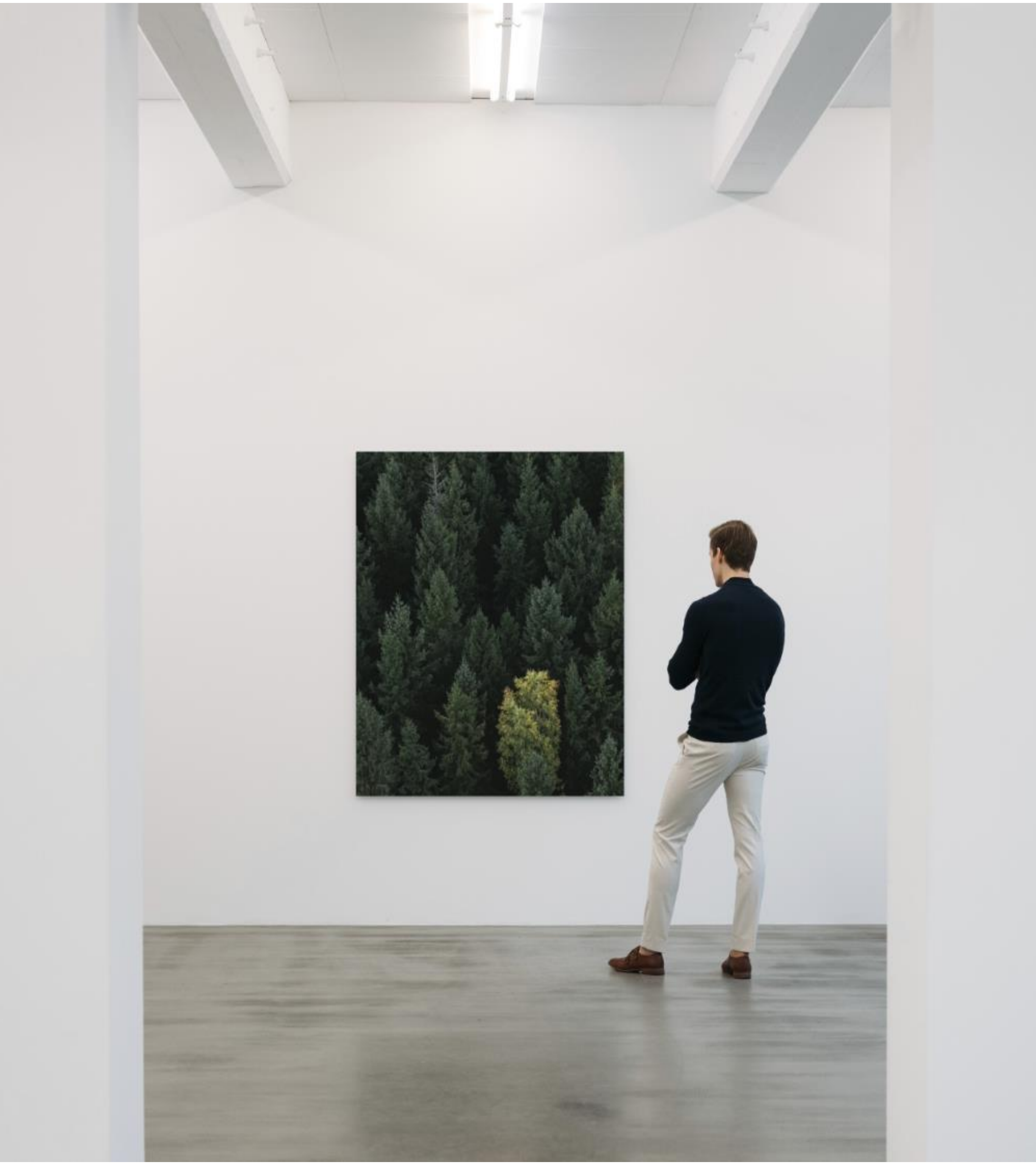
Climate & Sustainable Finance Research whitepaper: Capital replacement and transition arbitrage



January 2021

Investment case: transition arbitrage

In this white paper we look at the climate crisis as a capital replacement problem. Energy is a necessity and we can only withdraw fossil supply when a better alternative is in place. Renewable energy is ready but completing the transition by 2050 will require massive amounts of capital. A valuation gap between old and new assets, amplified by regulation, will drive capital to where it is needed, creating opportunities for transition arbitrage in capital markets. The main recipients of capital are described in Figure 1.

Green utilities. The primary energy sector has passed the tipping point and the repricing of capital is well advanced, even if we will still be using oil and gas for at least 20 more years. Green pure-plays command higher valuations, and the market opportunity in this segment is to identify companies that move faster towards renewable production. Oil and gas sector asset valuations are likely to decline further, limiting access to transition funding.

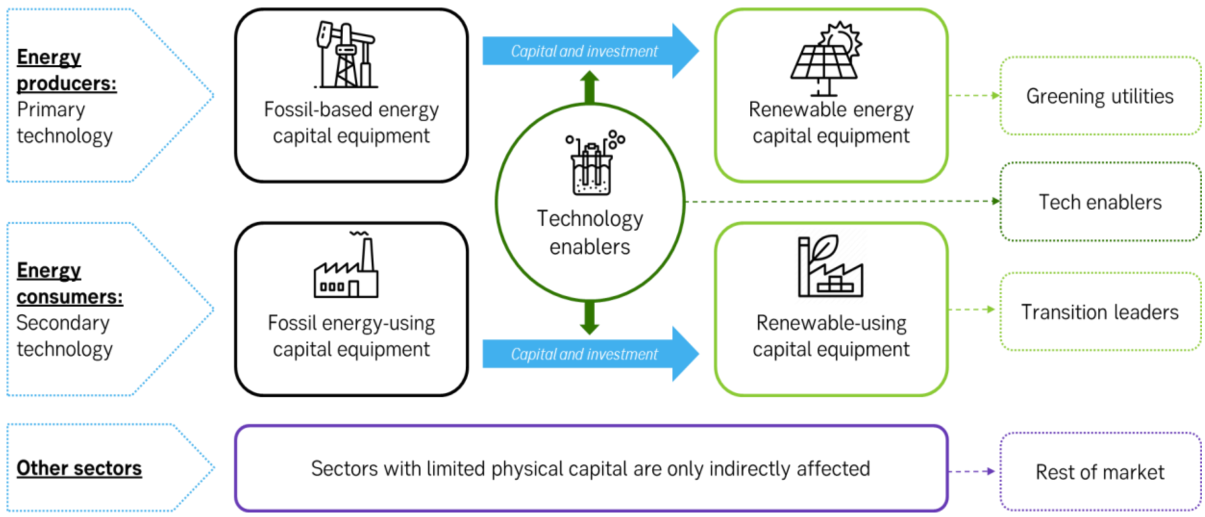
Technology enablers. Next in line are companies that supply key inputs for the transition. Outside energy, this is the only place where you can get high taxonomy alignment today. Suppliers of Power-to-X technologies, zero-emission vehicles and ships and other types of capital equipment that replace fossil input are likely to command high valuations. These are reflections of the potential for growth by orders of magnitude. The investment strategy is the same as for IT enablers: buy a portfolio in order to spread the valuation risk.

Transition leaders. Among industrial energy users, the cost tipping point has not been reached in any sector. In most sectors, zero-emission technologies appear to be at least a decade away from being profitable, even if most are developing pilot projects. However, as the cost of renewable energy declines and policymakers intervene, the tipping point could move forward. The opportunity here is to provide capital for transition leaders in each sector that benefit from a widening gap in valuation, profitability and growth.

The rest of the market. Sectors with low energy consumption only face indirect effects of the transition. Intensifying competition for capital will push yields and default risks up, and monopoly regulation will reduce large cap tech profitability. Banks will be exposed to transition risk because transition leaders are less likely to default and more likely to have obsolete collateral. All sectors, including banks, must report full supply chain emissions when scope 3 regulation comes into effect.

Capital market innovation. Financing an accelerated transition will require outside capital. Capital markets will play a key role in raising and allocating funds, and the EU Taxonomy offers a blueprint for allocating it. In 2021, more than USD1trn is likely to be raised from sustainable bond issuance. Equity markets will raise capital through IPOs and secondary offerings earmarked for transition investment. Sustainable financing will help mobilise the capital.

Figure 1: Transition arbitrage - exploit the gap between old and new capital



Source: SEB

Capital replacement and transition arbitrage

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Summary: Capital replacement and transition arbitrage

The Covid-19 pandemic exposed the fragility of our production model and paved the way for a radical policy regime change. We now have two possible ways forward. If we stick with conventional policy, debt deflation and climate crisis fears may yet be realised. However, if we break with convention and see the full range of policy tools at our disposal, the crisis is an opportunity to make our economy more sustainable and resilient. An accelerated renewable energy transition could achieve this goal, but it will require that we invest heavily in new clean technologies.

Capitalism's problems: pollution, poverty, power
The IT revolution has so far followed the same S-shaped diffusion pattern as earlier industrial revolutions.

New general-purpose technologies (GPTs) generally spend 30 years in incubation before they reach the cost-parity tipping point and the capital replacement cycle starts. The first 30 years of disruption is the 'gilded age', where falling prices for the new technology allows it to dominate and side effects emerge in the shape of inequality, monopoly power and environmental damage. Historically, regime changes involving social reforms, monopoly regulation and environmental protection have been needed to complete the diffusion in a golden age.

Like its predecessors, the IT revolution that took off in the 1980s has increased global living standards, but the negative side effects are becoming increasingly clear. Rising inequality threatens social stability, soaring debt undermines financial stability and the climate crisis is worse than any past environmental problem. Negative interest rates and extreme debt levels were already signalling policy failure before the pandemic occurred.

Three reasons why we need a regime change now
The structural problems that need to be addressed before the diffusion can be completed relate to the IT-enabled 'platform-based' global supply chain model. This has essentially allowed a vertical disintegration of supply chains, shifting basic production to cheap, less regulated economies, displacing jobs and allowing platform owners to capture a larger share of profits.

<u>Climate crisis</u>
The climate crisis is the most pressing of all problems, and this is partly due to a historical accident. Nuclear power was in line to be the next energy source, but due to some serious accidents, the development was halted in the 1980s. The rapid industrialisation of Asia and increased transportation was thus powered by the energy technology of the last revolution. This has resulted in an unsustainable increase in global CO_2 emissions and temperatures as well as a range of other serious environmental issues. This includes access to clean water, biodiversity and extinction of species.

The long-term implications of the current level of CO_2 emissions are severe, but any solution also needs to address the other side-effects of the IT model: the chronic excess of saving over investment, which has driven real interest rates to unprecedented lows.

<u>Social stability</u>
The displacement of low-skilled jobs from Western economies due to automation and globalisation has weakened the bargaining power of workers, resulting in a significant increase in income inequality. At the same time, large capital gains caused by falling interest rates has led to increased wealth disparity. This concentrates income in the hands of the wealthiest, who have the highest propensity to save. Rising inequality poses a threat to social and political stability, and the lack of demand ultimately threatens financial stability.

<u>Under-investment</u>
The other structural problem is weak productivity growth caused by low corporate investment. This is happening despite high aggregate profits and rising corporate debt, suggesting he root cause is increasing concentration of profits in the hands of platform owners. The most successful companies today have high profit margins and plenty of cash but do not own the physical capital. The companies that operate the physical capital stock have low margins and limited access to capital.

Energy transition can solve all three problems
Any solution must address all three interlocking problems, but there is no doubt that the most pressing requirement is that it must involve an improvement of energy efficiency. The transition to a clean energy system is the obvious candidate: it can reduce GHG (greenhouse gas) emissions, boost investment, create jobs and raise wages – and do it all at the same time.

30 years after Chernobyl, wind and solar power is now cheaper than fossil alternatives and they follow the same pattern as disruptive technologies in the past. This means that the faster supply is expanded, the faster the

cost comes down. Shifting to renewables is an economic gain, and the rewards will keep getting bigger as the diffusion continues. However, transition to a new core technology input is complicated. It is not enough to produce clean electricity; we also need to develop new ways to use it and replace all the capital equipment where fossil fuel input is embedded inside.

Faster transition is not easy
Accelerating a technological transition is complicated. First, substantial investment is needed to boost the supply and reduce the cost of zero-emission electricity and upgrade grid capacity. These technologies are already cheaper than the fossil-based alternatives, but it will take decades before they can deliver the same amount of energy as fossil fuels do today. Energy is a basic necessity, and it is thus crucial that existing supply is withdrawn at the same pace as new supply emerges.

An even bigger challenge is the transition for users of energy. Most production sectors use technology that cannot easily be converted to electricity input, and the technologies available today are very expensive. We cannot build the new energy infrastructure requires input from those sectors, so they must continue operating while new production technologies are developed.

This kind of innovation not only requires a lot of capital, which is not in unlimited supply, but also requires time-consuming experimentation and learning-by-doing. For the companies involved, it is costly and there is a risk of ending up with obsolete assets if you get it wrong. It also requires coordination across the supply chain to ensure that all components are ready at the same time. To accelerate the transition, economic policy must address all these concerns at the same time.

Capital replacement: a historical illustration
We illustrate a generic technology transition process with a historical example: the transition from horses to tractors in the first half of the 20th century.

The supply of horses reacted early. The total number of horses remained high at first as tractor production volumes were low and prices high. Tractors also required a whole value chain with petrol stations, equipment, mechanics, workshops and buildings. However, the breeding of new horses declined and the average age of horses at work rose immediately.

Financing for tractors came from the cash flow that was freed up by the reduced investment in the old capital stock. The Great Depression slowed the transition by reducing farming incomes relative to the cost of tractors. On the other hand, the sharp increase in wages after the war made investment in new capital more attractive.

EU blueprint for a new policy regime
How can we then accelerate the transition without a collapse in living standards? Our analysis suggests that a successful policy regime must:

1. Mobilise capital for direct investment in green energy production

2. Subsidise the development of supporting technologies like storage and distribution

3. Let market forces determine the allocation of capital, but subsidise innovation

4. Maintain cashflow from current technology, but direct it towards investment in new technologies

5. Provide guidelines for acceptable activities to facilitate this reallocation of capital

6. Incentivise vertical collaboration in development of new zero-emission supply chains

The EU Action Plan for Financing Sustainable Growth, and the Taxonomy regulation platform tick all the boxes and will in our view be the blueprint for global transition.

How capital markets support transition
From a capital market perspective, the regime change is likely to coincide with a low point for bond yields and a rotation towards value stocks as competition for capital and labour intensifies. However, not all value stocks will be winners of the transition.

Our investment case for 'transition arbitrage' assumes that energy transition must involve a replacement of almost all existing physical capital. This will be driven by a repricing of capital, which creates opportunities for arbitrage. The timing of this repricing will depend on when zero-emission alternatives become feasible. Energy and autos were the first sectors to reach this point, but others will follow. We should also see a wave of new technology enablers facilitating the transition. In an accelerated transition, the cash flow from current operations is unlikely to finance the investment.

Capital markets will play a key role in raising and allocating funds, and financial innovation is likely to be an important driver. Green bonds have already been an important source of capital for more than a decade, and new types of sustainable financing debt are emerging. Ultimately, due to the long time-lags involved, we suspect that equity markets must also return to their old role as a source of capital for investment.

The global market economy faces another systemic crisis

The past 250 years of industrialisation have seen a series of industrial revolutions, where clusters of new GPT combine to change production models. These all follow the same S-shaped pattern of diffusion with three distinct phases. Each phase takes around 30 years to complete (Figure 2).

It takes 30 years for a new technology to become competitive without subsidies. This is followed by 30 years in a 'gilded age' of disruption, which ends when side-effects of unregulated disruption emerge, typically in the shape of monopolies, poverty and pollution cause a systemic crisis. At this point, capitalism has in the past reinvented itself, competing the diffusion in a golden age that also lasts around 30 years.

This is embedded in the process. Disruptive technology shocks displace workers, making old skills obsolete and increasing income inequality. They create new kinds of natural monopolies that regulators are not prepared for, and they result in new kinds of environmental damage that did not exist before.

As a result, all industrial revolutions involved what now is known as ESG reforms. Regulation has changed corporate governance and labour conditions. Income redistribution has dealt with social instability, while environmental regulation and public investment in infrastructure like sanitation, sewage and transportation have dealt with environmental side effects.

