SSA) sector. However, this growth is somewhat offset by weaker financials issuance. In the financial sector, new instruments like green deposits are emerging, competing with green assets. Despite a generally positive outlook, we are slightly less optimistic about the financial segment compared to the broader Green Bond market.

AI's role in the energy transition is a hot topic. The need for data centers to support AI is driving demand for reliable power and water infrastructure. Currently, data centers consume around 2% of all energy. Therefore, they must achieve efficiencies that exceed this consumption rate through things like optimized supply chains, operational excellence, smart cities, intelligent transport systems, and advanced grid management. While data centers have the potential to meet and exceed these efficiency goals, their success will heavily depend on the location, reliability, and sustainability of the supporting infrastructure.

While most current focus is on addressing the power issue, we expect the water issue to become even more prominent as water stress increases from various fronts.

In today's Green Bond report, several contributors will share their insights on this topic, and especially on the role that AI can play in promoting circularity. Our contributors include the Institute of International Finance (IIF), Alleima (on steel production), and our own experts Thomas Thygesen, Erik Halldén, and Christopher Lyrhem.

Enjoy your reading,

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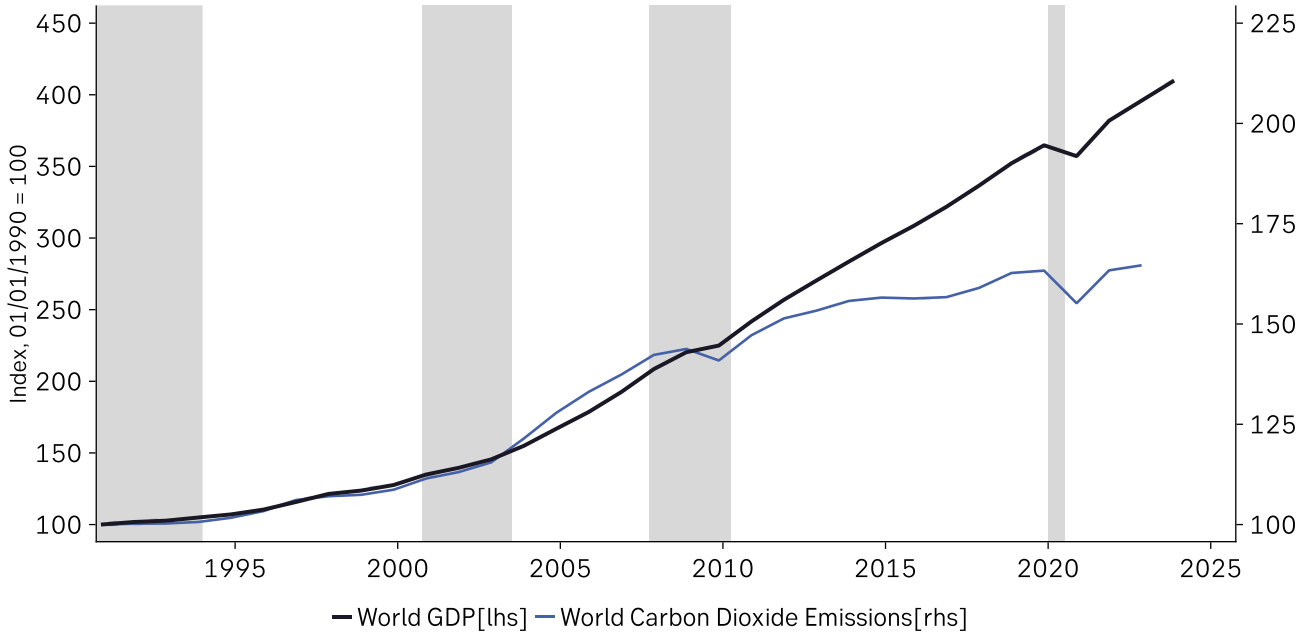
Transition update

The temperature is rising – can AI help?

GDP has decoupled from CO_2 emissions, but global investment is still too low to halt the increase in the temperature level. Western governments cannot match China's investment levels. However, we think AI can help both reduce emissions and create a more sustainable production model.

Figure 1 World GDP and World carbon dioxide emissions .



Source: IMF, BP, Macrobond, SEB

Better – but far from good enough

Significant progress that has already been achieved in halting the increase in global CO_2 emissions. Over the past 15 years, CO_2 emissions have decoupled from global GDP, both by reducing the primary energy consumed per unit of GDP and by reducing the emissions generated per unit of primary energy consumed. It is possible to generate GDP growth without increasing emission levels as much as previously.

It is probably no coincidence that this happened at the same time as renewable energy finally started to take a larger share of the global energy supply. First, it means that a larger share of our total energy supply now comes with no emissions at all. Second, renewable energy is much more effective at translating primary energy into end-user energy consumption than fossil fuels, so the same amount of primary energy provides more energy for end-users.

The result is an economy that generates less emissions per unit of production, allowing emissions to stop rising even as GDP continues growing.

This remarkable success is in our view a 'proof of concept' for the idea that human ingenuity coupled with large investments in new technologies can allow us to improve living standards for 8bn people on the planet without triggering an ecological and humanitarian disaster.

However, while this is all very encouraging, there is no case for resting on any laurels. Halting the increase in emissions is an important first step, but as pointed out in a recent speech, from UN Secretary General Guterres, new data from the World Meteorological Organization (WMO) showing there is an 80% chance the planet will breach 1.5C (2.7F) in warming above pre-industrial times in at least one of the next five calendar years.

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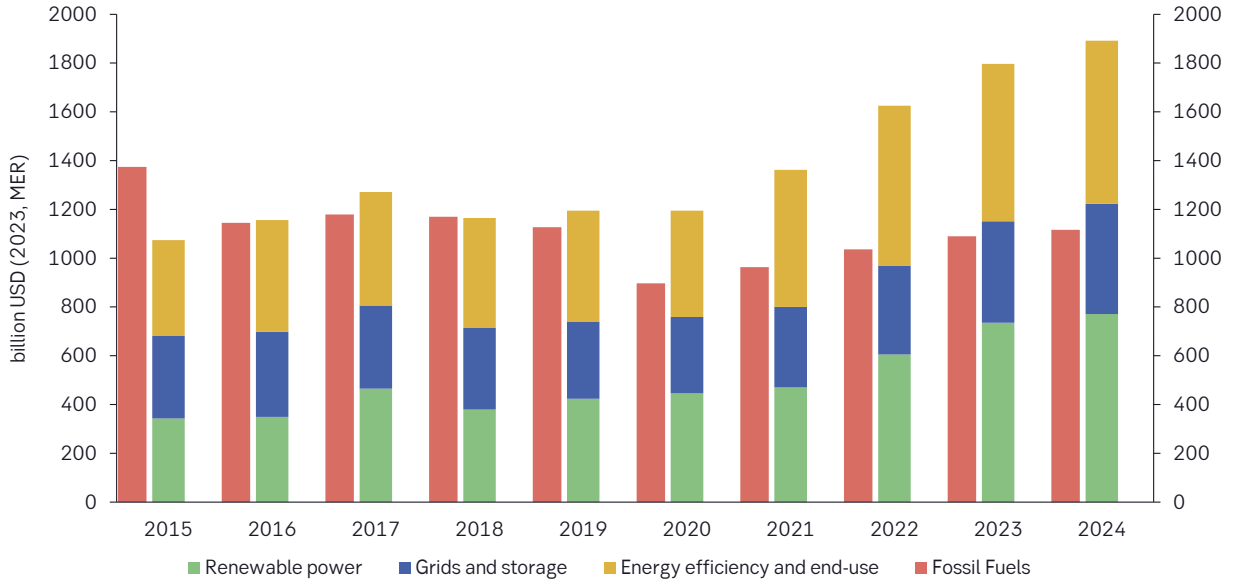
Figure 2 World investments in fossil vs. clean energy



Source: IEA, Macrobond, SEB

More renewable investment needed

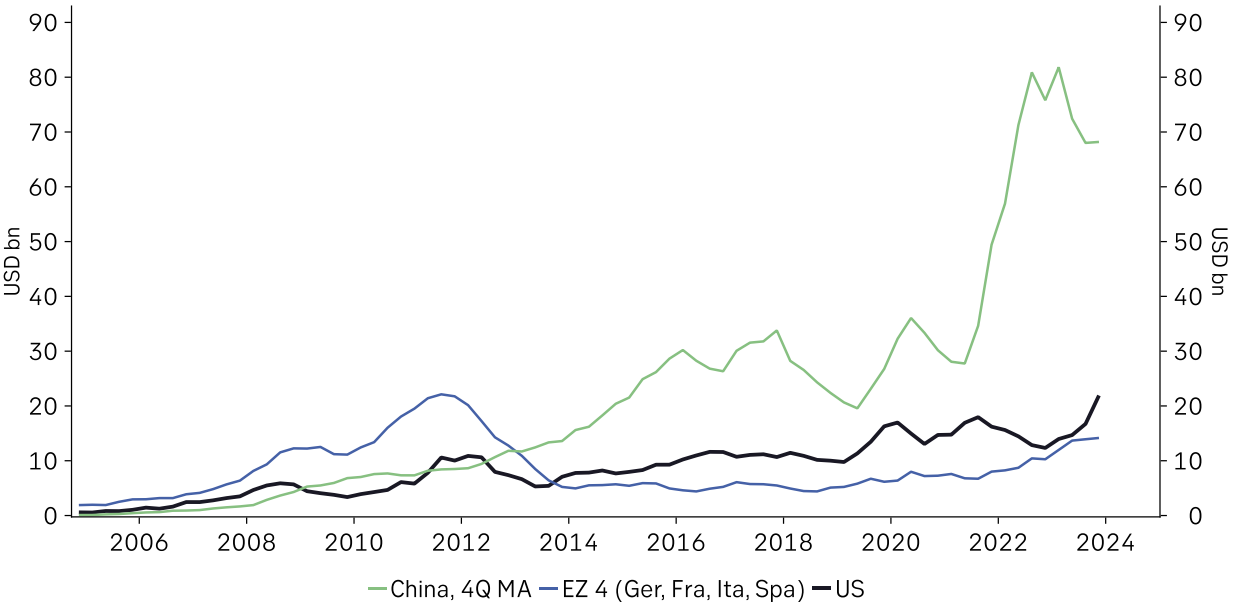
Establishing proof of concept has to be used as a driver for ramping up investments even faster to trigger the outright reduction in emissions needed to halt the climate disaster.

Again, significant progress has already been made. The latest World Energy Investment report from IEA shows that in 2023 more USD were invested globally in renewable power, grids and storage combined than in fossil fuels (Figure 2). The IEA forecast for 2024 suggests that clean energy investment on a broad scale will surpass USD 2tn. This means that global investment in clean energy will be close to double of what is invested in fossil energy.

However, if you only look at the direct investment in new renewable energy supply, we are still investing more in producing fossil energy than in renewable energy.

Furthermore, the increase in investment is not evenly spread among the major economies. China is far ahead of the curve after quadrupling clean energy investments since 2020. The US investment level has shown signs of catching up after the introduction of the IRA, while Europe remains far below the peak investment levels from the first surge more than 15 years ago. However, both regions are far behind China, and the gap is even larger for developing economies.

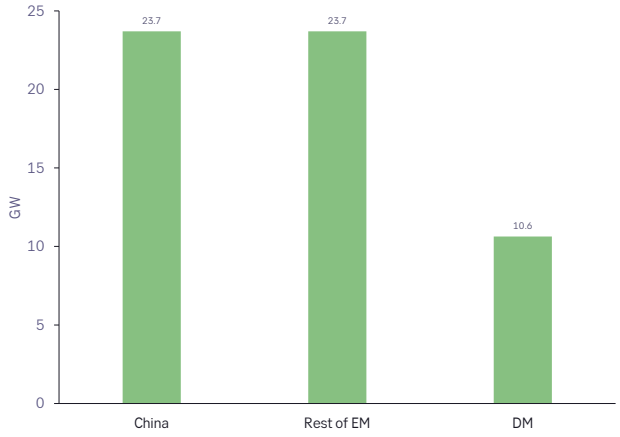
Figure 3 Renewable investments across regions



Source: BloombergNEF, Macrobond, SEB

The momentum loss for global investment over the past year is mainly due to China, where it appears that renewable investments have peaked and are levelling off just below USD 70 bn. However, this 'pause' has come on the back of a 6x increase in production of solar energy since 2016, a trebling of wind energy and doubling of nuclear energy production in the same time period. China also has the same amount of nuclear power plants under construction as the rest of the world combined.