Regime change and investment returns

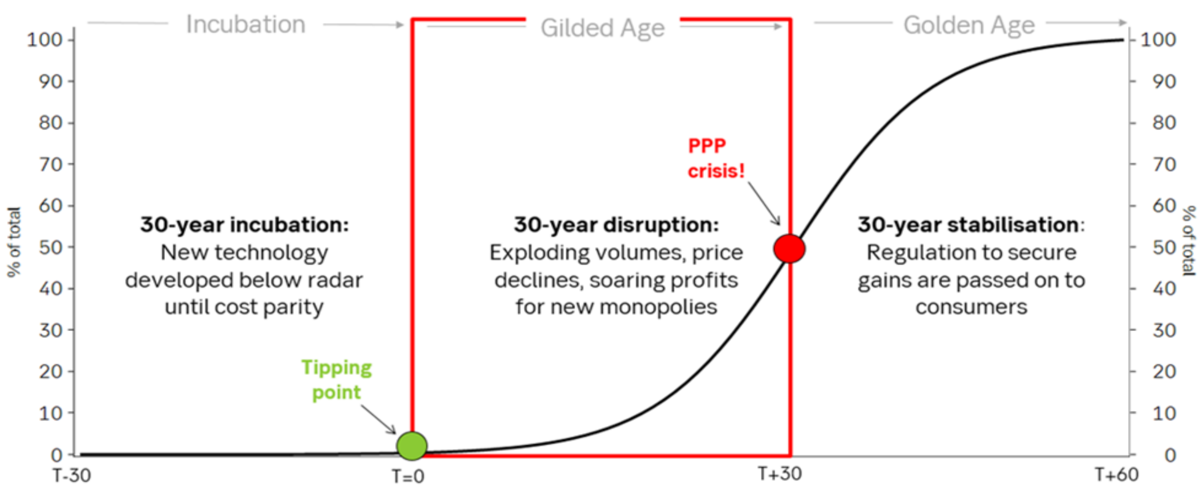
The shifts from disruptive, deflationary regimes to more incremental, reflationary regimes is clearly reflected in financial markets.

In the disruptive gilded age regimes, a structural excess of saving over investment leads to lower inflation, interest rates and bond yields and rising debt levels. The result has historically been secular bull markets in fixed income lasting several decades. As interest rates approach zero, direct monetary expansion marks the last period of desperation before the reset.

Equities do well in the first part of these regimes, not least due to new corporate giants with secular growth. This climate favours growth stocks over value stocks by driving multiples higher. Over time, rising debt and higher multiples lead to more and more volatile financial markets, until at some point interest rates cannot go any lower, debt crises emerge, and regime change follows.

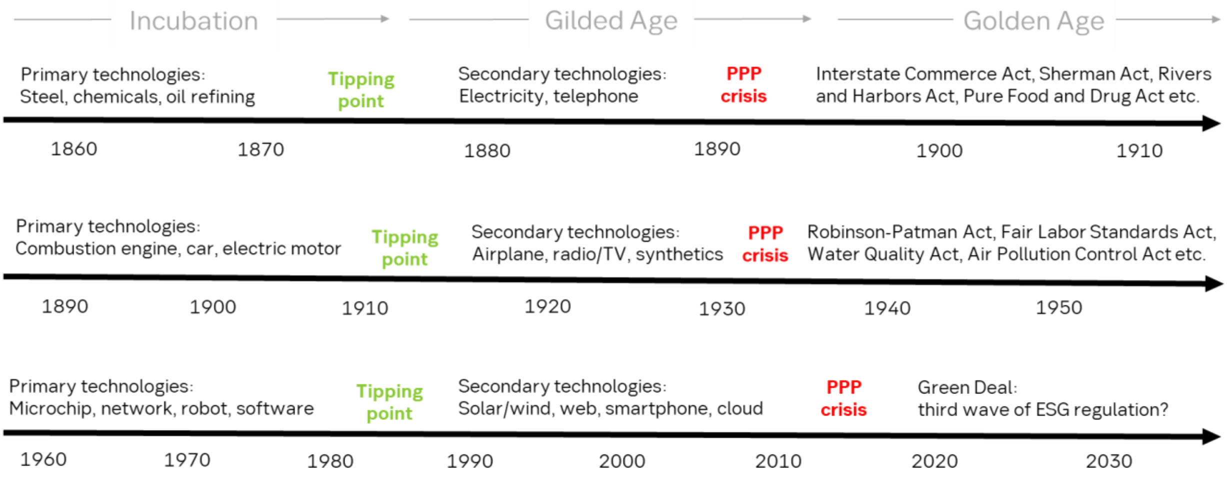
The golden age regimes are characterised by a long-term realignment of demand with supply, reducing the excess of saving over investment both in the private and the public sector and reversing the declining trend for inflation and interest rates. Figure 3 shows examples of the two previous industrial revolutions and we argue that the current revolution will follow a similar pattern, with ESG reforms about to be unleashed.

Figure 2: Systemic mid-way crises are part of all technology cycles



Source: SEB

Figure 3: Technology cycles, structural crises and ESG regimes

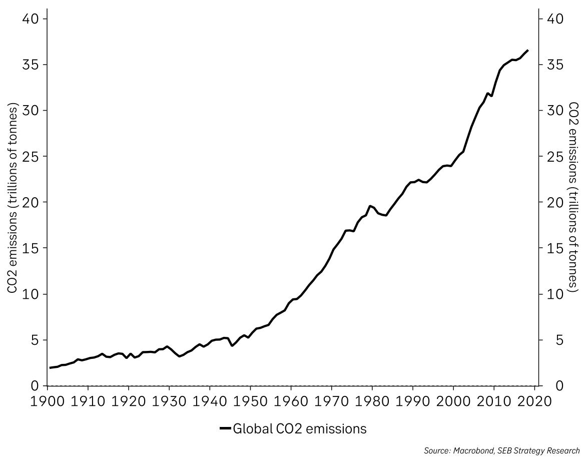


Source: SEB

The reflationary golden age regimes have had the opposite effect on bond market returns. ESG reforms reverse the structural excess of saving over investment, increasing labour's income share and pushing the corporate sector to invest a bigger share of profits. This has resulted in long fixed income bear markets, like the more than 30 years of negative real returns after WWII.

For equities, the picture is again split. In the first decades of the reflation, secular bull markets are driven by rising earnings and lower volatility. However, at some point inflation becomes too high as productivity gains are exhausted, and a high-inflation secular bear market follow. The long eras of rising inflation and bond yields typically sees value stocks outperform growth stocks as rising yields shorten the relevant DCF periods and monopoly rents are pushed back by regulators.

Figure 4: CO_2 emissions approaching 40 bn tonnes



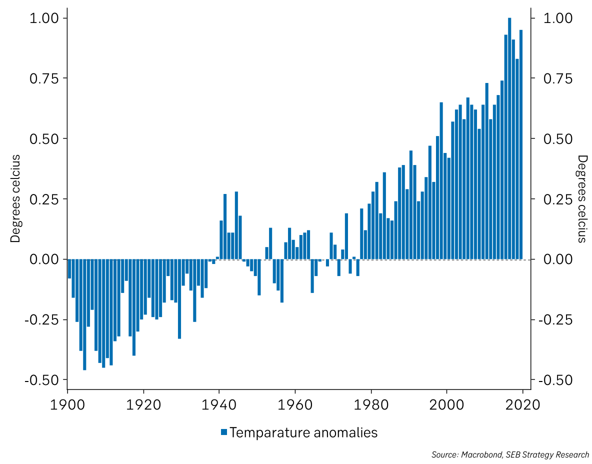
Source: Our World in Data, SEB

Three reasons why we need a regime change today

Clean energy needed to avoid disaster

The climate crisis is the most pressing and dangerous of the three problems. A combination of factors linked to the IT revolution has resulted in the acceleration of CO_2 emissions, which are now growing exponentially, approaching 40 billion tonnes (Figure 4). Thus, the global temperature level is rising in a way that could lead to an irreversible and catastrophic climate change (Figure 5). This is essentially the result of a technology failure.

Figure 5: Temperature anomalies for land and ocean

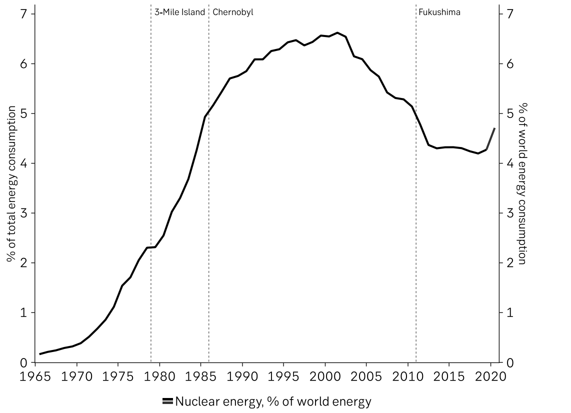


Source: NCDC, SEB

The climate crisis has intensified since the 1980s, which saw the start of the IT-enabled industrialisation of Asia and the end of the development of nuclear power. The latter had been lined up for 30 years as the zero-emission replacement to fossil fuels.

However, accidents like Three Mile Island in 1979 and Chernobyl in 1987 halted the development of nuclear energy and its share of world energy supply peaked at 6-7% around 1990 (Figure 6).

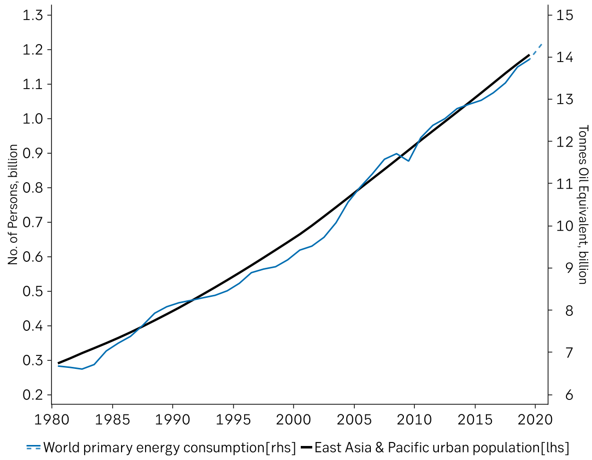
Figure 6: Nuclear s-curve died in the early 1980s



Source: Macrobond, SEB

Nuclear power remains in use in many parts of the world but the learning curve that could have driven costs below fossil costs was broken in the 1980s. As a consequence of this failure, the rapid industrialisation of Asia, which was made possible by the IT revolution, was powered by the cheapest, and most accessible energy source: coal (Figure 7).

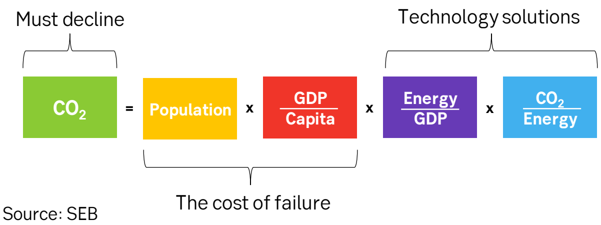
Figure 7: Asian industrialisation using fossil fuels



Source: Macrobond, SEB

The evidence is no longer disputable. We need to shift to a non-fossil energy infrastructure fast or sharply reduce our standard of living. This can be illustrated using the Kaya identity, which breaks CO_2 emissions into economic components (Figure 8). Population and GDP per capita have both increased by more than 70% over the past 30 years. Energy efficiency has not improved enough to prevent an 80% increase in emissions. There are only two possible ways to reduce emissions. Either we find technologies that slash the CO_2 emissions per unit of GDP, or we will be forced to accept a sharp decline in GDP per capita and possibly the population.

Figure 8: Kaya identity[1]



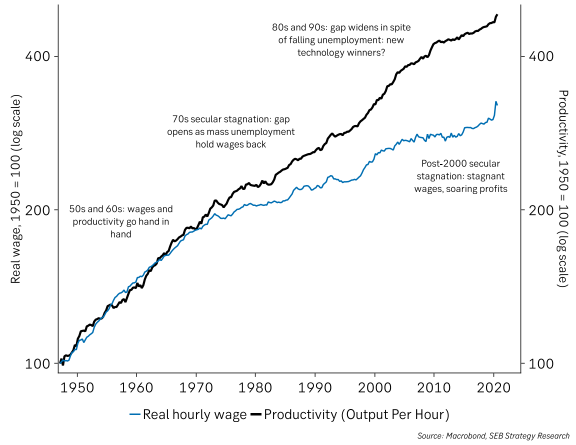
Source: SEB

Inequality leads to excess saving

The second problem is a breakdown in the policy regime that has been used to stabilise demand during the gilded age of the IT revolution. The economic disruption has led to rising inequality, which essentially puts money in the hands of people who do not spend it and companies that do not invest it while reducing the real income of the lower income groups.

This is partly due to the displacement of workers caused by the automation of low-skill jobs and the relocation of production facilities to low-wage, less regulated economies, where trade unions typically aren't strong. On top of this, global policymakers have not been tolerant of wage inflation since the inflation shocks of the 1970s, preferring to keep an unemployment buffer.

Figure 9: Wages and productivity



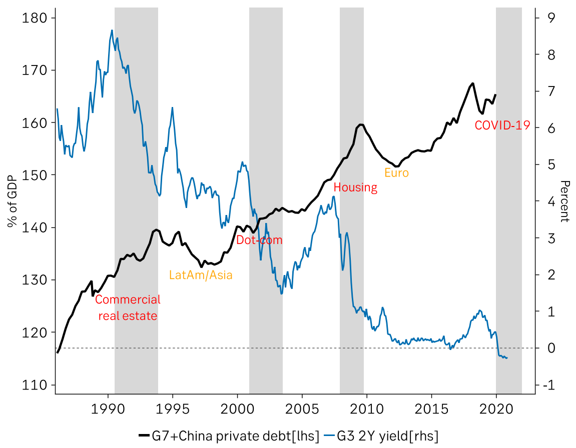
Source: Macrobond, SEB

[1] Kaya, Yoichi; Yokoburi, Keiichi (1997). *Environment, energy, and economy: strategies for sustainability*.

The result is an increasing concentration of income and wealth. Overall, wages have been unable to keep up with productivity growth since the 1980s, and the gap between the lowest and highest wages has been widening. This leads to excess savings, because the propensity to save tends to be higher in the highest income brackets.

During the past 40 years, we have relied on monetary policy to create enough demand to mask this shortfall. We have essentially stabilised the economy by filling it up with debt and driving interest rates lower (Figure 10). However, this is not a sustainable way to support demand. As interest rates decline, debt-income ratios increase, but at some point, interest rates can't decline any further and debt starts to become a major economic burden. We reached this point during the pandemic, and now we have to come up with new drivers.

Figure 10: The end of the line for central banks



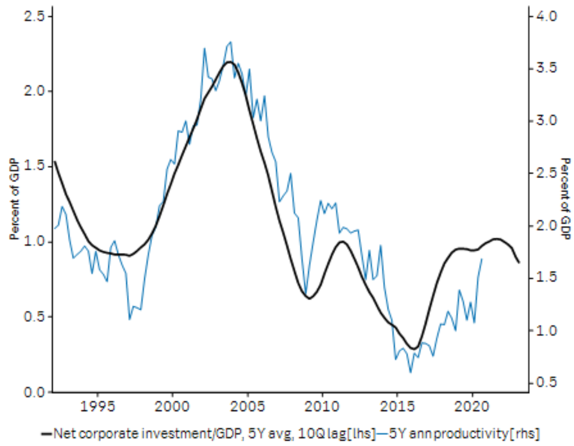
Source: Macrobond, SEB

However, this policy model was already malfunctioning before the pandemic, as central banks were forced to fall back on unconventional policies to sustain the recovery after the GFC and still failed to keep inflation stable. Now the interest rate is at or below zero in most of the Western world, and both private and public debt levels have soared during the pandemic.

Monopolies lead to corporate underinvestment

We appear to live in an age of technological miracles, so the paradox remains why the IT revolution has not led to more welfare and productivity gains? The main explanation is that over the past 10-15 years, corporate investment has declined. If you do not deploy the new technology, it will not lift productivity, and this is clearly evident in Figure 11. But why are companies not investing aggressively in the new technologies?

Figure 11: Low investment leads to low productivity

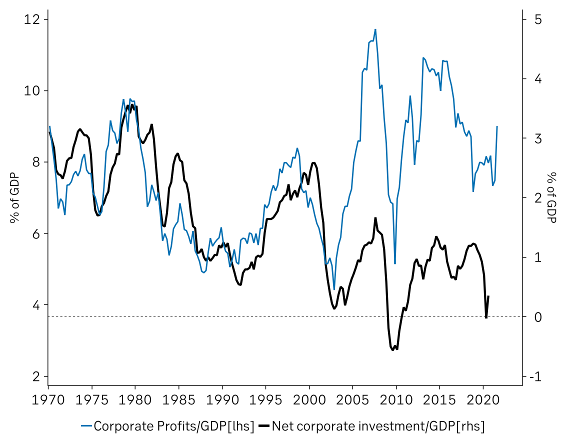


Source: Macrobond, SEB

The monopoly power of the new technology leaders is one key explanation. Corporate profit shares rose as IT allowed new global automated supply chains to emerge and production moved to low-cost and lightly regulated regions. Until the early 2000s there was a positive correlation between profits and investment, but the past 20 years have seen high profits accompanied by falling net investment (Figure 12). High profits and low investment levels are a clear indication of the increased monopoly power that has been developing over the past few decades.

The fact that corporate debt has increased sharply during the same period is a sign of a related problem in the current IT model. Profits and market capitalisation are increasingly being captured by companies that do not invest in physical capital stock, but instead control the access to products through virtual platforms. This leaves the companies that actually deploy physical capital with limited access to capital for upgrading the capital stock.

Figure 12: Rising profits without investment



Source: Macrobond, SEB

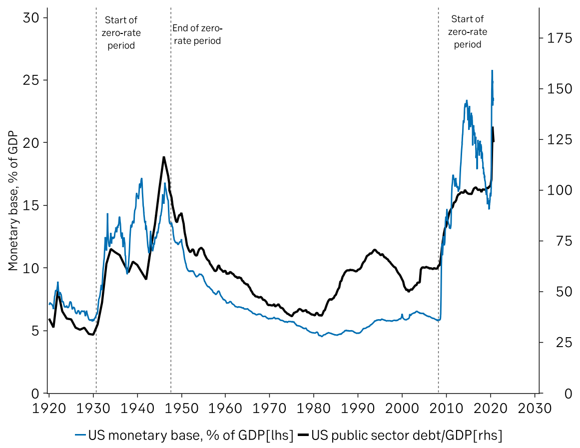
Regulation is needed to incentivise companies to invest more in new technology to increase capacity and create jobs as the economy recovers from the pandemic. However, companies can only take full advantage of the new technology if governments also create the necessary infrastructure. Due to the long-time horizons of the capital stock, infrastructure has always required some element of public support.

What a regime change must achieve

The structural problems we are faced with are interlinked and will have to be solved together. We cannot shy away from the decarbonisation of our economy, but without social and political stability, we will not be able to do that. Fortunately, the solutions to the three problems are not mutually exclusive. Both low wages and low investment suggest that there is a chronic problem with excess savings. In fact, too much capital is just standing idle, so there is plenty available if governments decide to use it.

Managing the extreme debt level is the biggest challenge in navigating the transition to a golden age. In the last technology cycle, the private sector debt burden had already been reduced by the time the reflation started in the 1940s.The next 30 years saw public debt reduced by inflation and negative real yields. A similar bold strategy is needed today. This time, governments will have to lead both private and public debt lower while reflating the economy after the crisis. Monetary policy is unlikely to drive the reflation as interest rates cannot go any lower and high debt levels weaken the transmission of QE unless it is coupled to government spending, otherwise it will only inflate asset prices (Figure 13).

Figure 13: CB's must fund public investment again

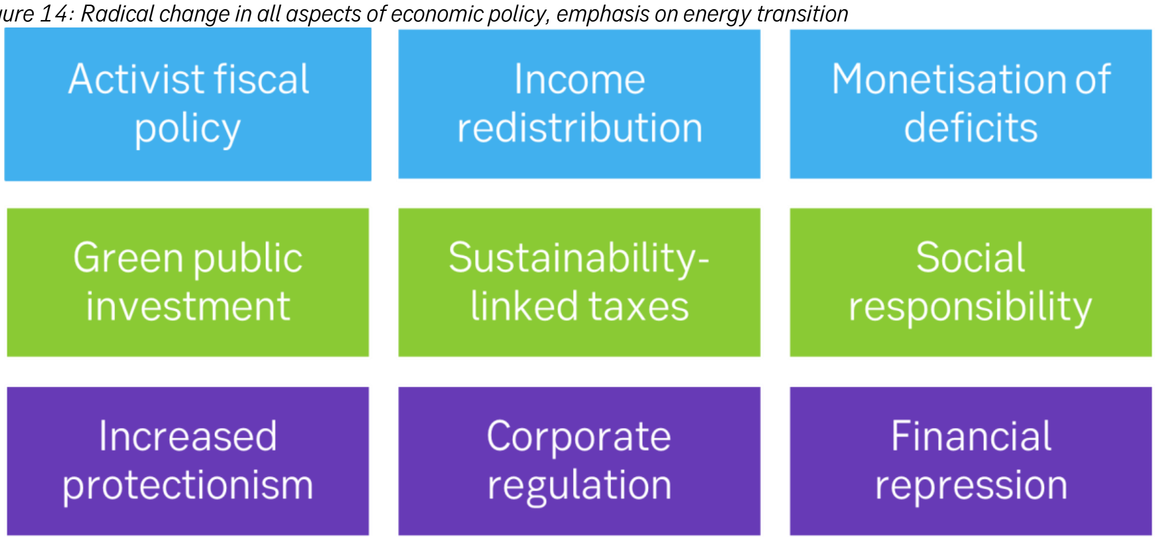


Source: Macrobond, SEB

Aggressive fiscal stimulus is thus required to reflate the economy after the pandemic in spite of the high public sector debt level, and governments will most likely also have to absorb some of the decline in private sector debt caused by stranded assets in the wake of the energy transition. This is only realistic if central banks intervene to provide funding at a negative real rate.

The good news is that the excess of savings over investment means the capital is available for a rapid decarbonisation, if governments invest in new energy supply, provide incentives for corporates to invest in new technology instead of buying back shares, limit monopoly rents and reduce unemployment to lift wages. The economic resources for an investment boom are there. All that's needed is political leadership.

Figure 14: Radical change in all aspects of economic policy, emphasis on energy transition



Source: SEB

Renewable energy is the only solution

There is no doubt that reducing CO_2 emissions is the top of all priorities. It might sound easy: just make fossil fuels very expensive. Unfortunately, as energy is a basic necessity, making it more expensive will not destroy the demand. In order to remove fossil fuels, you need to have an alternative in place. Fortunately, such an alternative is now at hand in the shape of renewable energy.

Recall the 30-30-30 model presented previously. After 30 years in incubation, new technologies embark on 30 years of disruption, where prices decline at the same time as production rises. This learning-curve mechanism is the hallmark of a technology revolution, identified already in the 1930s as 'Wright's Law' after a study of efficiency in fighter plane production. Innovation becomes disruptive when this pattern emerges. The process is initially characterised by high uncertainty and poor quality. Then the trickle turns into a torrent as more and more users join and apply the technology.

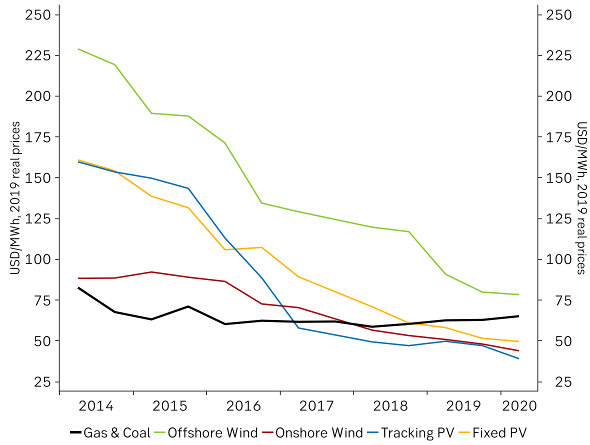
Renewable energy has reached the tipping point that IT reached in the early 1980s, and the learning curves in are similar to Moore's law for microprocessors, but it is a general principle; learning curve effects have been present in all technological revolutions since the beginning of industrialisation.

Past the tipping point

The primary energy production technologies have already passed the tipping point where they are cheaper than the incumbent alternative (Figure 16).

During the first 30 years of development, the cost of solar- and wind-generated power declined, but they remained above the cost of fossil fuels.

Figure 15: Cost-parity tipping point reached in 2010s

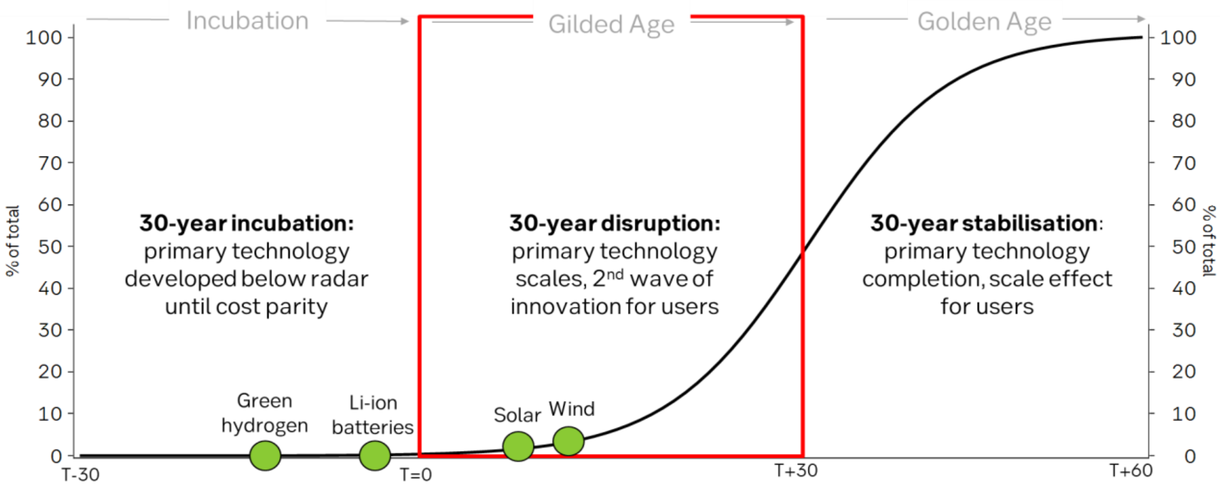


Source: BNEF, SEB

In this period, like with all other technologies, users had to be subsidised. 30 years after Chernobyl, it became cheaper to produce electricity (in isolation) using renewables than using coal or gas.

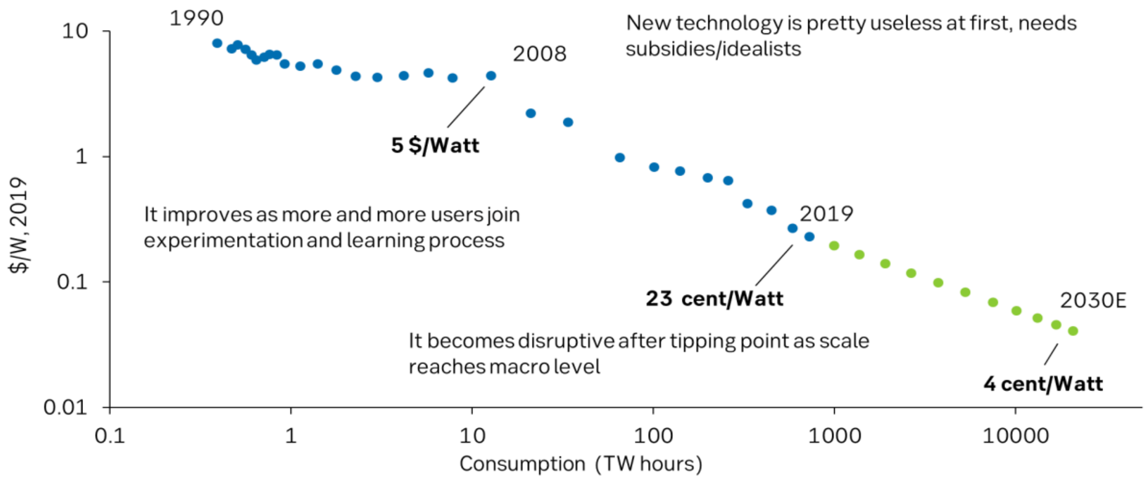
As you can see in Figure 15, it took another few years before the so-called levelised cost of energy (LCOE), which takes into account all costs needed to deliver electricity, fell below the cost of fossil fuels.

Figure 16: Renewable energy is a technology revolution



Source: SEB

Figure 17: Learning curve for solar



Source: BNEF, SEB

Scale effects, innovation feedback loops and 'learning by doing' will continue to drive prices lower over the coming decades as supply expands. once exponential growth takes off, history tells us there are still 30 years of exponential gains and price declines left. This means market forces are likely to drive a rapid expansion of supply, driving prices lower and lower in the process.

Today, it is indisputable that renewable energy is the cheapest way to generate energy across all alternatives. At the same time, the renewable share of total global energy consumption reached a level that is comparable to where the share of nuclear peaked in the 1980s (Figure 18). There is no reason to expect that this curve will be cut short in the same way as nuclear.

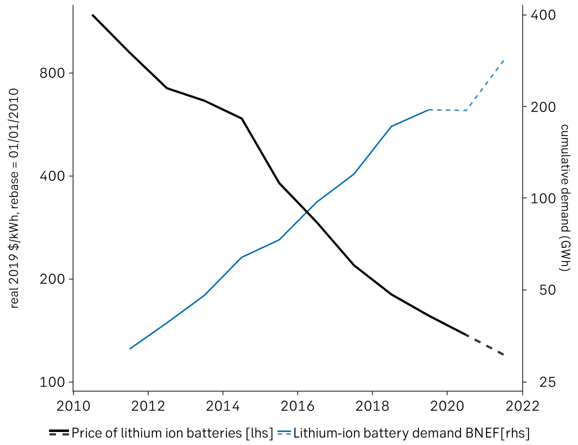
As Figure 17 shows, we are poised for a further decline to 3 cent/watt in the 2030's and another 80% drop in the following decade. We are on track to pay for energy the same way we now pay for internet access.

By the 2040s, renewable energy is likely to supply half of all global energy consumption and the marginal cost will be a fraction of what it is today. However, even if we were able to produce as much clean electricity as we want, there are two major challenges.

First, renewable energy production is not continuous, so storage technology is crucial. Second, there are many parts of the economy that lack the technology to replace fossil fuels with electricity so the electricity must be transformed into something else. Full deployment thus also requires a wave of innovation in facilitating technologies for using the renewable energy supply.

Since renewable energy production is dependent on wind and sunshine that are not always present, developing new technologies for storing clean energy and deploying it where and when it is needed are crucial. These technologies are slightly behind the primary technologies on the curve, as they can only really take off once the first part of the journey has been completed.

Figure 18: Price and demand of lithium-ion batteries



Source: BNEF, SEB

Batteries are the main solution for storage of electricity for future use, and the battery technology shows the same disruptive learning curve effect as the primary technologies (Figure 18). Lithium-ion batteries are closest to the tipping point after a decade of rapid development for use in electric vehicles. The cost of batteries is falling, and the learning curve looks very much like that of solar power itself.

However, as wind- and solar-based electricity become cheaper and more abundant, the development of new solutions is picking up in facilitating technologies too. For heavy transportation and production, batteries are unlikely to be the main storage tool.

Real resources are now being deployed into developing alternative solutions. Hydrogen, ammonium and other ways of converting renewable electricity into fuel can be used to replace diesel or coal in steel works, cement works, shipping, trucks and other key high-emission areas. However, most of the hydrogen produced is still done so using the incumbent technology, and this produces 3% of global energy related emissions in 2019 amounting to 33 giga-tons according to S&P Global[2].

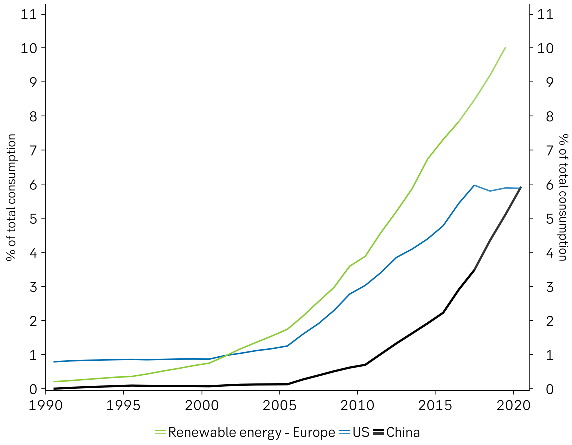
To become a viable competitive solution to existing fossil fuel alternatives, the majority of the production mix must shift from 'grey hydrogen' (where coal or natural gas is used) to 'green hydrogen' (based on renewables). 'Blue hydrogen' (where carbon capture technology is used) is largely viewed as an intermediate step to facilitate the shift.