Figure 4 New nuclear capacity under construction



Source: BloombergNEF, SEB

This is no coincidence, because China has deployed the full extent of its policy arsenal to make sure that it will reach its long-term target of capping emissions by 2030 decarbonizing the economy completely by 2060. For a more complete description of what this entailed, turn to Erik Hallden's article on this topic later in this issue.

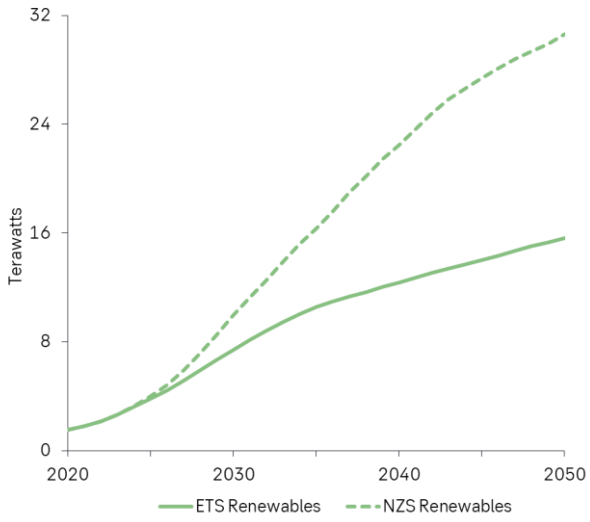
Europe and the US continue to play catch up

Europe and the US are far behind, but US started to catch up after IRA provided industrial policy framework. However, as the US Presidential election in November draws closer, the ability to ramp up investments in the clean energy space could be limited and the following years could prove more challenging for the clean energy agenda overall if former president Trump returns to office.

Europe is still waiting for a 'proper' industrial policy with actual money to back it. The EU green deal lacked the spending power of the IRA, and the outcome of the European Parliament elections held at the beginning of June also poses a risk for green investment levels. The voters have rebuked the 'only stick, no carrot' plan the EU had presented them with. This was clear before the election and climate policy was not a vote-winner anymore, but that realization could open for a more US-style capex-oriented climate/industrial policy. In our view, the current Green Deal would not allow Europe to keep up with and compete against the US and China.

Bloomberg New Energy Finance operate with two scenarios the Economic Transition scenario (ETS) and the Net Zero scenario (NZS), where the former trajectory reflects current efforts. Thus, while investments in renewable energy are increasing and there is substantial growth in the wind and solar capacity generation spearing the early stages of exponential growth, this needs to accelerate further. It has to happen at least twice as fast to reach the Paris aligned targets by 2050.

Figure 5 Wind and solar capacity in BNEF scenarios

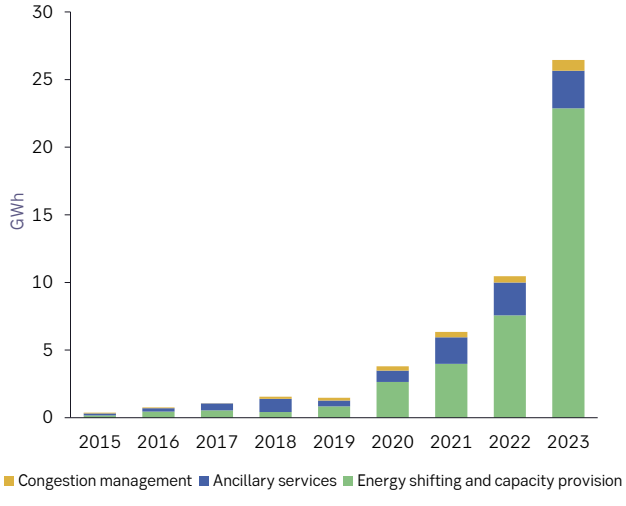


Source: BloombergNEF, SEB

More batteries needed too

Storage is needed to make use of the renewable energy capacity and supply created. This requires batteries to follow the same growth trajectory. Electricity prices tend to turn negative during periods where the sun shines and wind blows and in turn becomes more expensive when energy production from these sources is lacking.

Figure 6 Utility-scale battery storage capacity additions

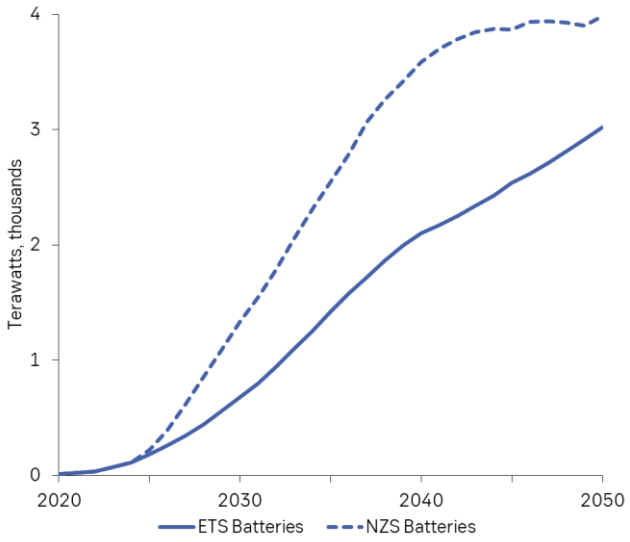


Source: BloombergNEF, SEB

According to BloombergNEF almost all lithium-ion battery volumes are used for EVs. However, there is also some considerable movement happening in the utility-scale space, where the growth is primarily driven by energy shifting and capacity provision (Figure 7). This could pave the way for the entire electricity system to store energy for future use and not just benefit the EV producers. Although still in the early stages, it is a crucial part of developing the clean energy infrastructure.

While the IRA in the US has provided some powerful economic incentives to build more battery factories, a similar push in Europe is lacking, while China is ahead when it comes to the battery efficiency and range for EVs. The overall challenge for battery production is similar to that of renewable energy: it has to happen at a faster pace to shift the growth path aligned with the net zero scenario.

Figure 7 Batteries in BNEF scenarios



Source: BloombergNEF, SEB

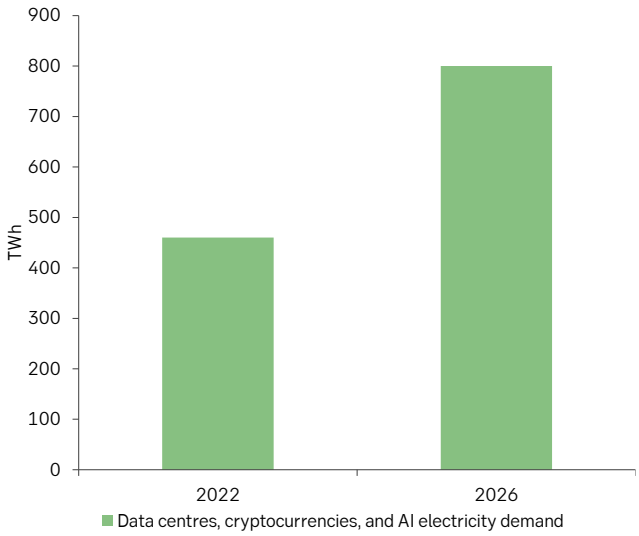
Can AI help? We believe it can

So, it appears that despite the progress, investment plans are still falling short of what is required to eliminate emissions by 2050. Against that back-drop, we ask whether AI can help? We think it can, at first by reducing resource intensity in our current economic model and ultimately by allowing a more radical transformation of our economy.

A potential risk is the amount of energy AI models and data centres consume. Estimates from IEA highlight that data centres consumed almost 2% of total global electricity demand in 2022 (Figure 8). With the rapid increase in AI models, the energy demand from data centres continues to increase, and IEA expects the demand to double before 2026.

While renewable energy is growing, it is still playing catch-up with CO_2 intensive alternatives to support the current demand of energy. If the growth potential of AI is true, then there will be needed much more energy just to support this growth story. This highlights the importance of the investment in renewable energy. However, the big tech giants that develop the AI models like ChatGPT and Gemini and expand the use of data centres are also investing in energy to support future demand.

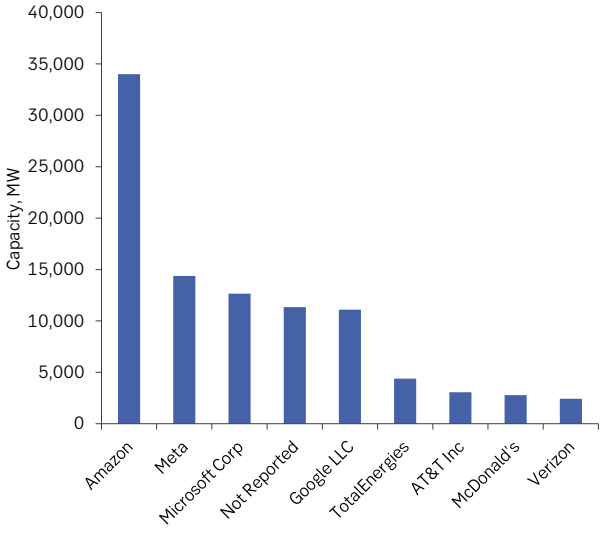
Figure 8 Datacenters electricity use



Source: IEA, SEB

Figure 9 shows the big tech companies also are the top buyers of PPA arrangements. Thus, there is a huge amount of capital flowing in from companies with tremendous cash flows behind them. This is a push that might be greater than government initiatives.

Figure 9 PPA agreements for companies



Source: BloombergNEF, SEB

What AI can do today

However, it is not only the securance of energy that will be the driver for benefits from AI. There are multiple examples of AI that will make the world more efficient and in turn minimize commodities needed for production of products and thereby decrease the pollution from multiple sectors. Below are some examples of what AI already can do for sustainability.

In industry, the integration of the Internet of Things (IoT) with automated supply chains is a step towards sustainable business practices. Predictive maintenance is just the first step towards offering capital goods as a service rather than a product. Right now, companies are enhancing industry operations through IoT and predictive maintenance technologies, which improves equipment maintenance and preventing failures and minimizes downtime.

Over time, we believe a new business model is likely to emerge, where companies could be mandated to reclaim their products as consumers are done using their products, which would create a closed-loop system. This aligns with the principles of circular economics, where the lifecycle of products is extended through recycling, repurposing, and recovery.

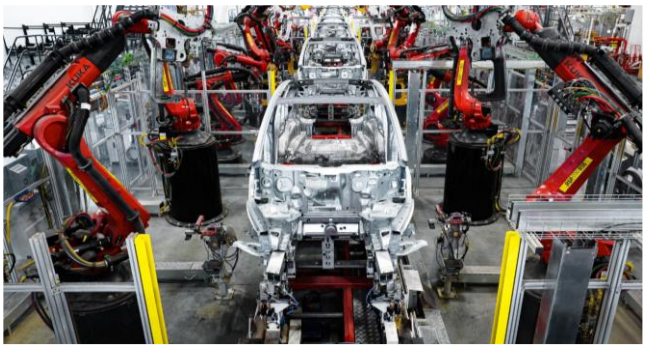
The task of sorting waste done by households, could be vastly improved through the adoption of robotic technology. Advanced robots can already distinguish between different types of materials with precision and speed, significantly optimising the recycling process.

The Norwegian company Tomra is transforming the waste and sorting segment with advanced sensor-based technologies that enhance the recycling process. The company's machines use sensors and AI to improve the sorting and recovery rates of recyclables like plastics and metals. This technology ensures high purity in recyclables, increasing their value for reuse.

In agriculture, large companies like Siemens and IBM have already offered tools to support 'precision farming' for decades, but AI should take this to the next level. Integrating AI into agriculture helps in predicting crop diseases, automating farming operations, and providing precise data for better decision-making. Furthermore, drones are being developed to enable precision farming with targeted application of irrigation and pesticides depending on the needs of individual plants. This reduces both the consumption of resources and pollution.

Autonomous cars have started navigating the streets of certain cities in the United States and China. While their widespread use is curtailed by regulatory challenges such as insurance and accident liability, they will operate first in controlled environments like mines, warehouses, and ports, but could soon spread into more general use. Right now, robotaxis have already driven more than 7.5 million miles in the US with passengers. The transition to autonomous driven will not only complete the transition to more sustainable vehicles, but there will be a lot less cars needed on the roads.

Figure 10 Examples of what AI already can do for sustainability




Source: SEB

Within research and development AI has the potential to accelerate innovation and learning curve processes by spreading newly developed results and best practices faster. Fero labs, with the help of AI, is driven up the efficiencies in steel recycling. AI has helped the company to work on more complex problems that would not have been possible before. "What used to take engineers months of dedicated work is now done in minutes – once deployed, our plants get results 90 times faster than traditional methods"[1].