In their latest report, IRENA argues that renewable hydrogen could be cost competitive with existing fossil fuel alternatives by 2030[3]. Similarly, in a study from November 2020, S&P Global[4] find that production costs of renewable hydrogen have to come down by at least 50% to 2.0 USD/kg-2.5 USD/kg by 2030 in order to be competitive and state that this would be feasible with solar or wind production costs of 20 USD per megawatt hour, combined with learning curve effects driving the cost of electrolysers down as capacity is expanded.

Exponential growth in supply
Renewable energy is already past the tipping point and showing the same exponential diffusion as other technologies in the past, suggesting prices will decline sharply also looking 10-20 years ahead.

Already now, renewable energy has exceeded the high point for nuclear power in the 1980s in both China and Europe, while the past four years in the US highlights the significance of political support in the early stages (Figure 19). The share of renewable energy simply stopped in the tracks when a fossil-friendly administration took office in 2017, but the latest election suggests the US will return to the leading edge within the next few years.

Figure 19: Renewable share above 10% in EU, US lags



Source: Macrobond, SEB

However, the supplementary technologies are not competitive and will need subsidies for some time. Batteries are closest, and we expect the improvement to allow EVs to become superior to fossil-powered vehicles without subsidies within a couple of years.

However, green hydrogen is at least 5-10 years away from being competitive, and here public subsidies will continue to play a key role in funding experimentation and pilot projects.

[2] How Hydrogen Can Fuel The Energy Transition | S&P Global Ratings
[3] Green hydrogen cost reduction: Scaling up electrolysers to meet the 1.5oC climate goal (irena.org)
[4] How Hydrogen Can Fuel The Energy Transition | S&P Global Ratings

Accelerating a transition is not easy

If the regime change is to be successful from a climate change perspective, the speed of the transition must increase significantly compared with historical episodes. Moving from the 30-30-30 model to a 30-15-15 model will involve massive investments into technologies supporting the development of renewables (Figure 20). Achieving a faster transition to meet the Paris agreement will require a coordinated effort of key stakeholders to transition the whole value chain simultaneously.

This is all good, but the problem is time. If renewables continue to follow the same diffusion pattern as earlier technology revolutions, diffusion will not be done until the 2070s. This is 25 years too late from a climate perspective. Speeding up a transition is a complicated task. The main problem is that transition involves both producers and users of the new technology.

The first step is to expand the supply of renewable electricity itself by investing aggressively in wind turbines, solar farms, grids and other infrastructure. However, many sectors today use production technology that cannot easily be converted to electricity as input. These sectors will play a key role in building the infrastructure, so they must continue operating.

A second wave of innovation among energy users is needed to complete the electrification. It is already underway, but this also requires time and capital. New production methods must be developed and then the entire capital stock must be transferred from the old technology to the new one.

First step: build the infrastructure
The first step in any attempt to accelerate the transition it to increase the supply of electricity. This is crucial for taking the next steps, because companies that will use the new technologies cannot start developing tools until they know what specific infrastructure they are developing tools for and when it will be available. There is a chicken-and-egg problem for markets here. There is no incentive to build a huge supply if there are no buyers, but there are no buyers until you provide the supply. Infrastructure investment also requires longer time horizons than private markets normally can operate with. As a result, the public sector has historically played a key role, whether it was building subways, highways, sewage systems or electricity grids.

This may sound obvious, but investment in renewables have in fact been stagnant for the past decade. The supply of renewable energy has still been rising at a strong clip due to the falling prices, but increased investment could speed up the price declines at the same time as it increases supply.

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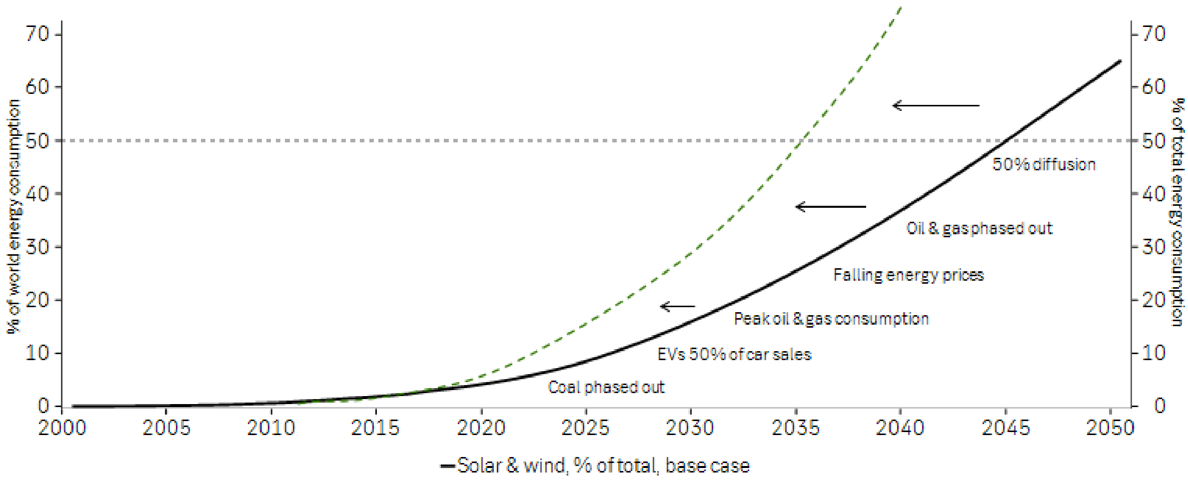
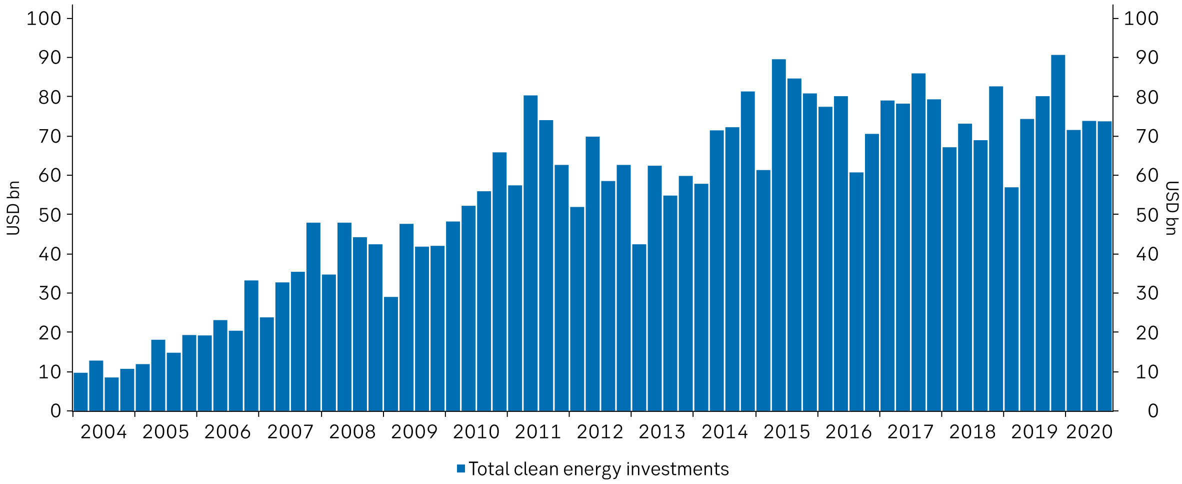
Figure 20: How do you accelerate a technology revolution? Both private and public investment is needed



Source: SEB

Figure 21: Break the renewable investment ceiling



Source: BNEF, SEB

If investment had continued the rising trend from the first decade of the century, investment would now have been almost twice as high in dollar terms, and the supply of green electricity would have been even further from today's level due to the positive feedback loop from the learning curve (Figure 21).

We call this part easy, because the technology that needs to be deployed has passed the cost parity tipping point and therefore does not need to be subsidised. With costs that are clearly below those offered by fossil technologies and budget restrictions eased by low rates and QE, it would appear to be obvious to step up the public sector investment in renewable energy and use the public stake to reduce the risk and increase the attraction of participating in the investment for long-term private sector investors.

Plans are underway to do this in both the EU and China, using green bonds to bring private investors on board. However, the US has fallen behind during the Trump presidency, and the incoming Biden administration has no guarantee of support for its ambitious plans to catch up in Congress. However, the cost of renewable energy is now so low that market forces are driving investments from US utilities in this direction in any event.

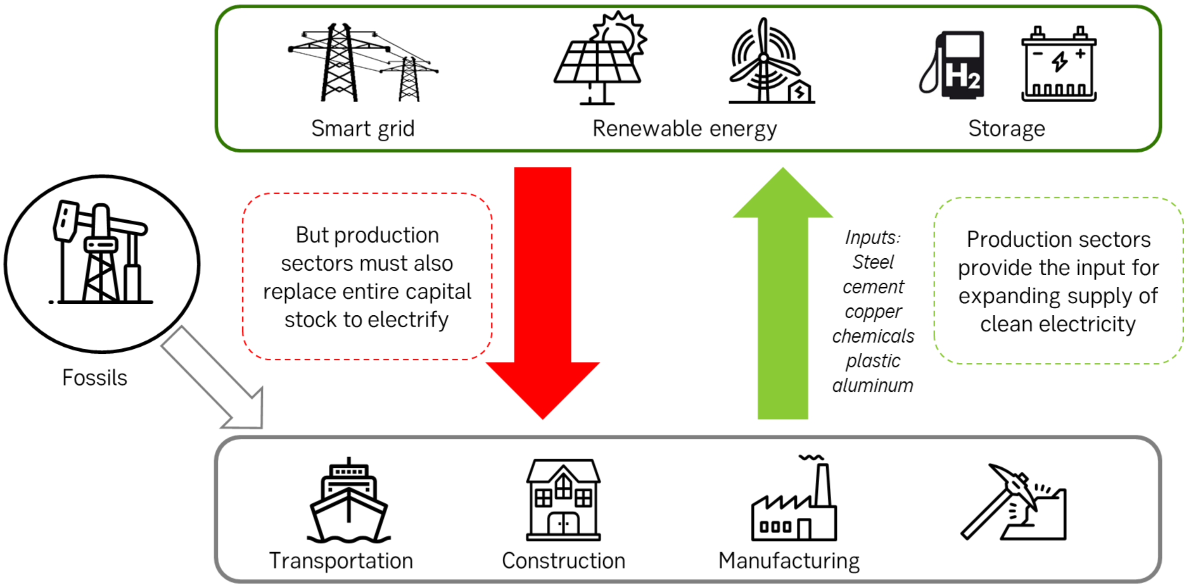
While raising a few trillion dollars for new infrastructure is no mean feat, the technology is now so advanced that increased supply will come almost regardless of what governments do, but speeding up the deployment will also play a key role in the second and more difficult part of the transition: the transformation of the technology used in the production sector.

Next step: innovation among energy users

Today, many of the sectors that provide inputs and materials to the renewable infrastructure cannot be powered by renewable energy (Figure 22). The energy needed in. shipping, construction, manufacturing and mining production processes is on a scale that the current renewable energy solutions cannot meet. More importantly, the energy input is deeply embedded in the current production technology, and you will have to develop and deploy new basic technologies before they can even consider using electricity as the key input. This process takes time, and even when new technologies are developed, it could take 5-10 years before they reach cost parity. Therefore, these sectors rely on fossil fuels to power their production.

As the capital equipment needed for producing renewable energy is dependent on input from fossil powered manufacturers, we must keep them operating during the transition. The demand for materials will also continue to increase as a result of urbanisation and improvement in the standard of living globally. Therefore, the need for materials such as steel, chemicals and plastics will rise and thus increase emissions if no actions are taken.

Figure 22: Replace capital stock of energy users too



Source: SEB

Living up to the Paris Agreement will require a transformation of the current business models of these sectors. Incorporation of circularity and recycling will be essential for ensuring increased energy efficiency, less waste and lower environmental impact.

There are several ways that companies can engage in this technological transformation, and every sector will need its own technological solution in order to plug into the renewable infrastructure. Some sectors cannot be easily electrified such as long-haul shipping, heavy-duty transport, in addition to the chemicals, cement, and steel industries to mention a few.

One of the most environmentally challenging parts of cement production is heating the ovens of the sintering and calcination processes to above 1,400 ˚C[5]. Several players within the industry have invested heavily in electrification of these processes. However, the embedded CO_2 stored in the limestone rock is another significant emitter. These emissions are not related to energy consumption and removing them will require completely new technologies that allow for a lower emitting production of cementitious material by use of alternative raw materials. The alternative is to use carbon capture technologies until a more profound change in technology is developed, but these technologies are also in their infancy.

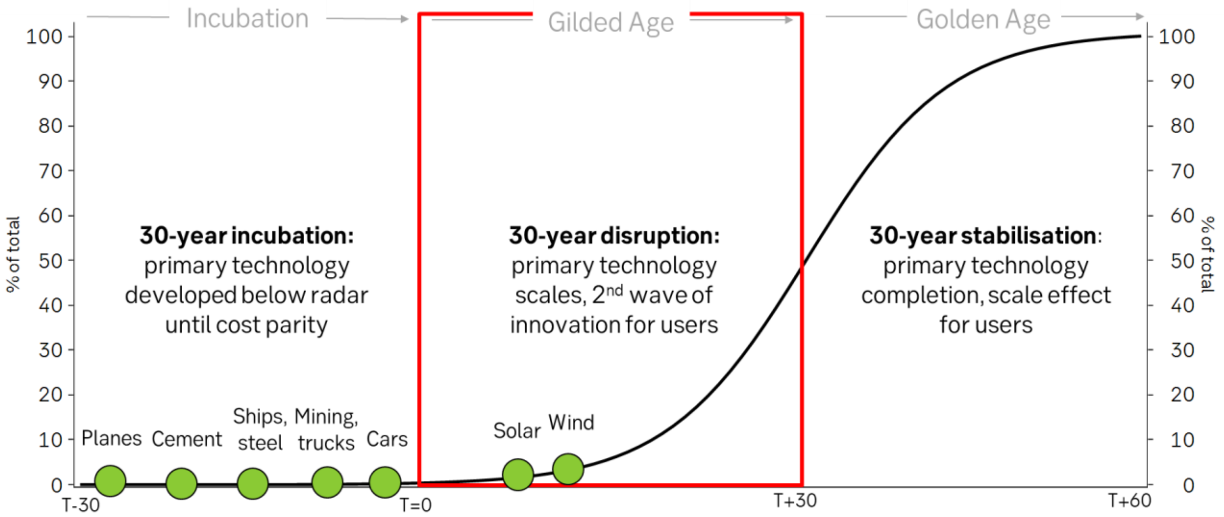
Similar trends can be detected within other sectors such as steel and plastics, all in search of a sustainable transformation of industrial production processes as well as a new energy source. Only when the new processes have been identified can the replacement of the capital stock begin. Large scale investments related to the development of new technology is not risk free. Some of the investments will turn out not to provide viable technologies that can support the transition. Clarity is thus required before the capital replacement can begin.

Once it starts, it will require large amounts of capital. For shipping alone, replacing the 50,000 vessels in the global merchant fleet will cost several trillion dollars. Replacing the four million heavy trucks and 20 million other commercial vehicles operating in the world today would come at a comparable cost, and this just covers transportation.

Spread out over two to three decades, the numbers are not huge in the context of global GDP, and the replacement would of course have happened anyway given enough time. However, the numbers are large compared to the sector's earnings, and in an accelerated transition companies must phase out existing, profitable capital stock faster than they would normally do.

[5] Material Economics (2019). Industrial Transformation 2050 - Pathways to Net-Zero Emissions from EU Heavy Industry

Figure 23: Secondary technologies still far from cost tipping points



Source: SEB

A sequence of tipping points
It is natural for the tipping point to be reached first in the primary technology sectors, in this case solar and wind production, but significantly later in the secondary technology sectors using the output of the first group. Renewable energy has already passed the tipping point, but energy users face different challenges and will not all reach it at the same time.

Figure 23 shows a stylised timeline for how we expect this to play out. The first sector that is likely to reach the tipping point is the automotive sector, where Tesla's model S kickstarted the development of superior technology already a decade ago. Within a couple of years, unsubsidised EVs are likely to be clearly superior to similarly priced traditional autos on virtually all parameters. This is likely the reason for Tesla's astounding leap in market cap in 2020.

However, most other energy-using sectors are not that close to the tipping point and will require at least 5-15 years to get there.

Heavy trucks are a few years behind autos, due to the challenges of powering larger vehicles with batteries. Hydrogen is a tested source of energy but is a less mature solution that may yet end up being preferred to batteries in this segment. Whether they are powered by batteries or hydrogen, there are already credible early models in operations, and we expect the tipping point to happen before the end of this decade. Mining may share many of the same solutions as heavy trucks.

Zero-emission shipping and steel production is likely to be several years further away from cost parity. In these sectors, zero-emission solutions are only in the embryonic stage. Small-scale hydrogen-powered ships and steelworks exist as pilot projects, but the cost is still way too high. Cement producers face even deeper problems as the CO_2 emissions are to some extend released by the clinkers used as input in the cement and not just from energy. Zero-emission aircrafts are likely the furthest from a tipping point, also due to the security concerns involved.

Vertical coordination needed
To increase the speed of the transition, development of new technologies must be coordinated throughout the entire value chain. No single company can carry all the technological transformation cost and risk alone, and the new technologies require a combination of different inputs to work. It is not just about the energy, it is also about transforming it into something that can power an engine, providing the infrastructure for the delivery and inventing the engine itself.

Figure 24 provides an illustration, showing how the successful development of alternative fuels to power shipping vessels will require a transformation of the entire value chain. If technological development allows for vessels to run on hydrogen rather than diesel, several parts of the value chain need to be altered for the transformation to be successful.

First, some company/companies must produce, store and deliver the hydrogen in volume. Then the ship engines will likely require re-modelling to transform hydrogen into energy that can power the ships. Fuel tanks will have to be redesigned so they can safely store hydrogen. Further down the value chain, ports must be redesigned to store large amount of hydrogen. The infrastructure leading to the ports as well as the logistical part of transporting fuel must adapt to the requirements of hydrogen fuel. If all of these inputs are not present at the same time, the probability of a successful implementation will decrease.

Supply chain collaboration

The need for coordinated transformation of all parts of the value chain is not just limited to the shipping sector. Transforming entire value chains requires significant investments and cannot be incurred by a single firm alone. The formation of strategic partnerships or vertical integration to co-develop technology solutions is thus crucial to the success of the transformation. In addition, consumers may have to pay a premium for the green output until production costs come down.

The coordination problem is a challenge to the IT-enabled business model, which involved a vertical disintegration in order to increase specialisation. The different parts of the supply chain are linked together by internet-based distribution platforms, which tend to capture a large share of profits. However, when innovation must be coordinated, then it also argues for a move towards a simpler, less complex value chain.

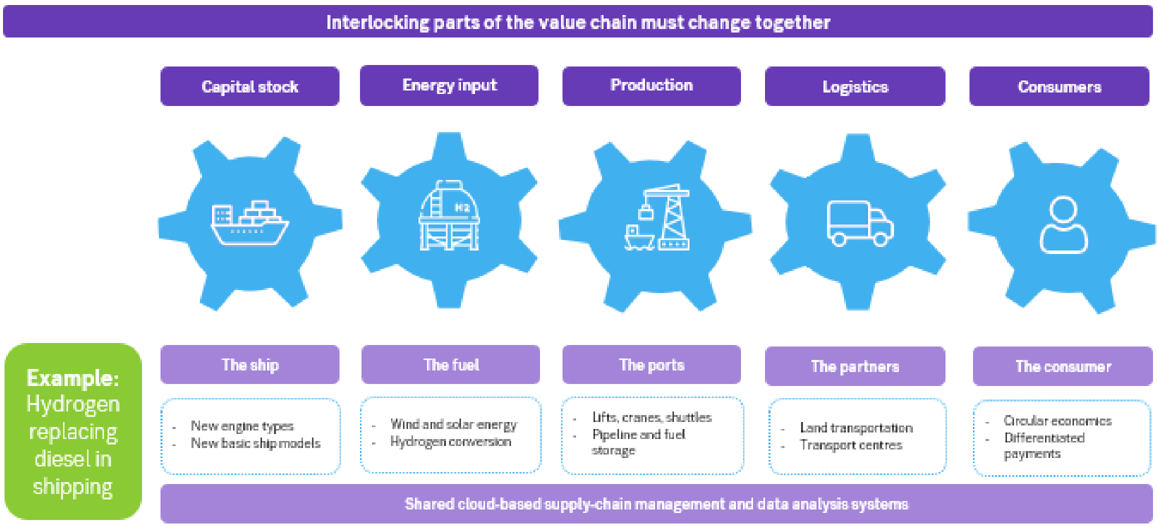
Less complex supply chains will also make it easier to accommodate the demand from stakeholders for companies to provide more information and transparency on the overall sustainability of their value chain. They also make the production sector more resilient towards trade conflicts, pandemics and other exogenous supply chain disruptions as well as the environmental risks from more frequent hurricanes, flooding or droughts.

Increased supply chain integration is not always optimal. Companies face a trade-off between longer chains allowing for more specialisation and shorter, less complex chains with lower exposure to shocks and allowance for a higher degree of control. Covid-19 has exposed the vulnerability of a truly global economy, where supply chains worldwide are interdependent.

A company should initially focus on optimising the sustainability of the value chain sections that are the most material in relation to the overall life cycle of its products or services. For some companies, environmental aspects may be the most salient due to e.g. high emission activities, whereas it for other companies may be more relevant to strengthen social aspects such as employee health and safety.

Either way, the renewable transition will demand massive investments into new technologies as well as new energy supply. Policy support through public investment, regulation and subsidies is needed to accelerate the transformation.

Figure 24: Transition must be simultaneous across all parts of value chain to succeed



Source: SEB

Capital replacement cycles: A historical illustration

Like any historical event, the ongoing energy transition is unique, but it also reflects some generic patterns. The last section of this report provides an analysis of the main historical technology revolutions from which we derived our 30-30-30 diffusion model. In this section, we draw some stylised facts derived from the transition from horses to tractors in the 20th century. Like the transition many sectors face today, this was a replacement of capital equipment using one type of energy (horses and hay) with capital equipment using another energy input (tractors and gasoline).

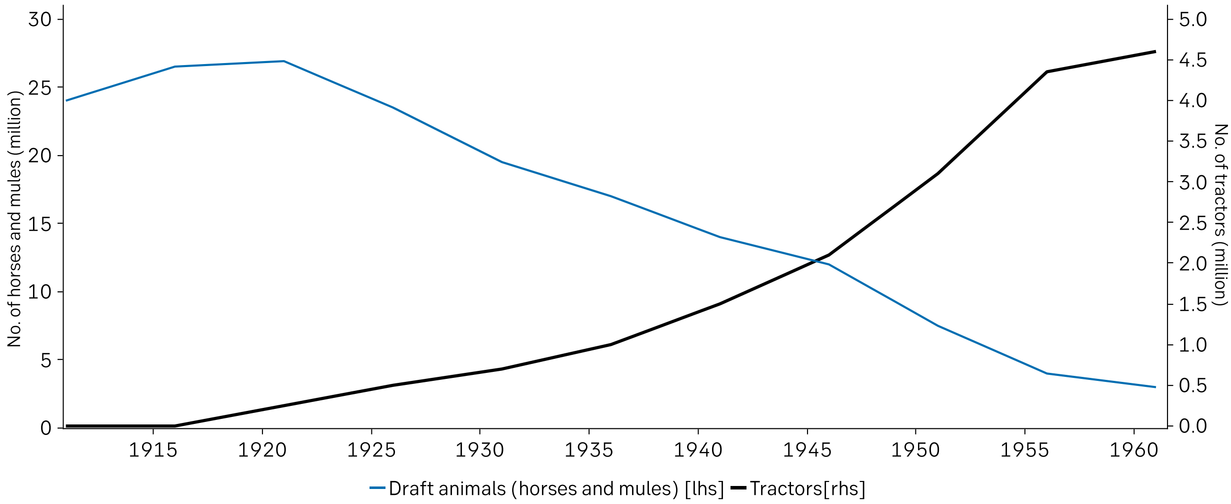
Figure 25 shows the number of draft animals and tractors in US agriculture in the first part of the 20th century. Tractors began being used in the first decade of the century, but the initial diffusion was slow, and the number of horses and mules continued rising to feed a rising population until the early 1920s. Even from this point, it took almost 30 years for tractors to reach 50% of their number at the end of the diffusion. There are several reasons why it took so long.

Tractors were on a learning curve and at first, the price was high, and they were only competitive in a few types of agricultural production. As their numbers increased, the cost went down while quality and versatility improved. It also took time to develop the necessary infrastructure around the new equipment with easy and widespread access to cheap gasoline and mechanics.

The incumbent capital goods sector also reacted as the price of horses declined even while the number of horses working remained at a record high. This delayed the cost parity tipping point further in some areas. At the same time, the breeding of new horses for the agricultural sector declined sharply, while the average age of the horses deployed in farming started rising already in the early 1920s. The development and replacement of existing capital equipment thus stopped, allowing cash flow to be redirected towards new capital types in a gradual capital replacement cycle.

The Depression in the 1930s curtailed both the internal cash flow and the access to capital of farmers wanting to invest in tractors. It also led to an abundance of cheap labour, which reduced the advantage of the less labour-intensive tractors. On the other hand, when diffusion finally exploded in the 1940s, one of the main drivers was a sharp increase in wages, increasing the cost-saving potential at a time when tractors were plentiful and cheap, and farmers had strong cashflows.

Figure 25: Capital replacement – when oil replaced hay as energy input, tractors replaced horses on the farms



Source: Olmstead and Rhode[6], SEB

[6] Reshaping the Landscape: The Impact and Diffusion of the Tractor in American Agriculture, 1910–1960.

Based on this and other historical examples, we have constructed a simple, stylised transition model. Prior to the first practical application of a new production technology, we assume that the situation is stable, and that capex will fluctuate around the required level to cover depreciation and maintenance for the existing capital stock and cash flow is sufficient to cover that as well as the market return (Figure 26).

Once the new technology reaches the cost parity tipping point, investment in the existing capital will start falling. For some time, it will continue to produce the same output and deliver the same profits, but now cash flow is redirected towards investments in new technology equipment. At first, this will generate negative cashflows as the new equipment (tractors) is relatively expensive.

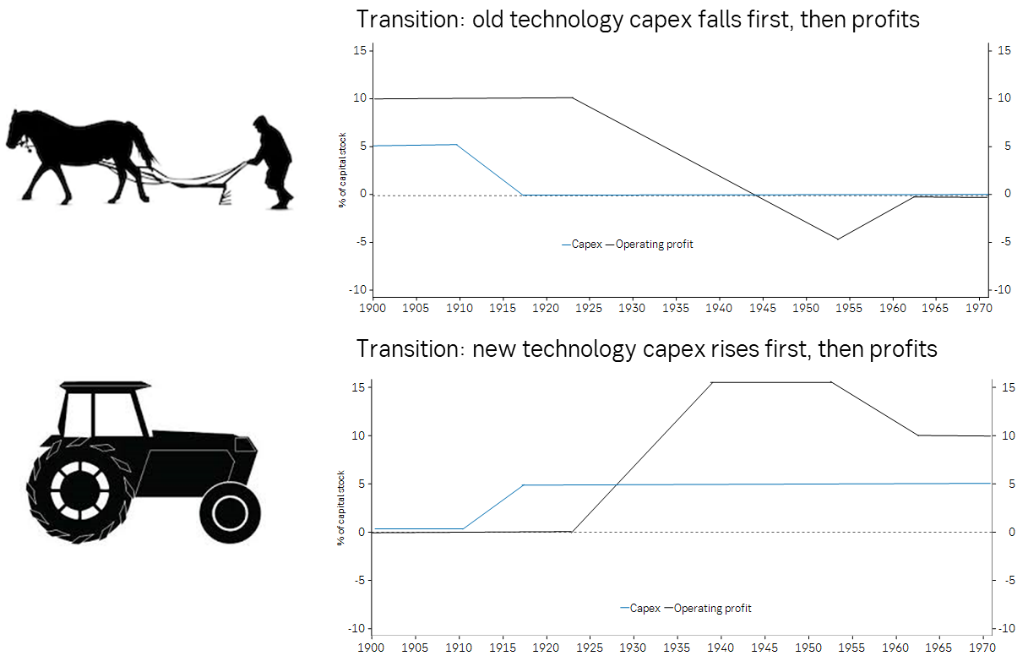
As the transition progresses and the cost of the new technology continues to decline, the profits and market value of the two types of capital move in opposite directions. The profitability of the new technology will be elevated during the disruptive first half of the transition as they operate in markets where most competitors have higher costs. The return on old technology capital will eventually decrease as farmers relying on horses face a falling marginal price dictated by tractors.

When the transition has been completed, the old capital stock will be fully depreciated and the profits from the new technology will reach a steady state, while the capex related to investments in tractors will stabilise around the depreciation and maintenance capex level.

The key conclusion we draw from this stylised example is that the speed of transformation depends on complex innovation processes that require both time and capital. Even if you could have created the five million tractors that were ultimately needed in an instant in 1910, the tractors available at that time would not have been anywhere near the quality and price that ultimately prevailed, and the farmers would have had to spend time and money on figuring out how to use them..

For users of a new technology, the speed of investment depends on how much cash flow the owner of the old capital stock, in this case the farmer, can allocate to the development of the new technology. The lesson from the 1930s suggests that making the existing technology more expensive is thus not an easy recipe for a faster transition if it destroys earnings. And if it is important to maintain production during transition, then you cannot remove the old capital stock faster than a new technology is built up, and it takes time to do that.

Figure 26: Transition to a new capital stock: a stylised illustration



Source: SEB

The EU blueprint for a new policy regime

Achieving the Paris Agreement goals through a renewable transition requires a new policy regime. But how should it be designed if it actually is to achieve the goal of a faster transition without a collapse in living standards? Based on the analysis in the previous sections, we can draw some preliminary conclusions on how policy can accelerate a transition in practice. A successful policy regime must:

1. Provide capital for direct investment in renewable electricity production

2. Subsidise the development and deployment of new storage and distribution technologies

3. Let market forces determine the allocation of capital but subsidise pilot projects and other development until cost parity with fossil-based alternatives

4. Keep cashflow from fossil-based production technology alive until alternatives are available but direct it towards investment in new technologies

5. Provide guidelines for acceptable activities and enforce transparency to facilitate a faster repricing and redirection of capital

6. Incentivise collaboration across corporate value chains in developing and deploying new energy solutions

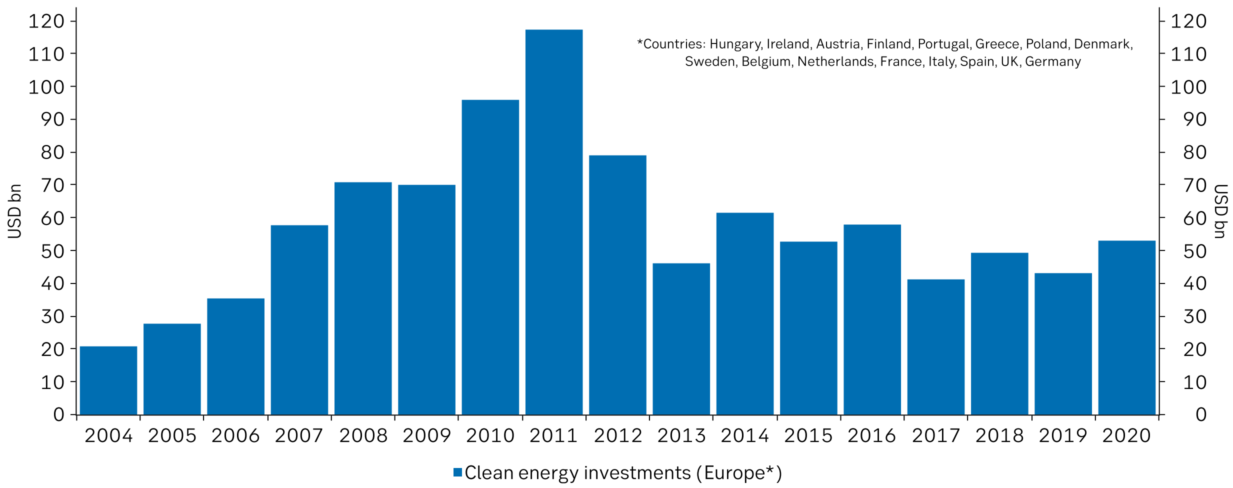
The EU efforts to create a new policy regime change with the aim of accelerating the transformation of capital from fossil-dependent technologies towards renewable energy inputs ticks all the boxes. The broader framework, which includes the EU Green Deal, the Green Recovery plan and the Taxonomy, highlights the importance of long-term strategies, value chain efforts and broader corporate governance when accelerating the transformation. The framework provides a blueprint for the way forward from the current crisis.

Part 1: Investment and subsidies

The first part of the framework is about raising capital for a new green infrastructure. The EU aims to combine its own funds with those of private investors to speed up the deployment of new energy supply. The EU Green Deal aims to mobilise EUR 1000bn over the coming decade for investment in this area with 500bn coming from the EU budget, 100bn from national governments and the rest raised by the EIB (European Investment Bank) from private investors with green bonds for infrastructure investments.