End-result: a circular production model

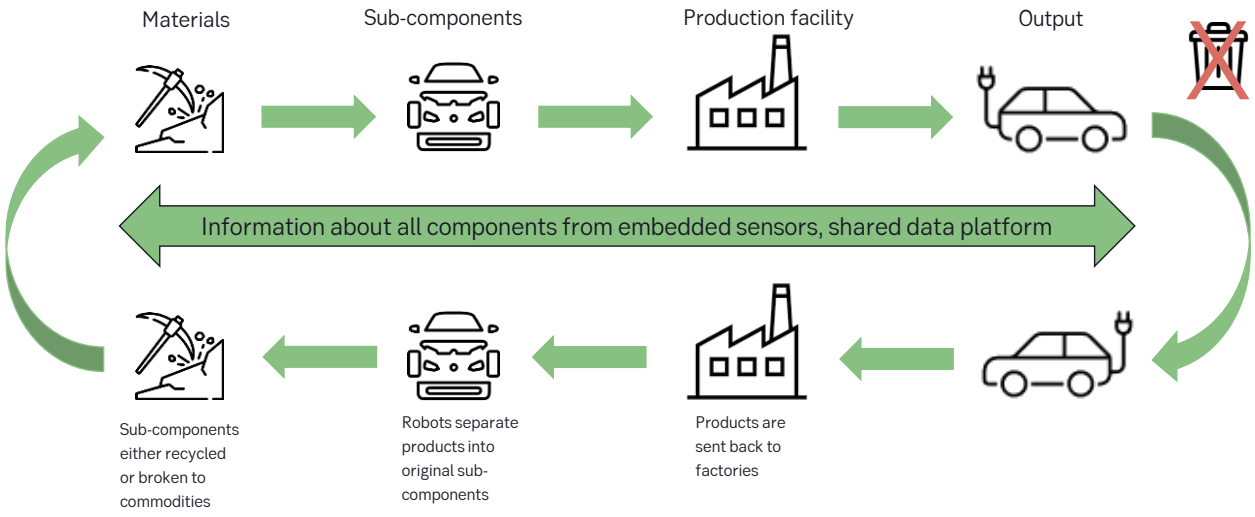
The concept of the assembly line is undergoing a revolutionary transformation that could lead to a future without manual labour involved in production at all. This could redefine the production landscape, and potentially increase the output while minimising human error and physical strain. This would also remove the main drawback of the assembly line model, the fact that it has been most efficient when producing large production runs of the same output, which has led to the centralisation of production in large facilities in global low-wage regions.

Companies are already experimenting with such models, especially in the production of electric vehicles. Tesla is working with the concept of parallel assembly where major parts of a vehicle are constructed individually and put together at the end of the process. However, the potential for transformation goes well beyond production because AI could ultimately also hold the key to a truly circular production model if we extrapolate the trends that are already underway.

The same robots that could put together a new EV could potentially also strip it apart again. Predictive maintenance using embedded sensors is one step in this direction on the production side, turning capital goods from a product into a service. 3D printing also allows more flexibility in turning recycles inputs into new products. On the resource efficiency side, robots are already sorting garbage more effectively than humans.

Combining these trends could in our view open for a truly circular production model where retired products are stripped apart and turned into new products, significantly reducing the resource intensity of the economy and allowing a relocation of production facilities closer to the end-market. This would lead to substantial changes in the global supply chain networks too, reducing the need for transportation of finished goods.

Figure 11 The circular production model: two-way supply chains



Source: SEB

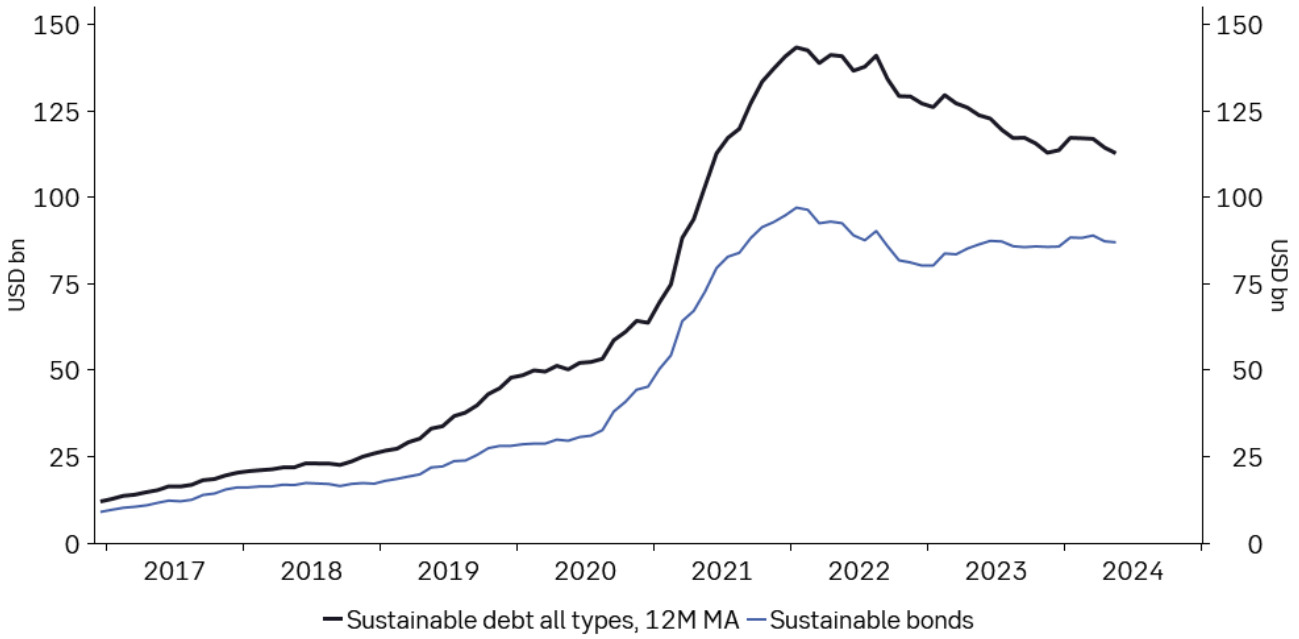
[1] AI is now writing "green" recipes for recycled steel | Fero Labs

Sustainable finance market update

All-time high market share in Europe amid sluggish growth

Amid fading hopes for interest rate cuts, growth in sustainable borrowing has tapered off. Europe reached record levels in sustainable bond market share in Jan-May 2024, but political headwinds are mounting. In the equity market clean equity prices are decoupling from sustainable fund flows

Figure 12 Rolling 12M sustainable debt transactions .



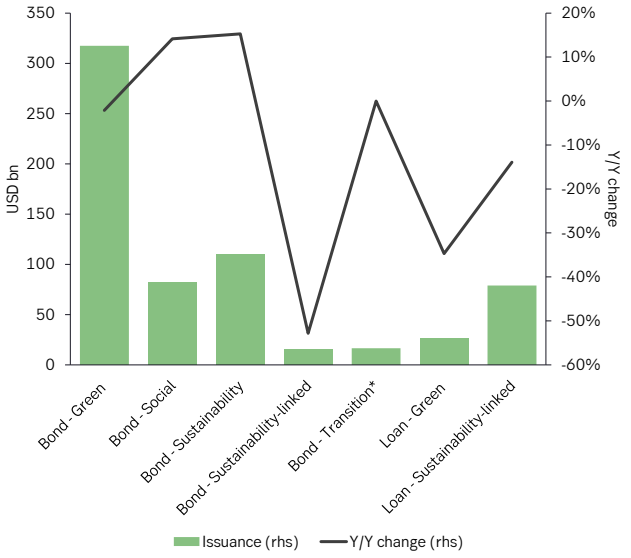
Source: BloombergNEF 31 May 2024, Macrobond, SEB

Sustainable finance market still looking for momentum

New sustainable bond and loan transactions in the first five months of 2024 amounted to just under USD 650bn globally. Sustainability-linked bond issuance continues to fall and even green bond issuance have seen a small drop year-over-year. New issuance of social and sustainability bonds has seen growth of close to 20 percent this year.

We are now also collecting information about transactions of transition bonds as well as social and sustainability loans. As we have described in our April 2024 edition, transition bonds have recently seen new momentum driven by Japan's Climate Transition Bond Framework and sector guidance. Aggregate new issuance of transition bonds in 2024 now stand at USD 15.5bn but the market has yet to diversify with only one transaction outside of Japan this year.

Figure 13 Sustainable debt transactions, YTD 2024



Source: Bloomberg 31 May 2024, SEB.

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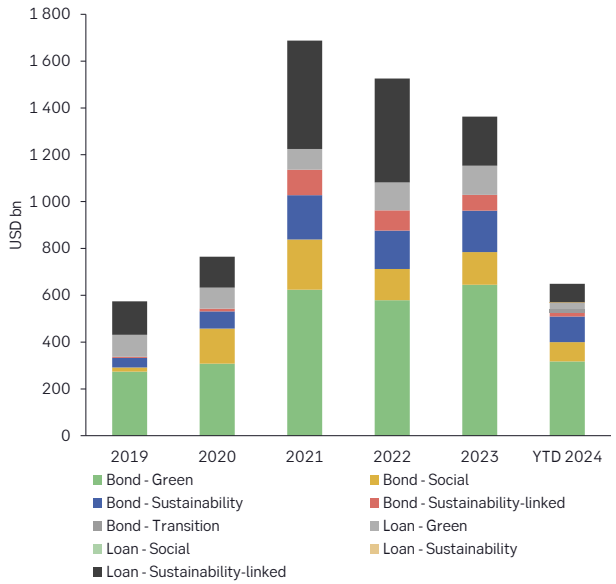
Overall, use-of-proceed bonds – primarily green bonds – are still forming the bulk of the sustainable finance market globally. The share of sustainability-linked loans has fallen dramatically in the past two years. Social and sustainability loans so far only represent a very small portion of the global sustainable finance market.

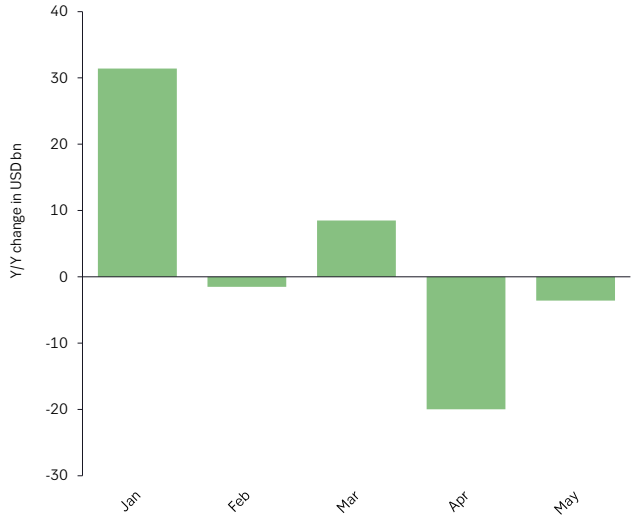
Figure 14 Sustainable debt transactions by product



Source: BloombergNEF 31 May 2024, SEB

The beginning of 2024 saw a sharp increase in sustainable bond issuance in part because of hope that central banks would start to lower interest rates by mid-year. As market expectations for quick turn to more expansionary monetary policy has faded, so have new issuance in sustainable bonds. Looking ahead, we now assume that the sustainable bond market will see no considerable growth in terms of issuance volume compared to 2023.

Figure 15 Y/Y change in sustainable bond transactions, YTD 2024

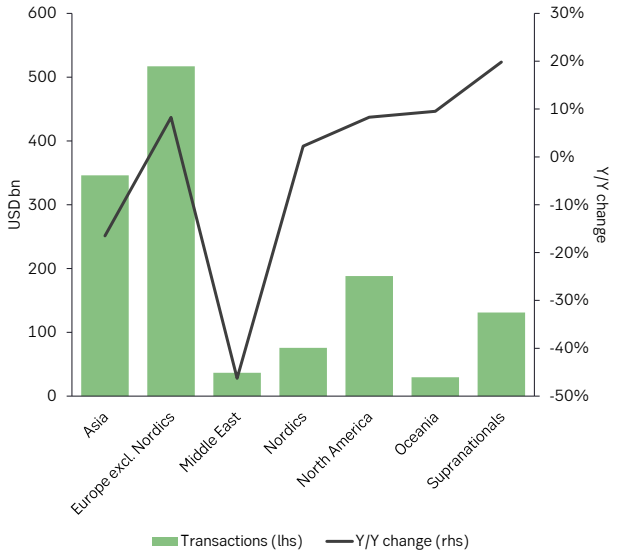


Source: BloombergNEF 31 May 2024, SEB

Sustainable bonds reach all-time high market share in Europe

Looking at the regional level, sustainable bonds continue to grow in the western hemisphere with issuance up 10% in Europe, North America and Oceania, but down 10% in Asia. Supranational institutions have seen a notable increase in new sustainable bond issuance, too.