The plan is likely to lead to a doubling of annual investments in renewable energy supply, taking it back to the higher level from a decade ago (Figure 27). It will also facilitate significant investment in renewable energy infrastructure as well as a range of other areas including building upgrades and transportation networks. It also contains subsidies and direct grants for investment in new, still unprofitable technologies like green hydrogen production.

Figure 27: Doubling of clean energy investments needed



Source: BNEF, SEB

The EU has also responded to the pandemic shock in 2020 by adding a Green Recovery plan worth EUR 750bn to the EU budget. This will be funded with common debt issuance in a major step towards a more robust EU policy framework, but the implementation and spending will be done by national governments. The aim is that 30% of the spending will qualify for funding with green bonds. Finally, the EU appears to be willing to push the envelope on carbon pricing schemes to match the higher ambitions. According to SEB Commodity Research, the price of emission rights is likely to rise further to around USD 40-50/ton as the EU raises the ambition on CO_2 emissions to a decline of 50 or 55% by 2030. USD 40-50 would make this realistic and reduce the mispricing of externalities.

Part 2: The EU Taxonomy 1.0

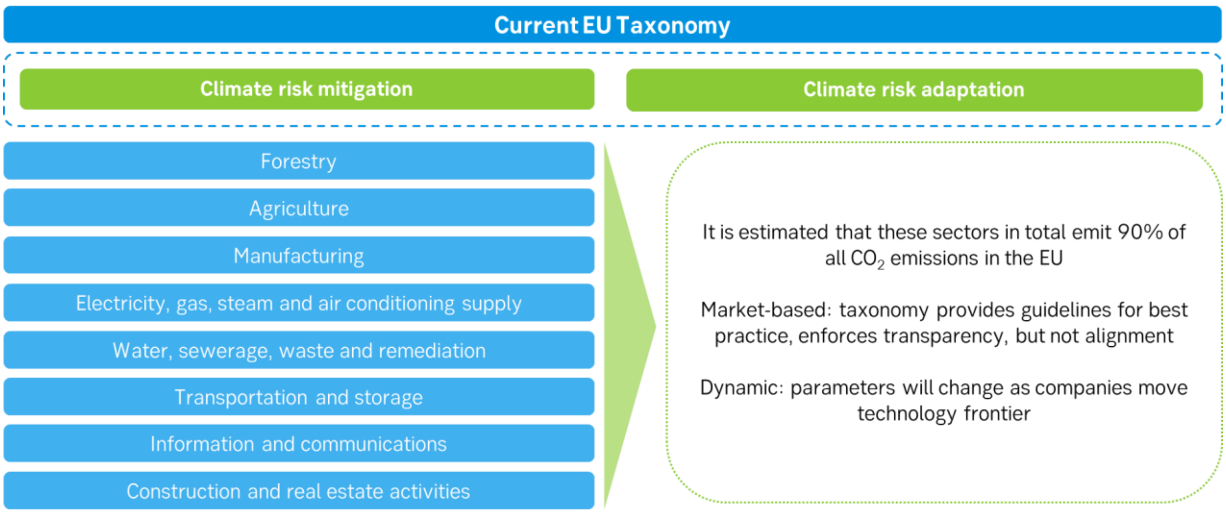
The second part of the framework focuses directly on the corporate side. The main tool is the EU Taxonomy regulation, which has entered into force in 2020 and will take effect from 2022. This initial version only concerns climate risk adaptation and mitigation. The framework identifies a range of activities for which threshold values have been set; these activities are estimated to account for more than 90% of the total CO_2 emissions in the EU (Figure 28).

Only companies engaging in these specified activities can be aligned (or not) with taxonomy thresholds. These companies are concentrated in a few sectors, so most sectors are generally not initially affected by the new regulation. The taxonomy thresholds are mostly related to GHG emissions, and they are supposed to reflect the best possible current practice. For instance, for a steel producer, if the CO_2 emissions are less than 1.8 tons for each ton of steel produced, then that part of the company's activities is said to be 'taxonomy-aligned'. The measurement may focus on revenue streams, capital expenditures or operational expenditures. Companies performing in line with or better than the threshold values have thus implemented the least destructive production methods available and are said to be aligned, as long as they do no 'significant harm' to other environmental areas such as water, waste and biodiversity.

The EU Taxonomy takes a market-based rather than a classic regulatory approach when seeking to affect market behaviour. When the Taxonomy takes effect in 2022, financial market participants and companies of a certain size will be obliged to publicly report on the metric(s) used for the threshold calculation(s). However, neither companies nor market participants will be forced to align with the thresholds and no legal consequences will be placed upon non-aligned companies or investors – at least for now.

Instead, the aim of the Taxonomy is to allow markets to know which companies are using the best available production methods within their sector and price them accordingly. In addition, companies will be able to map their progress compared to peers. This is meant to incentivise rather than force companies and investors to improve their taxonomy alignment through investing in technological transformations.

Figure 28: EU Taxonomy is designed to accelerate the transition



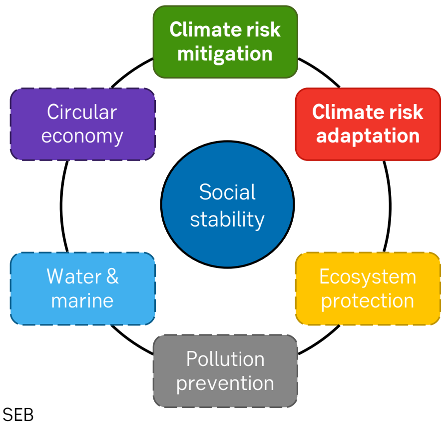
Source: SEB

The Taxonomy is dynamic in several aspects. One dynamic aspect of the model is the aim of achieving net zero emissions by 2050, but it also respects the need for time to develop and deploy new technologies and the futility of punishing companies for not deploying technologies that do not exist yet. As a result, the threshold values will be adjusted over time as technology improves, creating incentives for companies to lead the transition and define the standards that others will have to meet. It is when zero-emission options are available that the Taxonomy becomes truly important for most of the affected companies.

Part 3: The EU Taxonomy 2.0
The EU also recognises that sustainability strategies must go beyond purely focusing on GHG emissions and must take E, S and G into consideration if a company wants to perform in line with the ambitious EU trajectory. The taxonomies included in the current framework are thus going to be supplemented with additional taxonomies that have a broader focus.

The first version of the Taxonomy solely concerns climate risk. Within the next two years, the EU will add similar sustainability thresholds for Ecosystem protection, Pollution prevention, Water and marine and Circular economy (see Figure 29). It is important to note that optimising one taxonomy should not be done at the expense of the others. The inclusion of additional taxonomies will increase the complexity of taxonomy alignment evaluations as several layers will have to be considered. Complexity is exactly what characterises the attempt to identify the companies that will be the leaders across taxonomies in the long-term.

Figure 29: Broader sustainability model



Source: SEB

The EU is also planning to develop a ‘social’ and a ‘brown’ taxonomy. Inclusion of a ‘social’ taxonomy underlines the importance of viewing ESG holistically making sure not to compromise one of either E, S or G when optimising another. The recent Covid-19 crisis has illustrated the importance of ensuring proper practices within both the S and the G when being hit by severe supply chain disruptions.

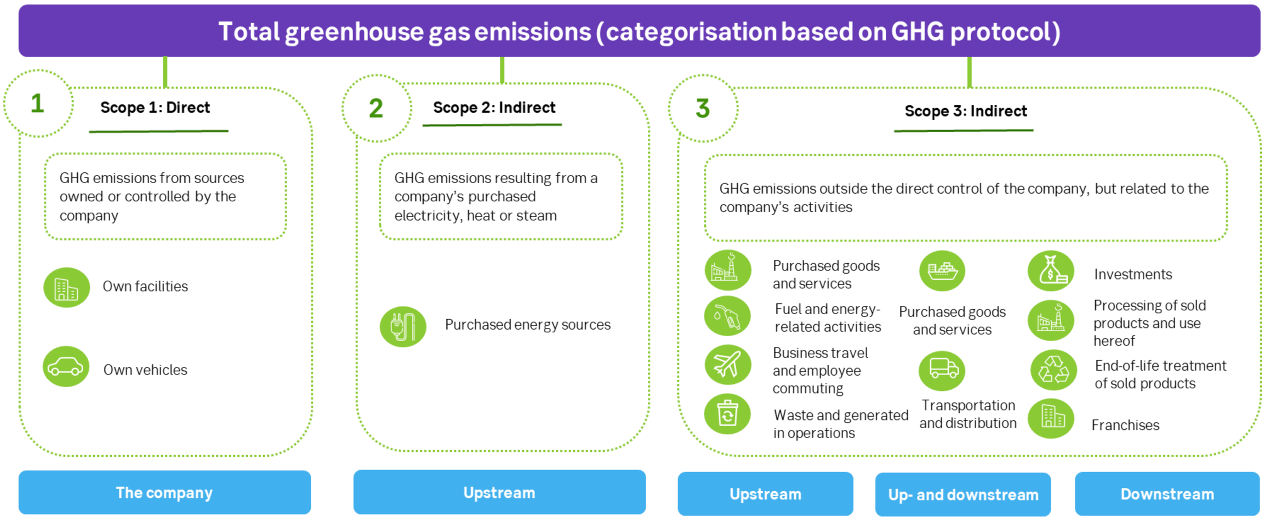
Part 4: Supply chain integration
The EU Taxonomy framework also respects the need to think about transition for a whole value chain at once by including scope 3 emissions in the threshold requirements within the next few years. Scope 1, 2 and 3 carbon emission categorisations relate to the scope of activities included in the GHG reporting (Figure 30). Scope 1 emissions relate to a company’s direct emissions, while scope 2 concerns the emissions related to purchased energy used to power, heat or steam the company’s facilities. Scope 3 captures the full value chain emissions of activities outside the company’s control. This entails both up- and downstream emissions related to a company’s products or services.

Inclusion of scope 3 emissions in the EU Taxonomy will force companies to report on full value chain emissions. This implies that companies will be held accountable for emissions throughout the value chain and not solely at the company level. In this way, companies are incentivised to engage in emission reductions throughout the value chain in order to live up to the taxonomy thresholds. This is likely to require cross-value chain collaboration. The increased focus on scope 3 carbon emissions highlights the importance of value chain considerations and recognises that a successful regime change must be driven by collaboration throughout the value chain.

A truly dynamic approach
With the Taxonomy, the EU is aiming to incentivise market forces to drive the green transition. As illustrated in Figure 31, the legislative environment will be constantly developed towards 2050. There are already several revisions and legislative proposals planned towards 2030. It is expected that even more will come in the years following 2030 as the level of ambition is expected to rise alongside the development of new ground-breaking technologies. Currently, eight sectors are included in the framework, but the EU has already announced that it will include additional sectors and sub-sectors as the scope broadens.

As an example, sea transport was added to the Transportation section in the updated Delegated Act version released on November 20, 2020.

Figure 30: Transition must be simultaneous across all parts of value chain to succeed



Source: SEB

The dynamic aspect is also reflected in the sector-specific thresholds. The aim is for these to be revised and tightened continuously towards 2050 or as new technological breakthroughs progress, allowing for significant improvements within specific sectors. In this way, companies will need to constantly improve their sustainability ambitions if they want to be top sector-performers with regards to taxonomy alignment. This will also require companies to credibly commit to a strategy supporting the transformation.

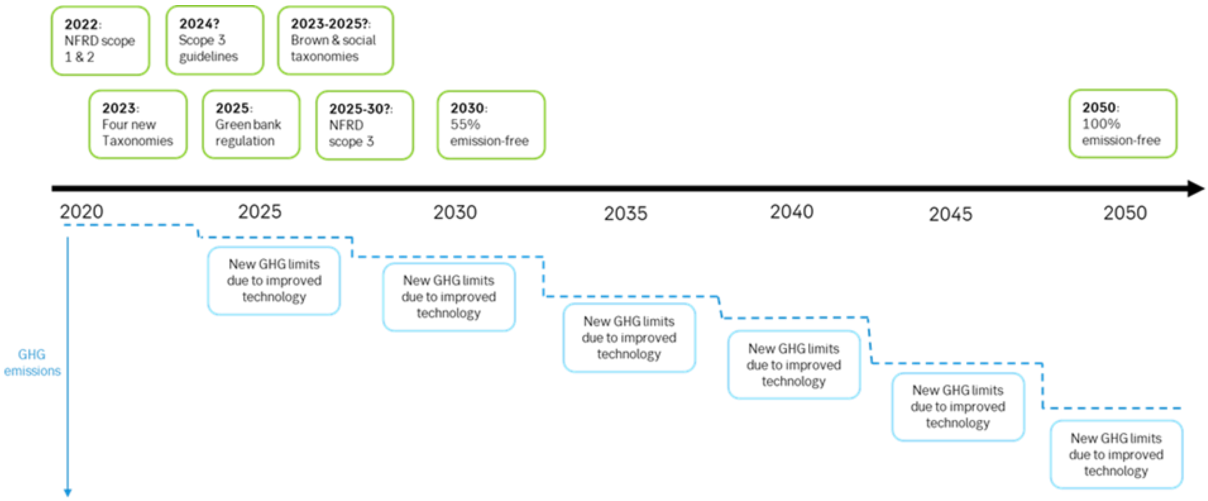
Being aligned is not 'enough'

The EU Taxonomy supports transformation of capital from the old fossil-dependent economy towards an economy reliant on renewables. It seeks to incentivise both companies and investors to accelerate the capital replacement cycle using tools that are perfectly aligned with our analysis of how to speed up the transition while respecting the complexity of such a change.

When scope 3 exposures are introduced in disclosure requirements and the analysis includes the whole supply chain, it could trigger major changes in business models across sectors.

When considering what it will take to be a leader in this new regime, taxonomy alignment alone will not be enough.

Figure 31: It is dynamic - EU plan to accelerate the transition will be implemented in the coming five years



Source: SEB

Value chain focus and collaboration alongside a detailed technological transition plan towards 2050 will be where the winners of the transformation are likely to be found. Our interpretation is that it invites investors to evaluate companies' progress in the transition more broadly along three dimensions: 1. Alignment today, 2. Emissions across supply chain and 3. Long-term decarbonisation (Figure 32). Identifying the companies that adopt the winning technologies can only occur through an in-depth, bottom-up company-specific analysis.

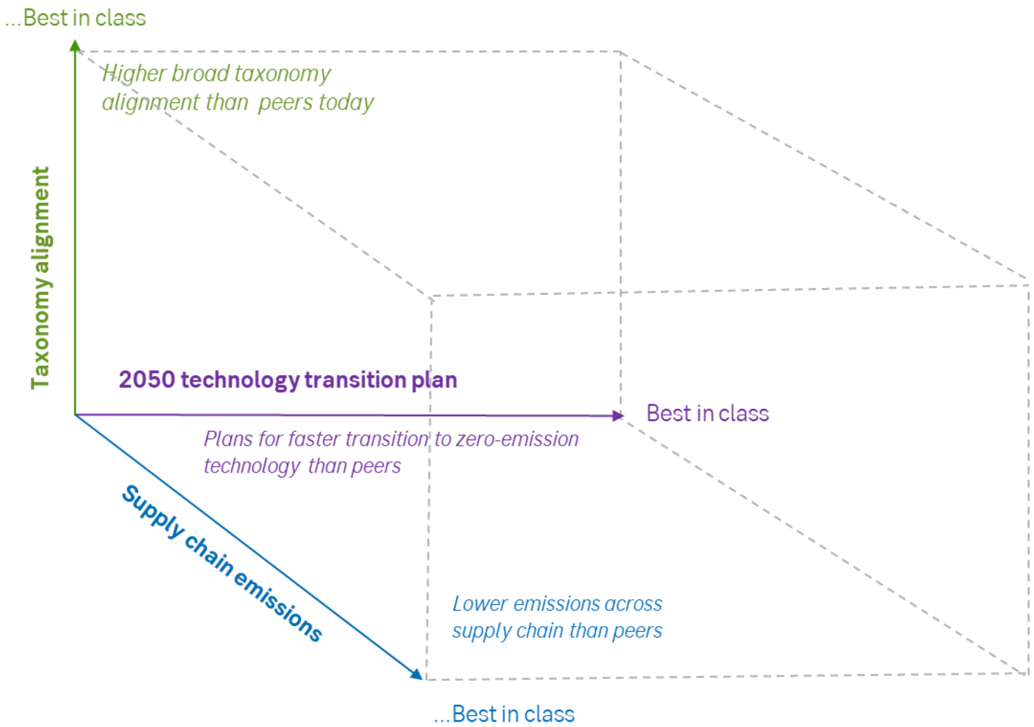
The first and most obvious dimension is to measure alignment with the existing thresholds. Today, this means measuring specific measures of GHG intensity in each activity, in some cases even life-cycle emissions. In the future, however, alignment will be measured against a whole range of parameters related to the new taxonomies as well. Companies above a certain size must eventually report the numbers called for by the taxonomies, while today we must estimate the numbers for most companies.