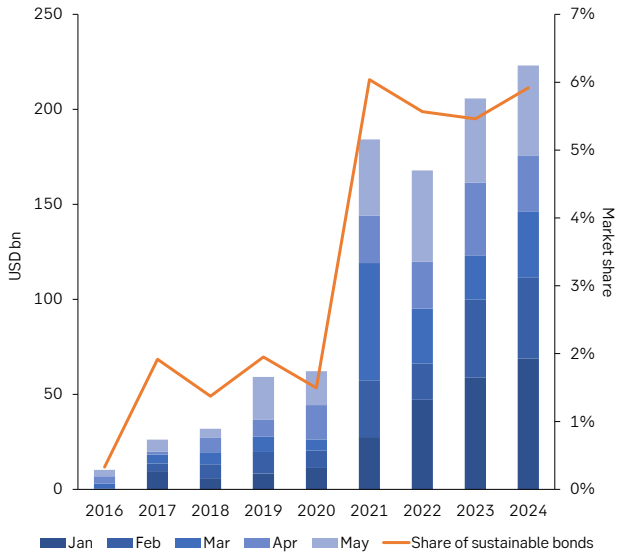
Figure 16 Sustainable green bond issuance by region, YTD 2024



Source: BloombergNEF 31 May 2024, SEB

Amid a stagnant overall fixed income market, sustainable bonds reached record-level market share in Europe both outside and in the Nordics in the first five months of 2024.

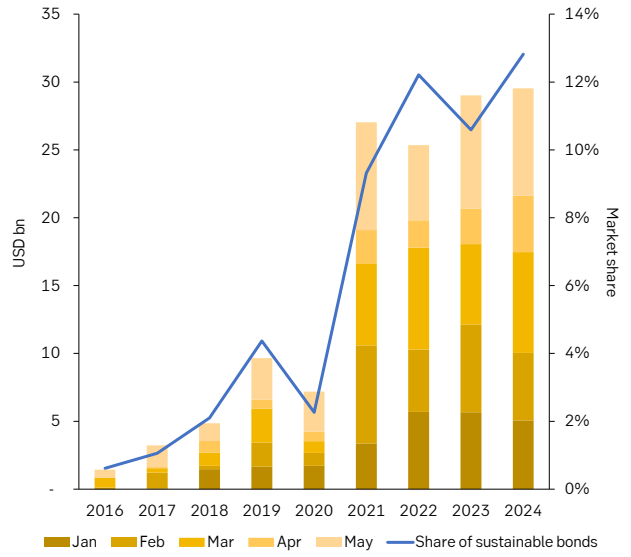
Figure 17 Sustainable bond market in Europe (excl. Nordics), YTD 2024



Source: BloombergNEF, Bloomberg, SEB- 31 May 2024

Sustainable bonds claimed almost 6% of all new issuance in Europe (excluding Nordics) and almost 13% in the Nordics.

Figure 18 Sustainable bond market in Nordics, YTD 2024

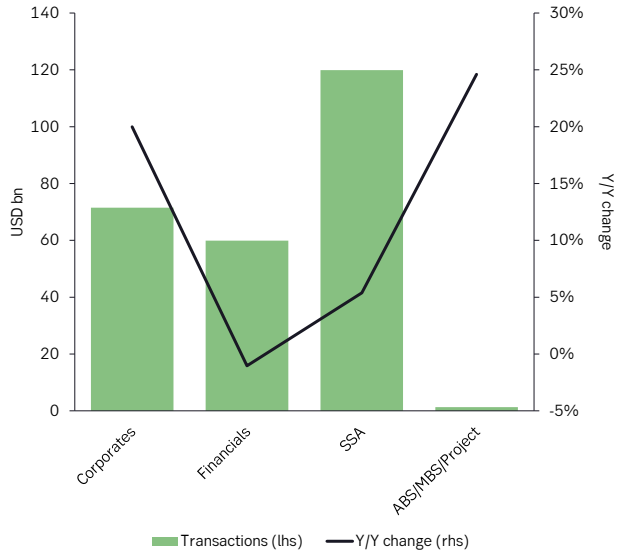


Source: BloombergNEF, Bloomberg, SEB- 31 May 2024

Corporate sustainable bond issuance up, but European Supranationals may face political headwind in H2

A closer look at the sector composition of European issuance of green, social, sustainability and sustainability-linked bonds shows that corporate borrowing has grown by more than a fifth so far in 2024. This suggests that market conditions for scaling sustainable finance in Europe's private sector is starting to improve.

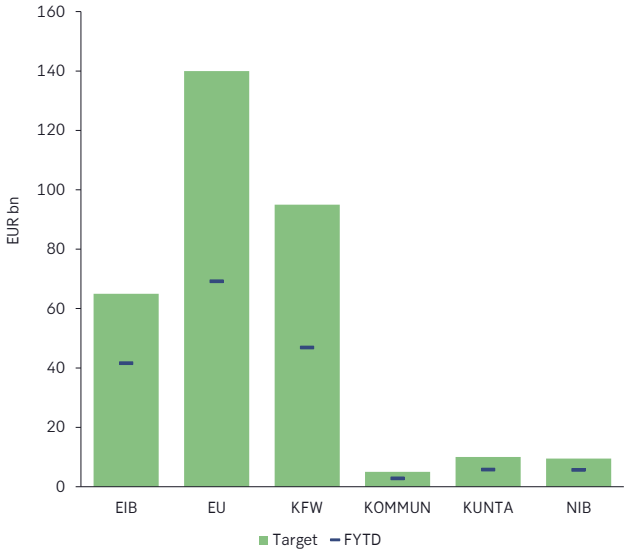
Figure 19 Sustainable bond issuance in Europe (incl. Nordics) by sector, YTD 2024



Source: Bloomberg 31 May 2024, SEB

With EU Parliament elections just behind us and a snap election in France ahead, it is interesting to look at how European Supranationals have made progress on their capital raising plans for sustainable and vanilla bonds. The numbers show that public issuers have reached anywhere between 49% to 60% of their funding plans for 2024. With the right-wing swing in the EU parliament and potentially even the new EU Commission and France's Government, EU level borrowing may come under pressure from calls for more restricted EU-level borrowing in the second half of the year.

Figure 20 Funding progress of Supranational EUR issuers (incl. sustainable and general bonds), YTD 2024



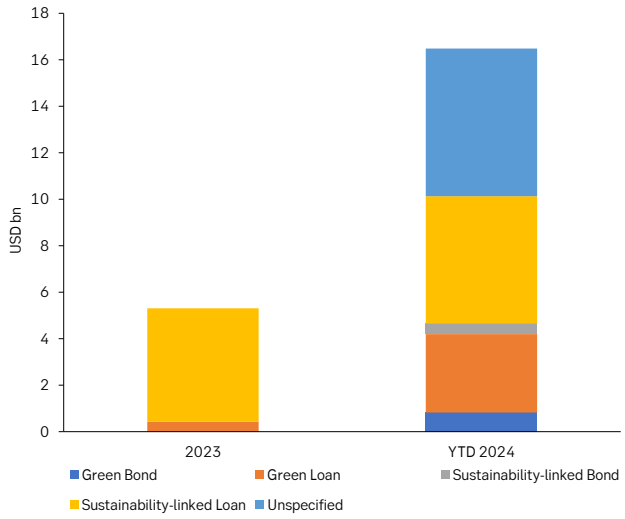
Source: Bloomberg 11 June 2024, SEB

Sustainable finance role in lowering AI's environmental footprint

Data centre companies form an essential and particularly energy intensive part of the AI value chain. These companies are increasingly turning to green and sustainability-linked financing as a means to secure funding for environmentally friendly projects and to meet their ESG (Environmental, Social, and Governance) targets. For example, US-based Stack Infrastructure announced in April, a cumulative fundraise of USD 3.3bn in green financing for water and energy-efficient global data center development. Similarly, German data center developer Maincubes has tied interest-payments for its May 2024 USD 1.07bn loan facility to the company's energy efficiency and CO2 reduction targets.

Looking at the market potential, sustainable finance for data center development until early June has already more than tripled compared to 2023. Loans represent the majority of sustainable financing for data center developers. This is similar to sustainable financing in the technology sector as a whole and different from CAPEX heavy industries like heavy industry where bond financing dominates. We expect more than USD 25bn in sustainable finance for data center development in 2024.

Figure 21 Sustainable finance by data center developers

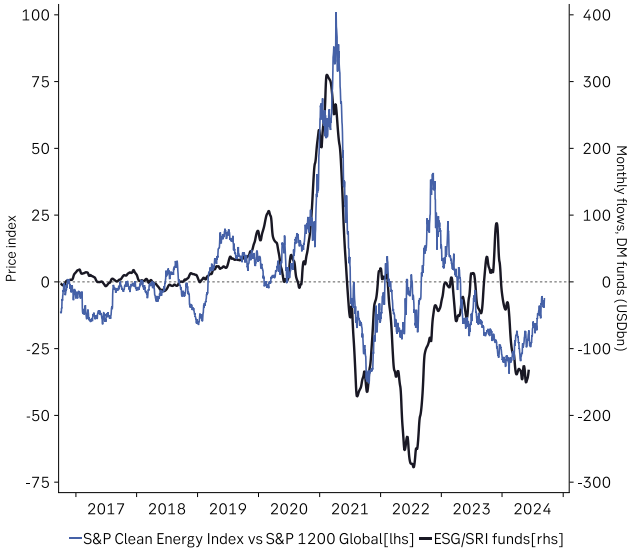


Source: Datacenter Dynamcis, SEB

Equity market: recoupling with fundamentals

In equity markets, the outflow from ESG-labelled funds has been gaining pace recently in both Europe and the US, but we are also seeing signs that the pricing of e.g. clean energy companies is decoupling from flows into labelled funds after a period of strong correlation.

Figure 22 S&P Clean Energy/Global 1200 & fund flows



Source: Bloomberg, EPFR, SEB

The boom-bust development in 2020-2022 in hindsight appears to have been a thematic 'bubble', fuelled by inflows that were unrelated to profitability and other fundamental factors and the subsequent outflows as performance ultimately reflected the fundamentals. In our view, we are approaching the point where the case for clean energy stocks can be made on a fundamental basis, especially if tech giants continue ramping up spending on securing a supply of clean energy for AI and data centres.

Sustainable finance regulation update

The Green Deal post EU elections: A blow that hurt but won't kill

The EU election results demonstrated weakened support for the green transition, but less so than many feared. Navigating this political landscape while delivering on the climate & environmental commitments will be a key challenge for the new Commission. Other unfinished tasks include the continued development of taxonomy activities and the revision of the SFDR.

Unsurprisingly, there are few regulatory developments to report on only a week after EU elections. As we await the composition and priorities of the new Commission, we instead take this opportunity to take stock of the past five years, as well as to outline what to expect next.

From tabula rasa to... a lot

Describing sustainable finance regulation at the start of the mandate mid-2019 is easiest done in the negative: there was no EU Taxonomy; no CSRD and ESRS; no SFDR; and certainly, no CSDDD. After a painfully drawn-out process with political horse trading, the CSDDD was passed this spring, albeit with a reduced scope. In other words, a move from a largely unregulated area of financial markets to the comprehensive and highly detailed frameworks that have become central to EU sustainability discourse.

While clearly comprehensive, has the regulatory agenda been a success? In light of the Commission's legislative schedule, the answer must be yes. Apart from investigating the integration of sustainability factors in prudential rules for banks, the plan has largely been carried through. Successfully completing the agenda, however, does not necessarily imply success in terms of content. It is worth noting, as outlined elsewhere in this report, that the EU is still lagging behind the US and China in terms of clean investments.

Questions also remain regarding the extent to which speed was achieved at the expense of usability. It is unlikely to have escaped the attention of anyone that certain EU Taxonomy criteria are challenging to apply. Equally, the double materiality assessment under the CSRD would have produced less pain and better outcomes with more guidance. Still, challenges are to some extent unavoidable when regulating new areas. There is also an argument in favour of seizing the moment while there is political buy-in, to subsequently correct any mistakes. Issues such as the above, combined with the previous Commission's target of reducing the regulatory burden by 25%, will undoubtedly make usability a key issue into the next mandate.

Post-elections outlook

The elections certainly contained some setbacks for the green transition. Several far-right parties made substantial gains whereas the green party group lost a quarter of their seats. The practical implications are somewhat uncertain, with the far-right historically having struggled to unite themselves to drive policy. The conservatives strengthened their position, making them less dependent on the extreme right than predicted by many. Previous Commission President von der Leyen therefore probably has a better, although still not great, chance at securing a second mandate supported by centrist parties.

Despite von der Leyen being a key driver of the EU Green Deal, members of her own party flirted with the far right during the election, including promises to unravel parts of the green deal. For von der Leyen to repeal her own legislation however seems unlikely (combined with it simply being a lot of work to undo law). On the contrary, the breadth of the internal conservative political spectrum, combined with the empowering election results may enable the conservatives to resolve these clashes internally. This could reduce the risk of backtracking on efforts made so far.

A more significant risk to existing policies lies in enforcement. If political support in Brussels and national capitals fades, both national implementation of directives as well as monitoring by competent authorities risk suffering. The result may be lowered ambition levels or higher tolerance of non-compliance. Until now, political parties that prioritised the green transition drove the policy agenda. As these forces weaken, the role of the private sector to express support for the transition becomes more important. This further underlines the need to ensure that the

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frameworks work in practice, starting by addressing usability issues.

Left over policy work for the new Commission

Unfinished files for the new Commission to shoulder, whatever its final composition, include the continued development of new taxonomy activities (currently work in progress in the EU Platform on Sustainable Finance). Equally, a revision of the SFDR was commenced last autumn. The consultation opened up for potentially changing the regulation fundamentally.

Beyond the above, we see potential for several topics to play an increasingly important role for sustainable finance. One is defence, which the Commission appears to want to mainstream within sustainability to support the sector's access to capital[2]. Closely connected is the strategic autonomy concept which received more attention towards the end of the previous mandate. The question is not only how to transition – but rather how Europe can secure its own transition. Interlinked is the focus on European global competitiveness. Concerns around regulatory burden as a competitive disadvantage mean that future regulatory initiatives are likely to face more intense scrutiny when weighing costs and benefits.

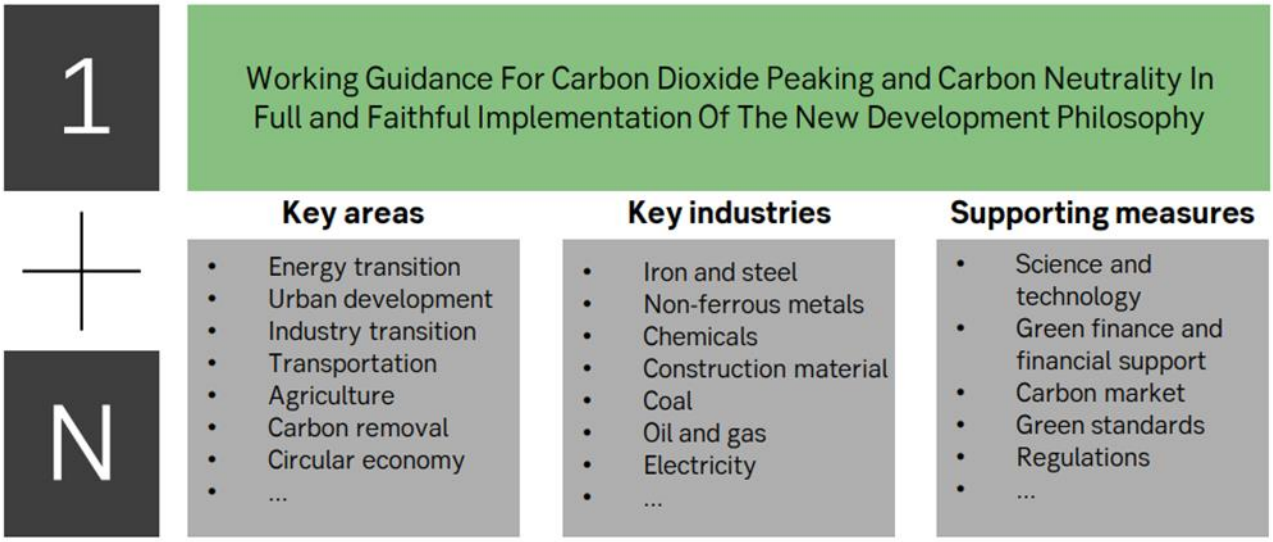
Significant investment needs, for the green transition and defence, may have increased the interest in enhancing European capital markets integration. We may finally be entering into a phase where there is a more common understanding of why this is needed. Finally, as we shift our horizon from 2030 and 2040 where the previous Commission had proposed a 90% emissions reduction target, tough discussions on how to achieve the final and most painful percents of decarbonisation will have to be had. These are only some of the issues to look out for as the formation of the new Commission and its political priorities take form over the next couple of weeks. We will be back with our take on it in the next regulatory update, after the summer holidays.

[2] See the Defence Industrial Strategy.

China's transition plan to reach carbon neutrality

China's 1+N policy framework aims to peak carbon emissions before 2030 and achieve carbon neutrality by 2060. Despite rapid renewable energy growth, coal consumption continues to rise. To achieve its targets, China must increase investments in energy efficiency and industrial electrification, which creates business opportunities for leading global technology providers.

Figure 23 Overview of China's 1+N policy framework



Source: SEB

China's climate policy framework

In September 2020, China announced its targets of peaking carbon emissions by 2030 and achieving carbon neutrality by 2060, the "30-60 targets". In support of these targets, the 1+N climate policy framework was released in 2021. This is China's first overarching policy framework to cover all aspects of mitigating climate change.

The "working guidance" (the "1" in the 1+N policy framework), is an overarching policy document that sets out guiding principles and targets for all relevant policy areas (Link to "Working guidance" and main policy document). It was released by the Central Committee and the State Council, China's top governmental institutions, indicating the high-level endorsement of the 1+N policy framework. The "N" stands for a collection of complementary policy documents that can be divided into action and implementation plans for key areas, industries, and supporting measures.

The 1+N policy framework contains many absolute targets as well as strategies to reduce emissions. However, most strategies are not outlined in detail and expressions such as "push", "strive" and "encourage" are commonly used to describe decarbonization initiatives. It can be viewed as a national guidance for how the policy framework can be implemented at provincial levels, as well as how industries and individual companies in China are expected to reduce emissions.

China has set up a Leading Group on Carbon Peaking and Carbon Neutrality which is headed by China's Vice President Han Zheng and includes many other political heavy weights from key ministries and agencies. Their mission is to support and coordinate the development and implementation of the 1+N policy framework on national and provincial level, as well as monitor the progress towards the 30-60 targets.

Provincial and corporate climate action plans

Based on the national 1+N policy framework, most

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provinces, as well as sovereign owned entities in China, have developed their own action plans on how to support the 30-60 targets. Some private companies, such as Tencent and Alibaba, have also submitted action plans.

Transition of key industries

Direct industrial emissions accounts for 36% of China's total emissions according to IEA. If indirect emissions from electricity consumptions are included, industrial emissions would be more than 60% of China's total emissions. Most industrial emissions are attributed to steel, iron, and cement.

The 1+N policy framework covers areas such as electrification of industrial processes, increased material recycling, and utilization of residual heat. Standards for calculating, reporting, and verifying carbon emissions from major enterprises and for low-carbon materials and products will be developed and aligned with international standards. Energy intensity benchmarks for key industries and industrial products will be tightened.

Targets mentioned in the 1+N policy framework:

- **Cement clinker:** prohibit expansion of total production capacity. Emissions to peak 2023.
- **Steel:** prohibit expansion of total production capacity. 20% of total steel output to be produced with electric arc furnaces by 2030.
- **Electrolytic aluminum**: 30% of electricity consumption shall be renewable by 2030.
- **Buildings:** All newly constructed buildings in urban areas should meet green building standards by 2025. At least 50% of the roof area of newly constructed public buildings and factories should be covered by solar PV.

Reducing industrial emissions through policies

Since the launch of the 1+N policy framework, more than 20 updated policies have been released to support emissions reduction in industries. These policies can be summarized into three main categories:

(1) Industrial structure upgrade

In 2005 China released the first list of industries which are encouraged, restricted, and eliminated. Since the launch of the 1+N policy framework in 2021, many new "green" industries have been listed as "encouraged". In the 2023 list, more than 50 "green" industries were included. These industries (such as energy storage, renewable energy, carbon capture, electric vehicles, and environmental protection) benefit from tax advantages and lower administrative charges as well as financial and permitting support from authorities. Many of these industries are also included in China's list of industries that are "encouraged" for foreign direct investment.

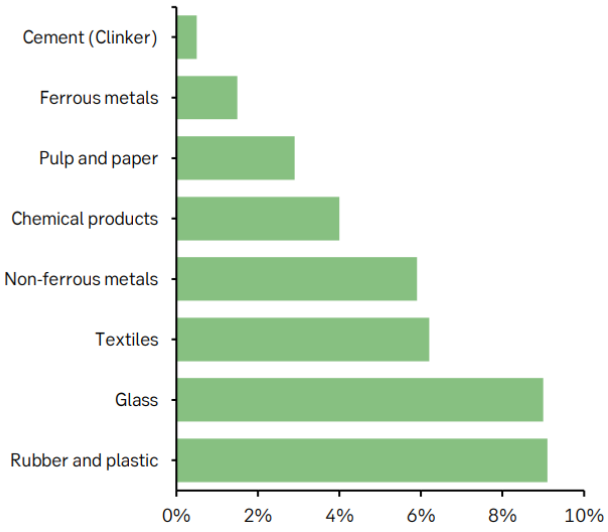
Restricted industries, such as steel, cement, electrolytic aluminum, petrochemicals, and chemicals have a limited room for expansion and any new capacity will need to adhere to stricter energy efficiency requirements.

(2) Controlling energy consumption

Since the launch of the 1+N policy framework, China has introduced many new energy efficiency standards and tightened existing standards. There are now more than 100 national standards for energy consumption quotas and more than 60 for energy efficiency.

In 2021, the Action Plan for Increasing Industrial Energy Efficiency was released, setting broad targets for industries for the period 2021 to 2025 including a target to reduce energy consumption per unit of value added by 13.5% for large industrial enterprises. In 2023, the efficiency targets were expanded to cover 80% of all industry sectors.

Figure 24 Annual increase of minimum energy efficiency standards 2020-2025 (CAGR), selected industries



Source: IEA. NDRC, SEB analysis

According to a recent study by CREA, the energy consumption per unit of value added for large industrial enterprises in China decreased by 2% between 2020 and 2023. This is far behind the ~8% decrease needed to stay on the trajectory towards the 2025 target of 13.5%.

(3) Promoting energy transition & circular economy

Optimizing the allocation of energy-intensive industries to areas where the renewable energy capacity potential is large, is a key measure in the 1+N policy framework. Many factories have already been forced to move to new locations, and many factories may move voluntarily as standards on emissions intensity forces them to relocate to provinces where the supply of renewable energy is larger as well as less expensive.

Targets for recycling and reuse of materials such as construction waste, steel, paper, plastics, and glass have been set on a consolidated national level. By 2030, relevant infrastructure will be implemented in all key industrial parks to support circular operations, and sorting systems for household waste will be implemented.

Energy transition

Coal, oil, and natural gas represents more than 80% of China's energy supply. China is investing heavily to increase the energy supply from renewable sources, and IEA expects China to account for 57% of the globally added renewable electricity capacity between 2023-2028.

The 1+N policy framework covers measures to strictly control new coal power and phase down coal power during the 15th Five Year Plan period (2026-2030), continue to develop utility-scale and distributed solar, wind and hydro power plants, buildout nuclear power, regulate oil and gas consumption, develop the electric power system with increased distribution as well as electricity storage capacity. The Dual Control policy (which sets targets on provinces total energy consumption and energy intensity) will be further strengthened and energy intensity targets will be linked to CO2 emissions.

Table 1 Targets mentioned in the 1+N Policy framework

Renewable energy targets	Status (Q1 2024)
30 GW of new energy storage by 2025 (e.g., utility scale batteries).	35.4 GW
120 GW of installed pumped hydro power capacity by 2030	53 GW
1,200 GW of installed wind and solar power by 2030	1,111 GW

Coal consumption objective	Status
"Strictly and rationally limit the increase in coal consumption over the 14th 5-Year Plan period" (2021-2025)	2021: +4.6% 2022: +4.3% 2023: +4.9%

In 2023 alone, China added 216 GW of solar PV capacity and 76 GW of wind power capacity, representing a y-o-y growth of over 60%. To put it in context, China added as much solar PV capacity in 2023 as the entire world did in 2022. However, China's transition from coal power to renewable energy is yet to materialize. China's National Bureau of Statistics indicates that China's coal consumption continued to increase during 2021 to 2023, partly to support the surging electricity demand that increased by around 22% during the same period. Coal power has also compensated for the decreased electricity generation from hydropower, caused by low rainfall since 2022.