However, knowing the alignment with today's thresholds is not going to tell you much about where the company is headed. Most of the market is not even included in today's Taxonomy, and for those that are included, the thresholds in most cases represent best practice using the existing fossil-based technology. As an example, the emissions that are deemed acceptable for steel producers today would be reduced by around 99% if a hydrogen-based model becomes cost-competitive.

It is thus only as innovation makes zero-emission alternatives possible that taxonomy alignment is likely to become an important reflection of transition leadership. Right now, the only way to really increase portfolio alignment would be to focus on the companies that are guaranteed to be aligned because their output is important for the transition like wind turbine and EV production.

The most important dimensions from a return and valuation perspective are likely to be the ones that we cannot measure directly anytime soon. Leaders will be the companies that beat their peer group not only on taxonomy alignment, but also in terms of shared emissions (and collaboration to reduce them) across the supply chain and the credibility of the plan to replace fossil-powered technology with zero-emission technologies over the next 20-30 years..

Figure 32: Identifying winners: 3 dimensions of transition leadership



Source: SEB

Transition arbitrage: Markets accelerate the transition

At the core of the regime change lies a capital replacement problem. The market driver of such a reallocation of capital is the repricing of the capital stock and the 'transition arbitrage' that this gives rise to. The market value goes down for the existing capital and up for the new capital stock including the intangible R&D capital used to develop it.

This process is only likely to start when the price tipping point for the new capital becomes visible. From this point on, investment in the old capital stock is likely to halt and the cashflow derived from continuing operations is likely to be channeled into the new types of capital. However, as internal funds are unlikely to be enough to finance an accelerated capital replacement cycle, capital markets will play an important role as well.

We thus estimate an extensive need for capital raises and loan restructuring and see an important role for both green and sustainability-linked bonds. We expect equity markets to return to their traditional role as providers of capital for investment. Financial innovation is likely to facilitate the raising of capital. Due to the need for coordination of the different components of a new production system, it is also likely to involve increased vertical integration and collaboration.

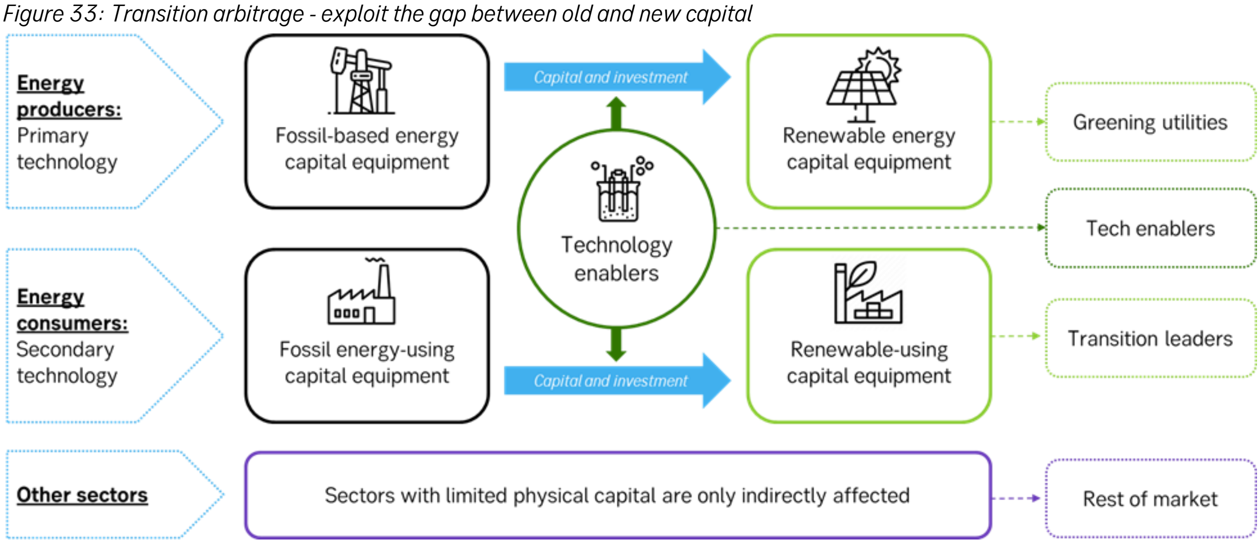
In order to provide an overview of the different transition arbitrage opportunities for investors, we use Figure 33 as a simplified illustration. It breaks the market down into four main groups: energy producers, technology enablers, energy consumers and companies with no significant physical capital stock to replace.

The transition will be different for each sector, both in terms of the technology deployed and the time in incubation. We have already seen energy producing capital being repriced along with many technology enablers. The automobile sector was the first energy-using sector to experience a repricing of a similar kind, but in the coming decades, we are likely to see one sector after another reach the same kind of tipping point as new technologies are developed.

Energy producers
The energy producers are already past the cost tipping point and the revaluation of the capital stock is already well advanced, even though we still have at least 20 years of exponential volume growth ahead for renewable energy. The transition has to a large extent been supported by public capital as the government is looking to safeguard the security of supply. This is also where a lot of green bond financing has been focused.

We expect long term debt financing to remain the funding tool for energy infrastructure due to the long-term horizon and relatively stable cash flows secured by government participation. As an equity investment, pure plays like Ørsted are rare and almost invariably expensively priced, although they may still offer good returns if they are able to scale with the market.

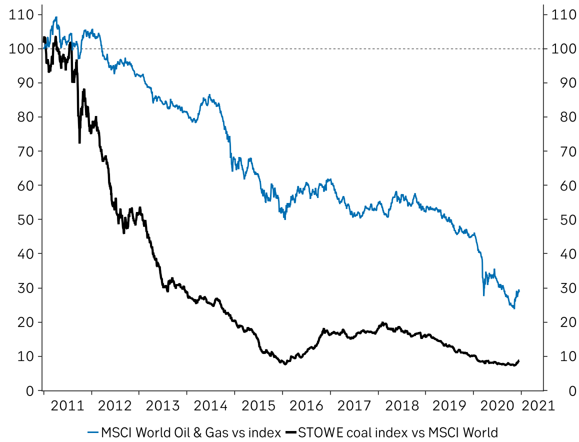
Figure 33: Transition arbitrage - exploit the gap between old and new capital



Source: SEB

Fossil producers will continue to generate positive cashflows in the coming years, but the value of their assets is likely to move towards zero. Such companies will start to resemble bonds, delivering a cashflow with negative growth until a fixed termination date. As the terminal date approaches, a company consisting entirely of fossil fuel assets will start trading at a price-to-book close to – or even below – one, due to the lack of growth potential and potential clean-up costs at termination. However, as the time to maturity is uncertain and highly dependent on political decisions, it is difficult to assess exactly when they become obsolete. This will of course depend on when the new technology will be advanced enough for a transition.

Figure 34: Repricing of fossil producers already happened

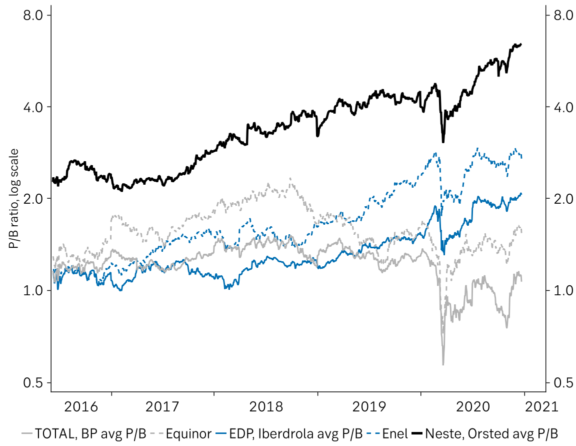


Source: Macrobond, SEB

As the fossil producers are often characterised by high debt levels and challenged by high depreciation, some of these companies might eventually come to struggle with solvency. On the other hand, as depicted in Figure 34, the stock prices of fossil producers have already fallen dramatically, which has eroded the equity value of the companies, but also led to very high direct returns. This constitutes an investment opportunity for investors that value the bond-like characteristics of the cashflow and do not care about growth (or sustainability).

Energy producers that transition towards renewable energy are likely to ultimately get higher valuations (Figure 35). However, the 'fossil discount' on fossil assets means that oil companies in transition should be valued with two different pricing-models; new technology assets as growing equity and old technology assets as bonds. As investors often associate fossil production with reputational risk, the pricing of mixed companies is subject to asymmetric information

Figure 35: Fossil producers try to escape 'fossil discount'



Source: Macrobond, SEB

Consequently, markets are likely to value mixed companies at less than the sum of the parts. It may thus make more sense to spin off the renewable part, if external funding is required for the transition.

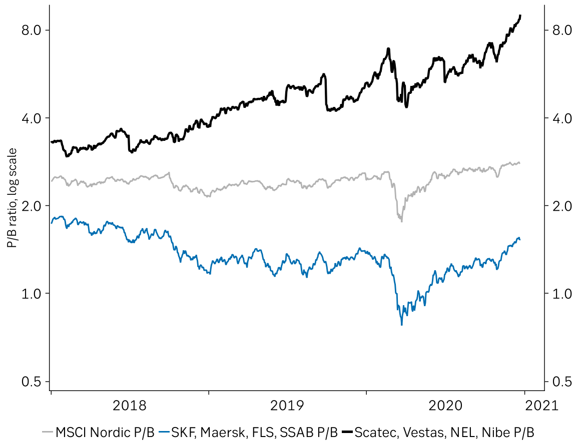
Technology enablers

Technology enablers are companies controlling key technologies that are used as inputs in the investment boom, both for energy producers and users. They consist of a mix of existing companies with tested technologies now used in new ways or companies with new technologies most likely at the venture capital stage, headed for IPOs.

As the demand for their inputs, consisting of everything from wind turbines, batteries, hydrogen engines to chemical catalysts, is likely to grow the same pace as the new capital stock itself, these companies are likely to be priced for a high long-term growth potential. To the extent that the technology enablers also control key technological advantages, they may sustain high margins for long periods of time. In many ways, these companies are the energy equivalent of the IT companies that provided the important bits and pieces for global distribution platforms and supply chains.

The valuation of technology enablers is thus always likely to be high as reflected in Figure 36 by the average price/book ratio of a representative group of Nordic technology enablers (black line) and energy users (blue line). However, an equity investor could secure a substantial return if she succeeds in choosing the maturing winners, where we expect the scale to increase many orders of magnitude.

Figure 36: Technology enablers get 'transition premium'



Source: Macrobond, SEB

The investment opportunity is to identify enablers relatively early in the growth process, spread the risk and make a careful assessment of whether the more mature enablers are potentially starting to become more like normal industrials. A recommended investment strategy within technology enablers could therefore be equivalent to that for IT companies: buy a whole portfolio of the companies that are early in the process and get a high return if just a few of them pan out.

Energy consumers

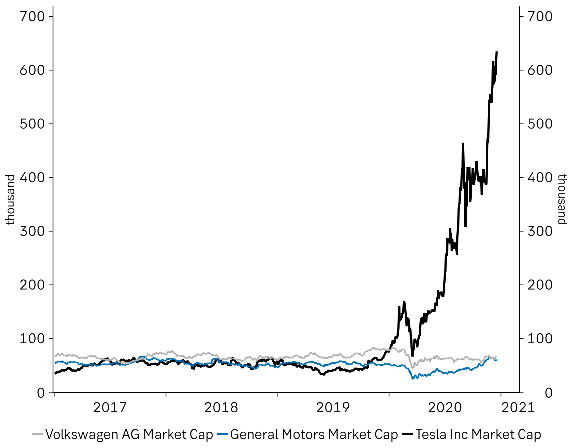
Among energy consumers, the cost tipping point has not yet been reached in any sector, as vital technology from the technology enablers is still to be developed (Figure 37). It is only when a tipping point can be discerned from extrapolating costs from pilot projects and prototypes that the repricing of capital can begin. Most sectors are still quite far from that point.

Energy users thus face a choice between the status quo of keeping a capital stock with a short timespan due to customer- and regulatory requirements or facing heavy investments in new technologies in hope of future growth. New technology investments, whether internal or through acquisitions, are not only expensive but can be very risky. The lack of clarity in relation to what the winning technology will be, increases the discount rate making the investment in sustainable assets less attractive. This fear has led to historically low levels of capex and a very slow transition.

Once they get there, the transition is extremely capex-intensive, but also likely to result in higher profitability, while the existing capital stock will be subject to high depreciation as it is likely to be retired before it was due for replacement.

This is evident in autos, where Tesla has been revalued compared to traditional car producers. We see this as a harbinger of what similar changes in other sectors, though most are at least 5–10 years from the cost tipping point. Steel, heavy transportation and shipping have however also started developing pilot projects.

Figure 37: Repricing will come to energy users too



Source: Macrobond, SEB

External capital from long-term investors is thus needed, and it is likely to come from investors that recognise the advantage of the new technology before the profits and volumes start to rise or from existing cash flows within the company itself. Due to the relatively risky nature of the investments this is more suitable for equity than bond funding, although issuance of sustainability-linked bonds will be a supplement as well as a powerful signalling too when trying to attract equity capital

The investment strategy is to identify transition leaders in each sector and benefit from the widening gap in valuation, profitability and earnings growth to the laggards in the same sector, but only when the new technologies are starting to become available. Likewise, investors can look for companies that engage in joint ventures, where companies from the same value chain join forces and benefit from risk-sharing and subsidies from governments. Recent events such as trade wars and thee coronavirus pandemic have also made vertical integration more likely to reduce risk.

Other sectors

The rest of the market is likely only to face limited effects of the energy transition and the capital replacement cycle. They are expected to do so mainly through scope 3 and sustainable value chain considerations. This is likely to be a secondary return driver for most companies.

The more important effects are indirect and related to the increased competition for capital as transition investment gathers pace. The result is likely to be a gradual increase in real interest rates, which is a problem if you have high debt levels, high valuations and high investment needs. Right now, corporate debt is extremely high, and many 'zombie companies' are most likely only kept alive because they do not have to pay for it, and the valuation of the mega large cap growth segment is extreme

At some point, the outcome is likely to be a serious deleveraging and a wave of defaults as only transition leaders get access to capital and laggards go out of business and a mean reversal for growth stock valuations once the capital replacement process gets traction is expected. This also means the transition will be important for banks who derive their main exposure from credit risk, as the transition leaders are less likely to default and more likely to have quality collateral. At first, a more sustainable long-term credit exposure may not be reflected in profitability for lenders. Over time, it is likely to be highly significant, especially when this enters directly into bank regulation around 2025.

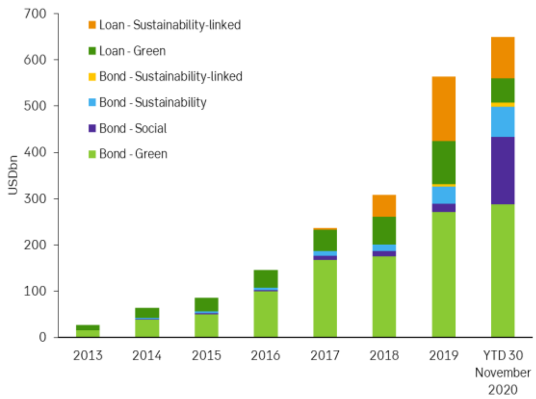
Capital market innovation: green bonds and equities
From a capital market perspective, there are several opportunities to be taken, as the cashflow from existing operations is unlikely to be sufficient to finance the massive capital expenditures that are needed over the coming 30 years.

Green bonds, which are always based on use of proceeds and backed by the issuer's entire balance sheet, have facilitated significant investment already. As depicted in Figure 38, annual green bond issuance is now more than USD 300bn, and we expect a continued growth in this segment.

The disadvantage of green bonds is that the use of proceeds model is exposed to greenwashing, once you leave the sanctuary of pure green energy companies. Sustainability-linked bonds address this concern by tying borrowing costs to tangible KPIs upon issuance. They are also likely to be an important commitment-signalling tool to the stock market, as the issuer accepts to be punished by a higher interest if they don't meet the objectives. So, while credit investors can invest directly in such bonds, equity investors can use them to identify companies who are serious about sustainable transition.

Equity markets are also likely to become a source of new capital, as most of the need for future financing will be characterised by higher risk. Green equity could play an important role in this context. However, the framework for green equity financing is still to be defined.