Policies supporting China's energy transition

Feed-in tariffs (FIT)

FITs were first implemented in China in 2003 and has been adjusted on a regular basis to promote renewable energy projects. With the rapid decrease in solar PV and wind power deployment and generation costs, most of the national FIT subsidies ended in 2021. However, renewable energy projects may still receive government supported contracts that guarantee purchase of all power produced at a fixed price for 20 years or more.

China's Dual Control policy

Since 2016, China has set annual provincial targets for total energy consumption and energy intensity of GDP, known as the Dual Control policy. In 2021, some provincial governments even ordered factories to cut back operation to allow the province to achieve their Dual Control targets. In 2022, NDRC announced that incremental renewable energy capacity in provinces will not count against their annual Dual Control policy quotas, which provides incentives for provinces to increase their renewable energy generating capacity. Renewable energy rich provinces who have surplus quotas after meeting their target can sell their green electricity quotas to other provinces, which provides further incentives to these regions to continue to develop their renewable energy capacity.

Green finance and financial support of the transition

The 1+N policy framework focuses on improving the evaluation mechanism and standards for green financial instruments such as green loans, equity, bond, insurance, and funds. Financial tools to support carbon emission reduction related investments will be introduced, as well as incentives for financial institutions to provide low-cost and long-term funding for green and low-carbon projects.

Banks encouraged to provide green lending

In 2018, People's Bank of China (PBOC) included green loans and bonds as eligible collateral for its Medium-Term Lending Facility (MLF). As a result, the spread between green and non-green bonds increased, with one study published by the Central Bank of France indicating an increase of the spread by 46 basis points. However, recent studies are indicating that there is no material pricing difference between green and non-green bonds in China.

PBOC has also introduced a green finance evaluation mechanism on financial institutions, where a financial institution's share of green assets in comparison with total assets are measured on a quarterly basis. Green assets are defined in China's Green Industry Catalogue which is the

basis for China's Green Bond Endorsed Project Catalogue ("China's Taxonomy"). PBOC also evaluates how financial institutions implement national and local green financing policies. The intention is to provide incentives for financial institutions to hold higher ratio of green assets.

PBOC's Carbon Emission Reduction Facility
An example of a financial "tool" to support decarbonization is the central bank's Carbon Emission Reduction Facility (CERF), where banks can refinance 60% of loans to eligible green categories at a low interest rate. In the end of 2023, the CERF facility supported a total loan amount of more than CNY 900 billion. As a comparison, the total issuance of onshore green bonds during 2023 was CNY 808 billion.

China's green bond market
China was the first country in the world to release a green taxonomy in 2015. Since then, China's Green Bond Endorsed Project Catalogue has been updated several times and regulators have made significant efforts to increase the alignment and interoperability with international standards. The inclusion of green bonds in the green finance evaluation of financial institutions in 2019, as well as the inclusion of green bonds in the list of eligible collateral in PBOC's MLF facility in 2018, have incentivized financial institutions to increase their engagement in the green bond market.

Emissions trading

China's Emissions Trading System (ETS) is a cornerstone of China's transition plan and is expected to make a significant contribution to the 30-60 targets. The national ETS was launched in 2021 and is limited to the power-generating sector. In February 2024, a government official said that the ETS will be expanded "as soon as possible" to additional sectors, such as steel, building materials and nonferrous metals. Once expanded, the ETS will cover 75% of China's emissions. The price per ton of CO2 in China averaged 68.2 RMB in 2023, up 23% compared to 2022. The price has continued to increase in 2024, averaging 86.4 RMB during the first five months. However, the price is still around 6 times lower compared to the EU ETS.

Key takeaways for businesses

Companies with a presence in China will benefit from understanding and following the policy development connected to China's 30-60 targets. It provides important guidance on industries that are prioritized/encouraged and that may benefit from various policy incentives as well as preferential treatment of foreign direct investment. It also provides guidance on industries that are closely monitored, and that may be subject to tighter emissions controls and limitations.

To achieve its 30-60 targets, China will need access to a wide range of essential technologies, services, and equipment. Many of these are specified in China's 2024 edition of the *Catalogue of Industries for the Green and Low-carbon Transition*. International companies operating within these industries have the potential to discover new business opportunities and benefit from an increased local presence.

Will China achieve its 30-60 targets?

There is no doubt that the 30-60 targets are a top priority for China. Renewable energy sources are being deployed at a faster pace than expected, and the 1+N target of reaching 1,200 GW of installed wind and solar power may be reached already this year, 6 years ahead of schedule. China continues to invest heavily in emission reduction technologies and has established market mechanisms to promote "green" industries. In the short run, China's ability to increase the energy supply from renewable sources will be vital. This will allow China to decrease its coal consumption, which according to IEA[3] may fall in 2024 and plateau through 2026.

In the long run, China's ability to invent, develop, and deploy new technologies at large scale to support the transition will be crucial. According to a 2021 IEA report[4], around half of the emissions reductions needed in China between 2030 and 2060 are expected to come from technologies that are currently only at prototype or demonstration phase.

Another key challenge is China's ability to achieve sustainable economic growth and emissions reduction simultaneously. China's investment-driven and manufacturing-intensive growth strategy has been a success story during the past decades, and an enabler for the sustained social stability which remains as a top priority for the Chinese Communist Party. Recent weak domestic demand and overinvestments in some industries pushes enterprises towards exports, with an increasing focus on the Global South following trade disputes with EU and the US. However, Turkey recently announced new tariffs on imports from China, and Brazil has launched a China anti-dumping probe after soaring imports.

If China's economic growth is threatened by weak exports and continued low domestic demand, China's top focus will most likely be economic growth, which risks derailing its progress towards the 30-60 targets.

[3] Source: Coal 2023 – Analysis - IEA

[4] Source: IEA - An Energy Sector Roadmap to Carbon Neutrality in China (2021)

Leveraging AI for a better, faster net zero transition

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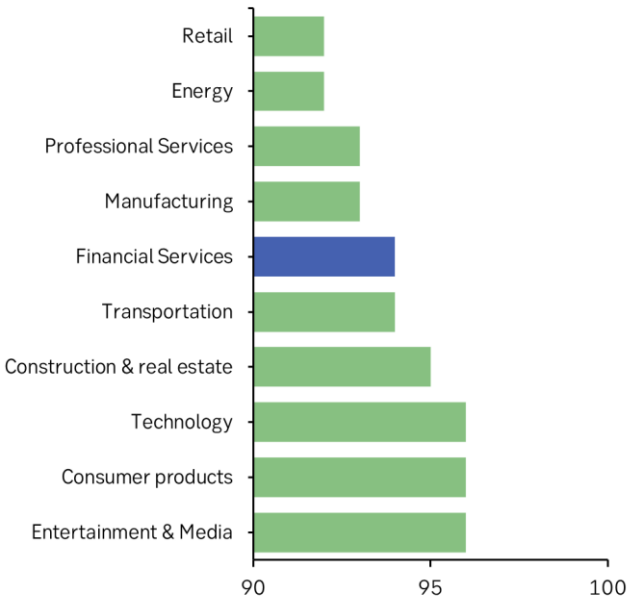
A powerful tool to drive sustainability

Artificial Intelligence (AI) is emerging as a powerful tool in gearing up sustainable finance, offering financial institutions new ways to navigate complex challenges and bolster decarbonization efforts across a wide range of sectors. Leveraging the capabilities of AI can help analyze large quantities of data, improve the accuracy of climate impact and other sustainability metrics, make disclosure a more cost-efficient and comprehensive practice, and foster economic growth while minimizing environmental impact. AI also has significant potential to support risk management—case in point, the BIS and the Monetary Authority of Singapore recently announced Project Viridis, a platform that integrates regulatory and climate data to help financial authorities identify, monitor, and manage climate risks in the financial system, running on an AI-based model.

Many financial firms, are of course, already using AI, specifically generative AI (GenAI), to enhance customer service experience and improve operational efficiency (Figure 25 & Figure 26). For example, McKinsey has estimated that GenAI could add between $200 bn and $340 bn in value annually, or 2.8% to 4.7% of total financial industry revenues, largely through increased productivity. Our 2023 IIF/EY annual survey on the use of AI in financial services, indicated that 86% of survey respondents expect a significant or moderate expansion in their model inventory due to the adoption of generative AI over the next three years (Figure 27).

The game changer for sustainable finance, however, is AI's ability to source and process far larger quantities of data than is possible through strictly human analysis. The financial services industry is data-driven, particularly in sustainability-related analysis, compliance and product development. AI's capabilities to process massive sets of data through increasingly sophisticated methods (e.g. machine learning, large language models for generative AI, and natural language processing) can identify patterns and make predictions that assist in assessing the impact of sustainable investments. This helps financial firms make more informed decisions and better gauge the risk-return profile of sustainable investments— warding off accusations of greenwashing and other reputational concerns.

Figure 25 Number of survey respondents by industry who say they plan to increase spending for GenAI usage (% of survey respondents)

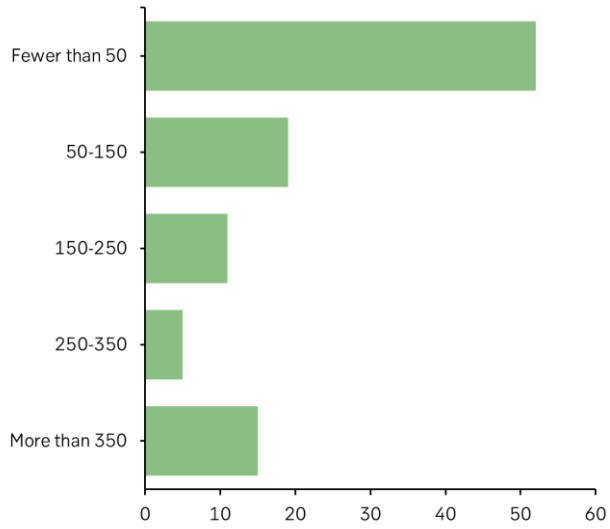


Source: Lucidworks 2023 survey

AI algorithms can improve the accuracy of sustainability metrics, enabling comparability across industries and sectors, building knowledge that could directly impact decisions—notably in areas relating to transition finance

and carbon trading. Improved satellite technologies aid in assessing risks impacting climate, biodiversity, and nature-related factors in long-term investments. For example, a fuller understanding of the environmental impact of carbon offsets enhances the integrity of voluntary carbon credits.

Figure 26 IIF survey respondents' # of AI/ML use cases in current model inventory



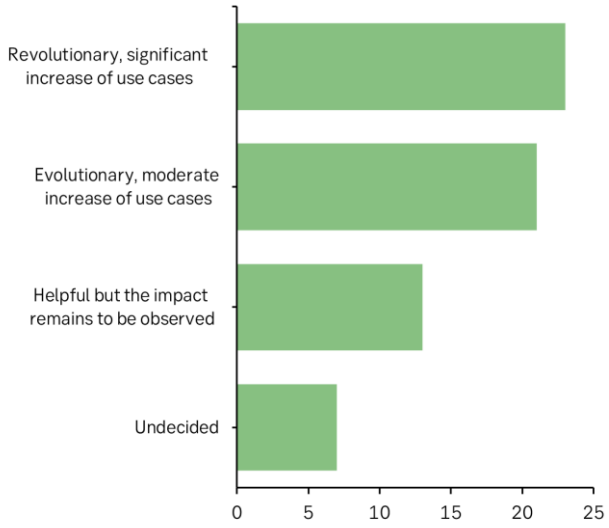
Source: IIF-EY Annual AI/ML Survey

Another case in point: predictive modeling can help fill in the gaps of ESG disclosure, facilitating much more reliable and comprehensive reporting of ESG factors and investment impacts. For example, regulatory changes that might result in cost-intensive updates to software and documents can be assisted by AI technologies that would improve efficiency and reduce costs.

However, the adoption of AI also raises concerns around energy consumption and carbon emissions, the substantial computing power required for AI technology consumes large amounts of electricity (Figure 28). The IEA estimates that data centers, cryptocurrencies, and AI consumed almost 2% of global energy demand in 2022, and that number could double by 2026. However, efficiency improvements (including AI's potential to help improve energy consumption) could lower AI's overall carbon footprint in the medium-term. Another environmental concern around AI is water consumption, highlighting a need for transparency in light of global concerns over water crises.

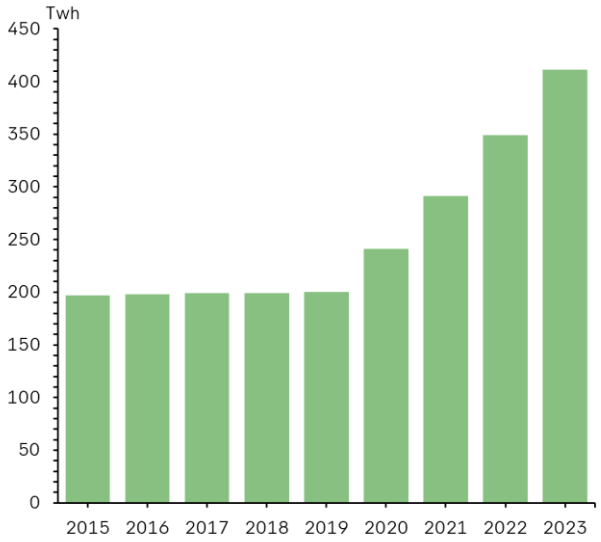
There are also concerns about data integrity as AI's effectiveness hinges on the quality of the data it is trained with, posing risks of perpetuating biases and creating flawed outputs if data sources are inaccurate or non-representative. Data privacy and sharing are also areas often scrutinized, particularly as firms are often reliant on third parties for accessibility to AI technology and output.

Figure 27 IIF survey respondents' views on how GenAI and technology may impact their business



Source: IIF-EY Annual AI/ML Survey

Figure 28 Data center power demand has steadily increased since 2020 – by 2028 analysts expected AI to make up about 19% of total data center power demand



Source: IEA, Goldman Sachs Research

Despite these concerns, the intersection of AI and sustainable finance represents a powerful and transformative force in addressing global challenges related to climate change. By harnessing the power of AI, financial institutions can promote responsible investing, mitigate risks, and contribute to a more equitable and sustainable net zero future.

Utilising AI as a green transition enabler

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Driving sustainability through the product offering

With over 160 years of metallurgy expertise, Alleima is a global manufacturer of high value-added products in advanced stainless steel and special alloys, as well as solutions for industrial heating. The company has leading market positions in niche markets and is naturally diversified, being exposed to different stages of the business cycle, and products to be used in a broad array of application areas.

Figure 29 Alleima stainless steel and special alloy production

Source: Alleima

Sustainability is an important part of the strategy and is permeating the entire value chain, from recycled steel used in production to the superior properties of the end-product. As of 2023, the rate of recycled materials used in Alleima's production amounted to 80%, while about 96% of its electricity use was fossil-free. While constantly working for further improvements, Alleima's greatest contribution to a sustainable future is through its product offering.

The company has a clear strategy to grow within sustainable segments, one example being electrical industrial heating solutions. Heavy industry currently accounts for about one-quarter of global greenhouse gas emissions. According to the World Economic Forum, these emissions need to decline by 93% to achieve net zero by 2050. A large share of the emissions is derived from the heating process. As 75% of the world's industrial furnaces are fossil fuel-driven, electrification of these processes is a prerequisite for net zero, which plays well with Alleima's offering for sustainable heating solutions.

Alleima Guru – shortening lead time to tomorrow's technology

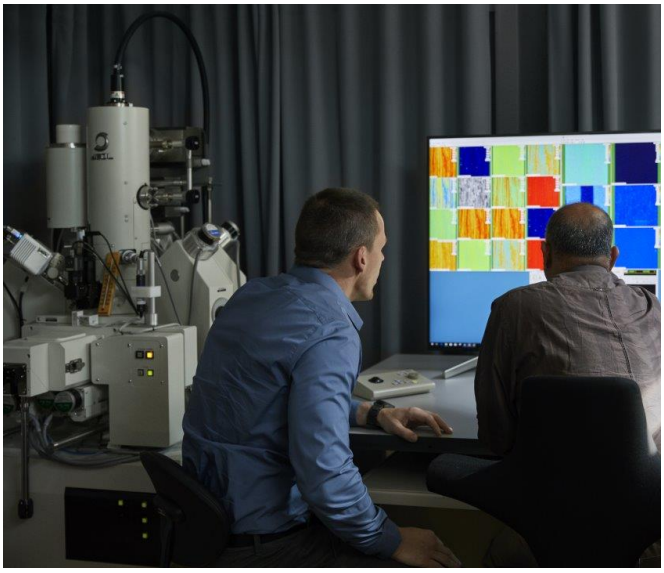
Alleima has weighted more than 50% of its R&D budget towards industries enabling the green transition such as hydrogen, renewable energy and electrical industrial heating. At the same time, improved sustainability through safer and more durable end-user products is a key driver throughout the whole product offering. As a materials innovator and technology leader, the company has introduced the Alleima Guru, an advanced solution powered by a Large Language Model (LLM) and other AI tools.

The Guru is designed to leverage the capabilities of an LLM to enhance R&D efforts. Its primary aim is to integrate and utilise an extensive repository of some 60,000 documents, including research papers, technical reports, and patents that Alleima has amassed over more than a century of alloy and process development.

By significantly improving the efficiency of data retrieval and analysis, it reduces the risk of "reinventing the wheel,"

where a lack of knowledge about existing solutions leads to redundant research efforts. This integration is expected to facilitate quicker problem-solving, streamline the onboarding of new researchers, and reduce dependence on key personnel.

Figure 30 Alleima Guru being used to shorten R&D lead times



Source: Alleima

Key functionalities of the Alleima Guru include its ability to connect with and draw insights from R&D reports dating back to Alleima's early years. This capability ensures that even the oldest, yet still relevant, research can be utilized effectively. For instance, information about alloy properties and production processes from decades ago can be easily accessed and applied to current projects, potentially accelerating innovation and improving the quality of new developments.

It also includes advanced content search, document localization, summarization, comparison, and hypothesis generation. These features not only make it easier to locate specific information but also to understand and utilize it in a broader context. For example, the Guru can generate hypotheses based on existing data, aiding in the formulation of new research directions and facilitating the brainstorming process among researchers.

After a successful proof of concept on a smaller amount of data for one specific product, the Guru will go live at the end of June connected with the full scope of R&D related documents. This milestone marks a significant step forward in Alleima's journey towards integrating AI into its core operations, highlighting the potential for AI to revolutionize the way research and development is conducted.

Only the beginning of what AI can offer

In addition to enhancing R&D efforts with the Guru, Alleima is currently investigating another platform to implement advanced analytics and AI into several steps of the production.

Production process improvements is another example of where AI can be applied to. By analyzing data from the production process in real-time, anomalies and potential defects can be detected earlier, allowing for immediate corrective actions. This not only improves the quality of the final products but also reduces the amount of scrap and rework, contributing to a more sustainable production process.

AI can also play a crucial role in predictive maintenance. By continuously monitoring the condition of equipment and analyzing performance data, AI can predict when maintenance is needed before a failure occurs. This proactive approach can help avoid unexpected downtime, extend the lifespan of equipment, and reduce maintenance costs.

The list goes on, and the possibilities seem endless. As the potential continues to be explored, Alleima is committed to ensuring that these technologies are implemented responsibly. This includes addressing ethical considerations, ensuring data privacy, and promoting transparency in AI-driven decision-making processes.

In the future, when Alleima has made theoretical knowledge accessible and processable within the Guru, and actual production data consolidated in a Data Platform, the synergy of these data sources combined with artificial intelligence and advanced analytics tools will significantly accelerate the company's development of new advanced materials and products. This integration will not only enhance innovation and problem-solving capabilities but also further strengthen Alleima as a leader in material science and technology, shortening lead times to tomorrow's technologies.

Unleashing AI

The catalyst for systemic transformation

Through autonomous vehicles, humanoid robots, and novel renewable materials, etc., AI holds the potential to become the first major catalyst for systemic transformation, ushering in a paradigm shift from ownership to usership of physical goods and products – prospectively enabling the incentive change needed for a globally scaled circular economy.

Since the start of the Industrial Revolution, the core economic incentive when making physical goods and products has intrinsically been built on the maximization of the number of units sold to customers, as well as the minimization (optimization, alternatively) of their lifespans, where short product lifespans encourage customers to make frequent repeat purchases. The economic incentive is based on units and linearity. Through the combination of autonomous vehicles, humanoid robots, remanufacturing, and renewable materials – AI could become the needed catalyst for a paradigm shift towards an economic model based on access and circularity.

Since the turn of the Millennium, we've seen previously unquestionable physical products convert to being fully digital. The Software-as-a-Service (SaaS) model now dominates most informational sectors worldwide. The access-based business model proliferated in the digital world when ones and zeros reached a state of near-zero marginal cost and became "renewable". For providers, this model resulted in higher earnings, whether through profits or increased valuations. In essence, the core digital manufacturing incentive changed, and then the global market changed.

In the *physical* realm, however, the access-based business model is still in a miniscule state. We make units of products for customers to buy and consume. The reason for this is quite simple. Material input into physical activity is inherently not easily accessible from anywhere, not close to being near-zero marginal cost, and certainly not renewable. Products are made to be purchased and consumed by their owners.

Globally, this linear unit-economics model is the strategy that management and boards strive to perfect. It's a game of units, not a game of service (or access). In this game, both manufacturers and their retailers need to make products at the location where it's most cost-efficient, and then the products need to be distributed swiftly to customers all over the world. Offshoring has exploded since the start of the 1990s, and offshoring means that the feasibility to refurbish and remake physical products has diminished. Supply chains have gotten much longer in distance and in turn also diminished the ability to standardize parts that go into products so that they are easily replaceable and remade.

The main point is that it seems irrational not to engage in the linear unit-economics model from most perspectives. Products must be affordable, or manufacturers risk losing market share. This necessitates factories in low-wage countries. The linear model is inherently rigid and resistant to change. In order to change this rigidness, there needs to be something economically better than the unit-economics model.

The collective power of disruptive innovations

All throughout history we've seen disruptive innovations transform marketplaces because they offered the "job to be done" (the customer value) in fundamentally novel ways. For example, the telegraph outperformed physical message delivery. Computers were better than manual systems. The first, second, and third Industrial Revolutions formed into distinctive iterations of what gives their names – through the convergence of disruptive innovations. When new innovations come together, they support an aggregate change on a global scale.

Despite the constant increase of innovation, the linear manufacturing model has not changed. This persistence is due to recent disruptive innovations making the linear model more efficient. For example, e-commerce greatly accelerated offshoring. Efficiency has made the linear model more rigid.

Enter *Artificial Intelligence*, the most impactful technology offering the next era of human evolution.

Christopher Lyrhem

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AI, as a general-purpose technology, promises to enable a circular economy and fundamentally rewire global manufacturing in the coming decades. If this turns out to be true, the impacts on most sectors will be profound and is hence vital to explore.

Historically, when systemic change proliferates – the change is not in a vacuum, it is the result of several disruptive innovations building and enabling it. Things always build on top of each other.

We are witnessing the start of a domino effect, beginning with cost-efficient smart sensors now widely installed in physical products. Smarts sensors can now track physical activity at an order of magnitudes higher level than only 10 years back. This capability has led more companies to experiment with the access-based "Product-as-a-Service"" model. While some companies have long adopted this model, the vast majority have not. This model can be placed into the umbrella term "usership" (instead of ownership of physical products).

All products to become robots

Furthermore, only over the past couple of years, we've seen an exponential rise of AI's ability to execute human-like behavior, and even significantly surpass it. AI can now generate text, images, video, audio, and even code. The pace of improvement is unlike anything we've ever seen and in the coming years we will witness AI to take on the human senses so that it is able to not only execute tasks within the digital realm, but also out in the physical.

When paired with smart sensors, AI can transform any product into a utility-generating robot. Products can now perform tasks that we tell it to do. In other words, we're starting to see the Play-button arrive in the physical world. Pressing Play on products to paint our walls, clean our houses, weld components together, and even drive us where we want to go.

When products gain the ability to perform tasks autonomously, it unleashes the ability to sell the product as a service, instead of only selling it as a unit. From ownership of units, to usership of access. In other words, we pay for the utility to be performed, not the unit itself.

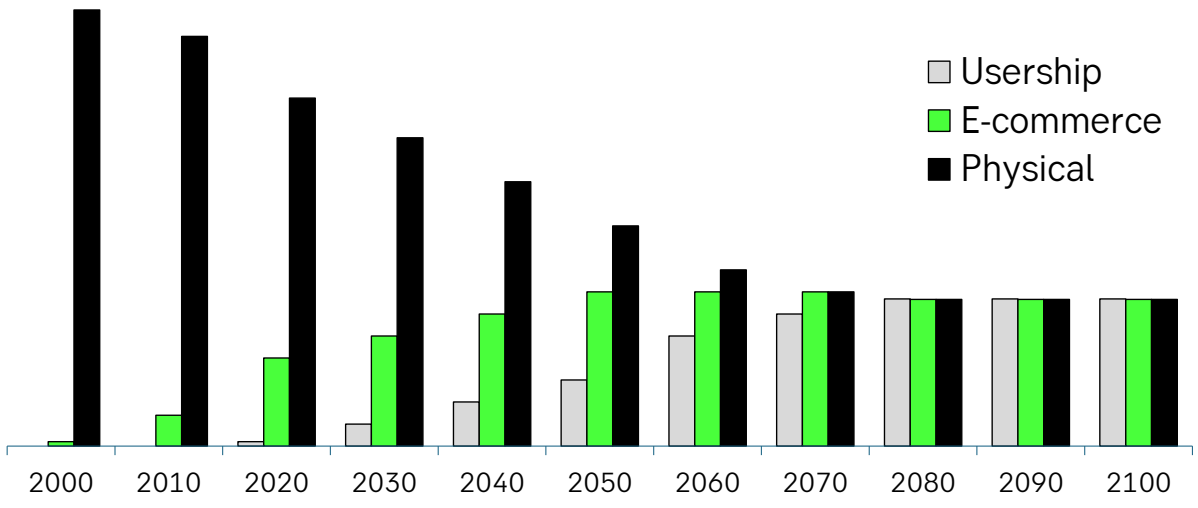
Further, when manufacturing companies start selling physical products as a service (on a proliferated global scale), managements and boards across sectors, countries, and continents – could (prospectively) raise the question of making the lifespans of the products longer. This is because when you place a product into a marketplace and it earns revenue multiple times, not only one time – you want that product to last as long as possible.

The economic rationale could hence change from minimized (or at least low) durability over time, to maximized durability. Such outcome starts with designing a product for durability a long time before it's made – which in turn will require an increase in quality of material input. When a product is subscribed to by its user – the maker wants that product to last as long as possible.

Let's take the car as an example. As cars become autonomous in the next few years (as indicated by Tesla, Amazon, and Alphabet), customers will be able to summon them with a click of a button. No matter where they are, it will arrive at your feet and deliver you securely to wherever you want to go.

Figure 31 The prospective shift from ownership to usership could take off in the coming decades

(% shares of total commerce)



Source: Christopher Lyrhem, SEB, Regenerate the Economic Machine

This will by most likelihood diminish the prevalence of personal car ownership. We don't need to own a car unless we want to. Some of us will instead subscribe to autonomous mobility services and share cars with other people. For the manufacturer of such autonomous cars, the economic rational will be to produce the cars with high durability – and in the long-term, even design it for remanufacturing (remaking it to its' birth state).

This could be the incentive change we need in order to curb global carbon emissions, because people change when incentives change. People rarely change due to new directives and regulation change, and change is most often sprung from inventions.

Humanoid robots: redefining the workforce

The impacts AI could have on manufacturing and consumption is not only circled around the business model, but also in terms of how we actually make products. Just like all products will be able to become robots to various capacities, the equipment and machines within factories that make these products – will also become dexterous beings, able to take on a lot more tasks than today. So far, we've seen a massive increase in industrial robots that are programmable to certain tasks. However, they are bulky mechanical animals that cannot evolve.

Moreover, there is a new breed coming, in the form of Humanoid robots, which are dexterous and can be upgraded so that they understand what to do even if the problem is novel for them. Humanoid robots have seen a massive increase in investments over the past few years and the number of manufacturers is now well above 30 – predominantly from the US and China. This application segment of AI is still a quite underappreciated segment, because it's not only about the technological progress itself – it's also about macroeconomics and demographics.

Firstly, when Humanoid robots are equally as good as humans on low-skilled manufacturing jobs, the cost advantage low-wage regions hold over high-wage regions could diminish. Perhaps even eliminated, because Humanoid robots will be able to do a quite high share of what human labor can do, and will be able to do it without sleeping, breaks, vacation, and even insurance – at a much lower cost. This could hence improve the economic rationale of having a factory close to the point of consumption, close to the customers that use the products.

Secondly, declining birth rates and an aging population in both developed and developing countries can result in fewer manufacturing workers per unit of economic output. This creates a need to use AI and robotics to maintain productivity and economic growth in a competitive global economy. Thus, the integration of robots into the workforce is not just about technological progress but also a response to demographic challenges.

Artificial material discovery

There is one major piece left in order to create a global society where manufacturing is local, and remaking has become the name of the game. Specifically, the development of materials that can be perpetually renewed and reused. Since Google DeepMind released their finding over almost 400,000 potentially novel materials, discovered by their AI-models, the theoretical endgame scenario for novel materials replacing traditional materials – has shaped up as a potentially transformative factor in increasing the current 7% global circularity level (source: Circularity Gap Report 2023).

AI could revolutionize the core structure of the global manufacturing footprint. Discovering cost-efficient, renewable materials would reduce the need to purchase virgin materials from specific regions. Historically, we've always replaced traditionally used materials with novel materials. Plastics, advanced metal alloys, and cement, are each an example of this. Renewable materials that can be continually remade would greatly enhance the economic feasibility of local manufacturing.

Companies that sell physical products would have the ability to service their customers through their balance sheet (or third-parties), where the material is placed and serviced onto customers through the balance sheet – as opposed to the current model where depletive materials flows through both the balance sheets and income statements. It could be a fundamentally new way to structure economic activity and financial models.

Autonomy on wheels – A driver for the sharing economy

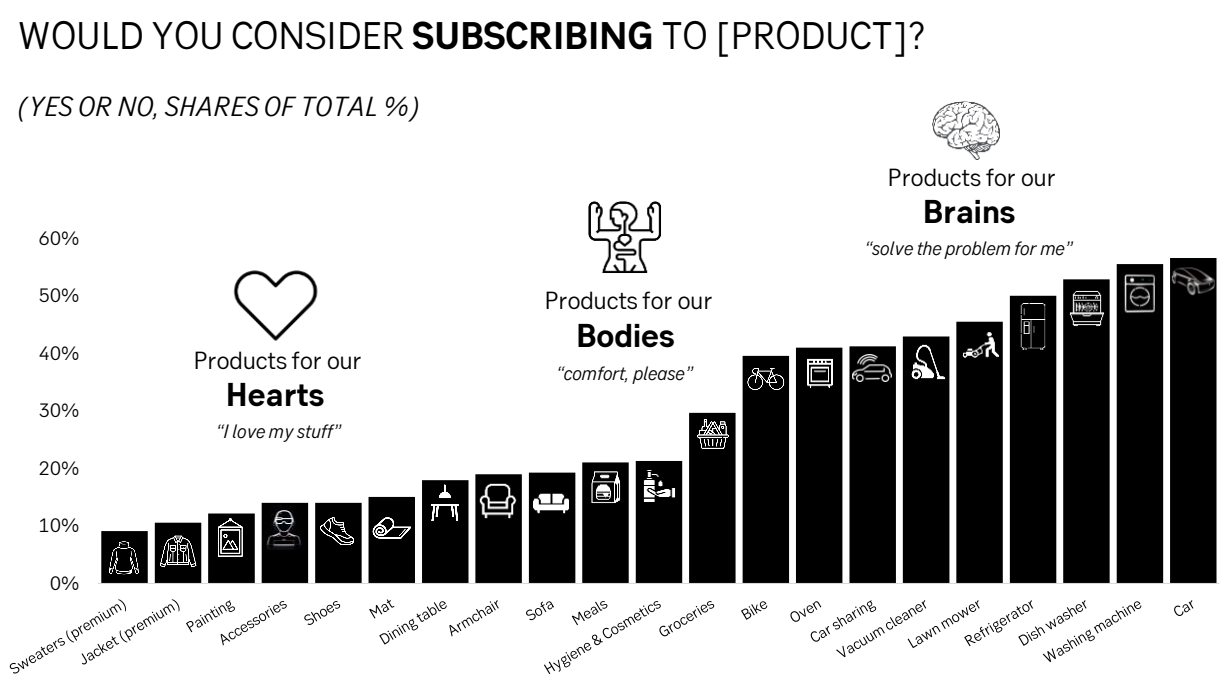
There is also a fourth impact of AI looming on the horizon. This impact is distinct from the previous three and may be more relevant in the next 3-5 years, compared to the 5-10 year timeframe for the others factors mentioned above. Namely, autonomous mobility as a catalyst factor for the sharing economy (usership in other words). When autonomous cars proliferate in society, they will be able to move products with very low marginal-cost, as well robots and materials. Seamless movement of physical objects in an interconnected system could scale the first three impacts.

Once autonomous vehicles arrive, the 80% share of the logistical cost that is human driving – can be diminished substantially, and the availability of logistics could increase exponentially. For example, whenever an owner of a product (private or corporate) wants to re-sell or rent out a

product, they will be able to do so by the click of a button, whereby an autonomous vehicle arrives and takes itself to the next buyer or renter.

Autonomous mobility could create a next mile-delivery infrastructure. Not only the last – but the next. Such infrastructure could serve as a general-purpose platform for any manufacturer or reseller of physical products. This enables them to sell products and earn a profit when the customer resells it – or rent them out. Currently, this poses a significant challenge for companies adopting a Product-as-a-Service model. This is because when customers unsubscribe (stops paying for usership), it is quite the hassle to move the product at hand to another customer, especially making profits from it. Autonomous vehicles can hence become a proponent for the sharing economy – which helps change the core economic incentive, from volumes to access.

Figure 32 SEB Subscription Survey 2023



Source: SEB Subscription Survey 2023 (from Regenerate the Economic Machine)

Furthermore, in our SEB Subscription Survey 2023 (from Regenerate the Economic Machine), we found that the prospect of the car becoming a pioneering product category for usership – is very high. In the chart above, we have compiled the binary yes-and-no responses on the question: "*would you consider subscribing to the following products*"?

The data clearly concludes that products that solve a problem for us are filled with high share of electronics to a relatively high-ticket price – are more prone to partly convert from ownership to usership. Meanwhile, products that design our lives (bodies and homes) are not prone to convert.

Final thoughts – Expect the unexpected

In economic terms, the physical world is an order of magnitude bigger than the digital world (5 times to be exact). AI's application value will likely reflect the current global GDP composition (85% physical, 15% digital), making AI in the physical world highly relevant. Moreover, AI's ultimate impact in the physical world will be to disrupt the linear manufacturing model, replacing it with a circular model, rather than merely improving efficiency.

Efficiency innovations have so far, and will most likely continue to, not curb global greenhouse gas emissions, especially as the global middle class is expected to grow another billion in the current decade (from 4 today to above 5 billion) and prospectively upwards of 3 billion more people by the year 2050 (to almost 7 billion) if current trajectory prevails. Meanwhile, the global population is expected to increase from today's 8 billion to 10 billion during this time period.

Therefore, disruptive innovations will likely be a lot more effective than perfecting the current economic architecture and model. The avoidance of consumption is critical and the usership economy is a vital factor (especially the sharing subsegment) – and AI is a key to unleash the incentive for this.

My main argument in this article is that AI is essential for disrupting the current linear and wasteful economic model,

a view that differ from most economists. This conclusion is based on extensive research on disruptive innovations, customer surveys showing a preference for usership, manufacturers' interest in usership models, and the urgent need for a global circular economy.

For this to proliferate, we need a business model that is more lucrative than the current model. It's all about creating the right incentives. Companies need an economic upside in order to forcefully transform their factories, supply chains, logistical infrastructure, sales organization, and the way they create customer value. AI is a core proponent for such transformation.

In the next 10 years, the physical and digital worlds will be able to fuse together when the pairing of smart sensors and AI proliferate in society. Physical products will autonomously solve customer problems more effectively, adopting successful business models from the digital realm. The streaming services of prior physical products will enter the bigger physical realm and make streaming a prominent choice of business models. We all desire the simplicity of pressing a play button to eliminate problems and focus on what truly matters, and when adding Humanoid robots, autonomous factories, and novel renewable materials to the mix – the outlook for reshoring and a shift towards a globally scaled circular economic incentive is more than intriguing.

Expect AI to lead to the *unexpected in* the manufacturing world.

This article is based on the report **Regenerate the Economic Machine** (link).

You can find a presentation material of the report in this link

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