Figure 38: Sustainable finance markets have grown



Source: BNEF, SEB

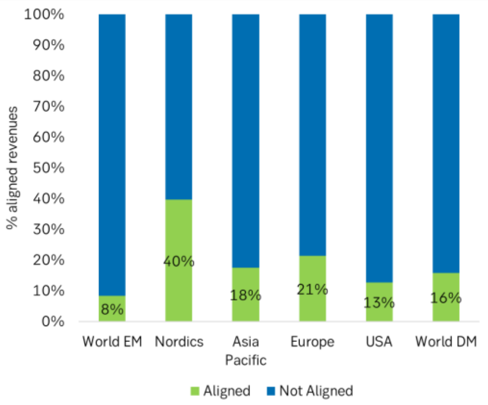
In the context of accelerating the transition, the only model that makes sense is one that ties share issuance directly to investment, in the same way as with issuance of green bonds. This would mean that investing in taxonomy-aligned capital stock is the only way to increase the number of green shares. 'Green' companies without a need for new capital could potentially buy back outstanding shares and issue the same amount of new green shares and benefit from a higher share price.

Nordics have first-mover advantage
The trends we describe here are already well advanced in the Nordics that appear to be ahead of the global curve both when it comes to corporate and financial innovation. This reflects a strong historical tradition for both sustainable business practices and early technology adoption, in combination with political leaders that have been prepared to lead the way for the private sector. The leadership is evident in all areas, from pure-play green energy companies to technology enablers and supply-chain alliances involving energy users.

The Nordics were early adopters of clean energy technologies. Hydropower and nuclear energy already made up a large part of the energy supply before anyone had thought of using solar and wind. Nordic governments have also been early in financing substantial investments in wind power projects. Perhaps the best-known example is Denmark's former state-owned oil and gas company Ørsted, which is currently the only company of its type to have completed the transition from oil & gas to pure renewable. The early government support for investment has probably also helped create early winners in the technology enabler space such as Vestas and Nibe Industries.

The result is that the Nordics currently have a higher taxonomy alignment as % of potential alignment than any other region (remember that technology enablers mostly come with full taxonomy alignment due to their output), as you can see in Figure 39 which is based on input from SEB's IMT database. This is not in itself a reason to invest, as alignment does not say much about direction. However, to the extent that it reflects a high share of mature technology enablers, it is certainly a strong indication of a head start in the transition process.

Figure 39: Taxonomy alignment (listed companies)

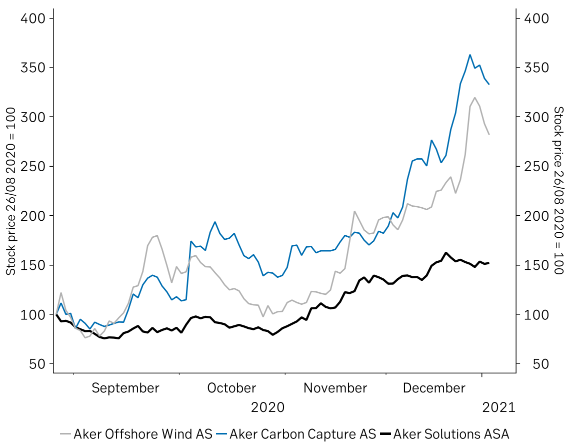


Source: SEB IMT tool

More recently, a new generation of enablers has emerged in the shape of start-ups and spin-offs. In Norway, NEL is an early mover in the hydrogen space but several new entrants are lining up and are likely to reach the IPO stage shortly. Finnish shipbuilder Wartsila has emerged as a pioneer in the development of hydrogen and ammonium-based ship engines, while Norwegian Scatec is among the first movers in solar.

Meanwhile, the 'fossil discount' was evident in Aker Solutions' spin-off of its wind technology and carbon capture divisions (Figure 40). Both spin-offs tripled in value in the last months of 2020, while the original owner also gained in value at the same time.

Figure 40: Example of spin-offs



Source: Macrobond, SEB

Perhaps the most exciting sign of the emerging first-mover advantages are in the energy-consuming space. There is currently a surge in collaborations and vertical integration across supply chains, attempting to create a blueprint for a new green supply chain (Figure 41).

These alliances typically involve similar combinations of companies. There is usually a green energy producer seeking to increase their market, technology enablers that can facilitate the practical use of the energy producers output, capital goods producers that embed the new technology in their products and capital goods users that need to reduce their direct emissions to stay investable.

The examples are only intended as illustrations and do not imply that the participants are good investments. Nonetheless, the number of new projects and the interactions between information-sharing companies is a powerful sign of a huge transformation as old-economy companies start behaving like giddy tech companies, sharing everything to maximise the common speed.

Figure 41: Recent vertical collaboration partnerships

Source: SEB

Background: Five industrial revolutions in 300 years

With long intervals, clusters of new 'general purpose technologies' combine to change the production model. Traditional macro models do not offer much insight into the process, but it is at the core of Austrian economist Joseph Schumpeter's theory of economic development, in which high profits and monopolistic competition are the drivers of regular episodes of "creative destruction".

The model we show here is inspired by the work of the late Richard Freeman and Carlota Perez. The core idea is that clusters of multi-purpose technologies transform the entire economic system, diffusing through the economy following the same pattern that is known from the diffusion of individual technology products.

This is not a smooth, linear process, but moves in fits and starts, with periods of radical and disruptive change alternating with long periods of more incremental change. It takes time because technologies keep getting better for decades. The first cars were no better than horse carriages and the first telephone no better than a telegraph, but that changed over time.

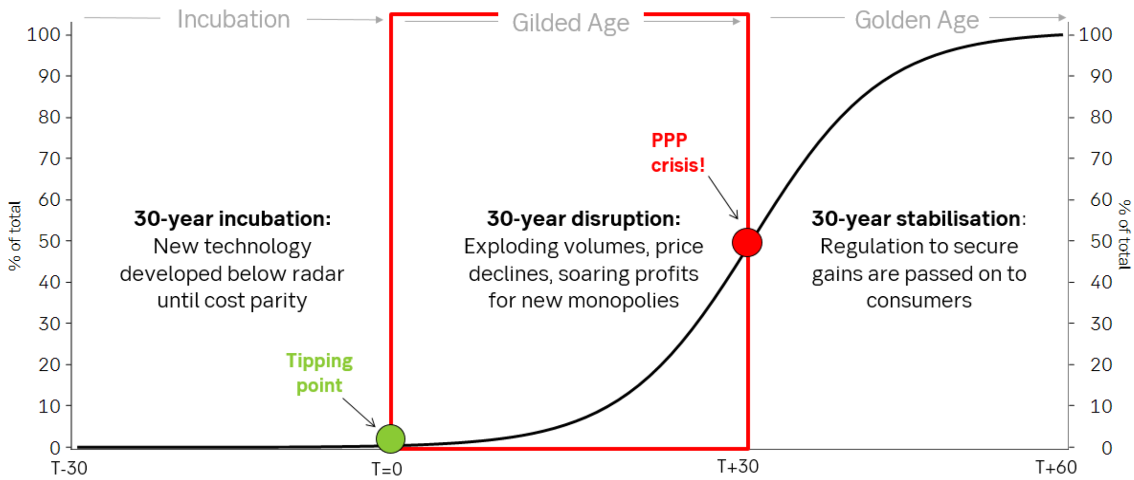
The historical technology cycles were very different, but they all followed the same S-shaped pattern of diffusion. This was driven by decades of falling prices and rising output following the original invention. It takes around 30 years in each of the three phases to complete an industrial revolution, both in the 19th and the 20th century. That's why we call it the 30-30-30-model. The three phases are:

Incubation. Major inventions are typically made several decades before a new technology regime enters the macro realm. Most of the major companies that come to dominate the new economy are also formed in this phase. However, practical applications are still too weak to unseat the existing regime. This phase is driven by a series of trial and error processes, which happens below the radar.

Disruption. The revolution starts with a "Big Bang" application that demonstrates the superior potential of a new technology set and starts the development of new production models around it. New companies grow into major corporate leaders. Capital goods prices fall and asset prices soar as the new industries achieve high profitability and monopolistic market power. Deflationary pressures emerge as supply leads demand. Side effects like monopoly power, inequality and pollution eventually cause a mid-way crisis and requires a regime change from Gilded to Golden age.

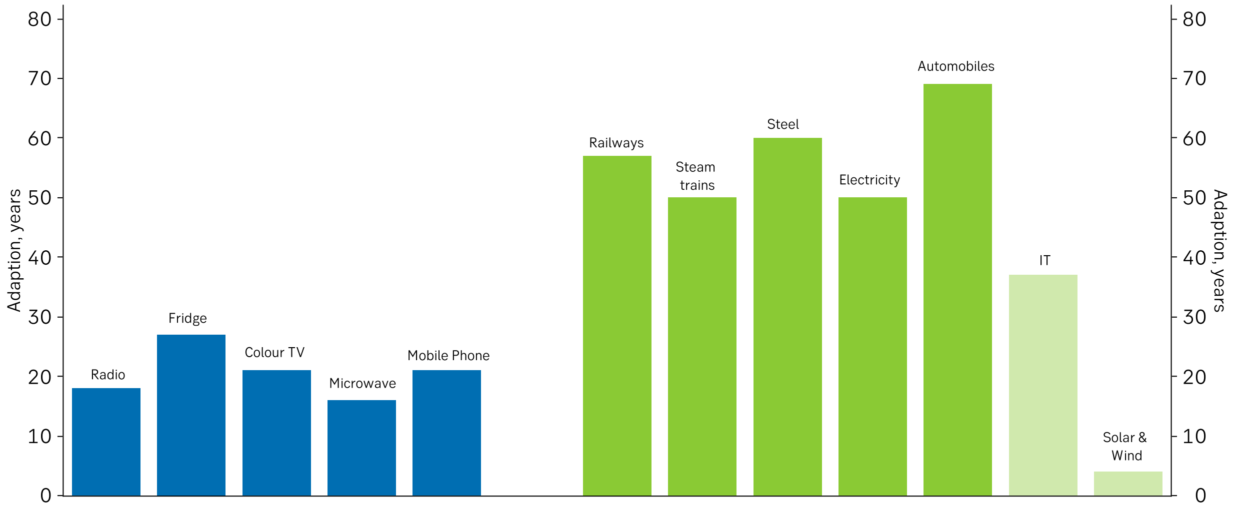
Stabilisation. After a political reset, demand starts catching up with supply and inflation stabilises. The rate of technology diffusion slows once the majority has made the switch to the new mode and volumes replace margins as growth drivers. In the end, as the penetration rate approaches 100% and technological progress is exhausted, slowing productivity growth leads to rising real wages and falling profits in the now heavily regulated economy. Then the cycle starts again.

Figure 42: Systematic mid-way crises are part of all technology cycles



Source: SEB

Figure 43: Diffusion of different technologies



Source: SEB

Diffusion of technologies vary in magnitude and speed of diffusion. Most new technologies can be used in the existing infrastructure, resulting in an average diffusion time of 20 years for the less disruptive diffusions. In contrast, deep 'general purpose technologies' such as railroads, steel, electricity and automobiles require a whole new infrastructure to be installed and deployed before they can be used effectively, resulting in a longer average timeline of 60 years.

And it's not enough with just one technology: Consider the auto industry in the early part of the 20th century. For the technology to be fully deployed, the car was not enough in itself. It also required breakthroughs in refining, a massive network of paved roads and gas stations, repair shops and mechanics etc. These could only be developed once the car was in place. And only then did it become clear that we could rearrange our cities with the post-WWII suburban revolution.

Figure 44: Overview of previous industrial revolutions

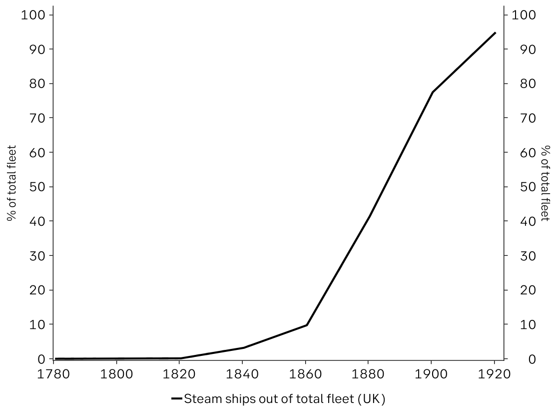
	Canals, textiles & water power	**Railroad, telegraph & steam**	**Steel, electricity & heavy industry**	**Mass production, autos & oil**	**IT, internet & renewables**
Period	1770s-1820s	1820s-1870s	1870s-1910s	1910s-1980s	1980s-
Production unit	Watermill	Steam mill	Factory	Assembly line	Supply chain
Accommodation	Mill housing	Mill towns	Cities	Suburbs	Megacities
Communication	Mail	Telegraph	Telephone	Radio/TV	Internet
Transportation	Canals	Railroads	Subways	Highways	**Electrification**
Power source	Water	Coal	Electricity	Oil	**Renewables**
Public policy	The work House	Schools, hospitals	Social insurance	Welfare state	**???**

Source: SEB

The age of water, canals and textiles
The first industrial revolution was driven by inventions in power, iron and textile production made in the first half of the 18th century. Starting in the 1770s, the cotton and iron industries led an investment boom that turned Britain into the world's first industrialised nation. In the early 1800s, the Luddite movement marked the first backlash against the new technologies. The boom faded after the Napoleonic wars.

The age of steam, iron and the telegraph
The first wave of industrialisation had its origin in inventions that were made in the late 18th century, notably the Watt-Newcomen steam engine. In the early part of the 19th century, innovations using steam power started to emerge in many parts of the economy. Steam engines were at the core of the new factory system, steam locomotives drove the new railroads and steam-powered iron ships transformed global trade. Simultaneously, the telegraph allowed information to move instantly over long distances.

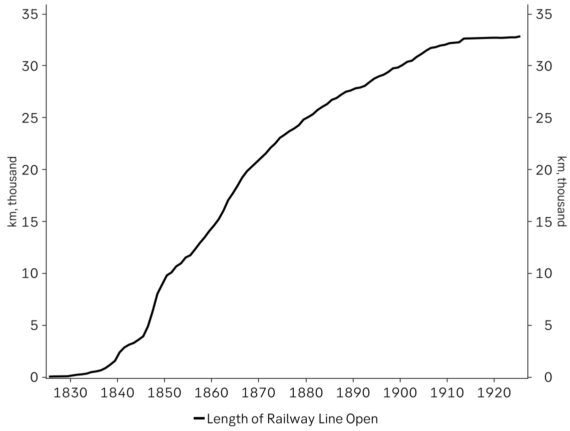
Figure 45: Steam ships



Source: Geels[7], SEB

The Liverpool-Manchester railway (1831) was the breakthrough application, and Britain was the undisputed leader in this revolution, providing 20% of world manufacturing output in 1860, but was joined by the United States, France and Germany. The railway crash of 1848 marked the mid-life crisis, while the repeal of Britain's Corn Law in 1846 could be seen as a first attempt to redress income imbalances. By the 1860s, the railway boom was exhausted and both continental Europe and the US saw an end-game of war and inflation.

Figure 46: Railway lines

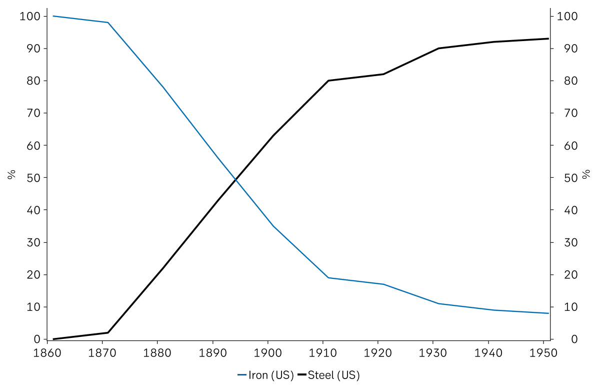


Source: Kriedel and Norbert[8], SEB

The age of steel, telephone and electricity
The next industrial revolution was powered by breakthroughs in the production of steel, allowing a surge in volumes and decline in prices at the same time. The inventions behind the new steel production methods were made and used on a small scale in the early 1850s.

It was not until Andrew Carnegie opened his Edgar Thomson steelworks in Pennsylvania in 1875 that things really took off. In the 20 years following this pivotal moment, steel prices declined 80% in real terms, while production increased manifold. By the early 1900s, steel had virtually supplanted iron. This paved the way for heavy machinery and engineering as well as tinned food, steel ships and the skyscrapers that created the modern metropolis.

Figure 47: Penetration of steel 1860-1950



Source: Freeman and Louca[9],SEB

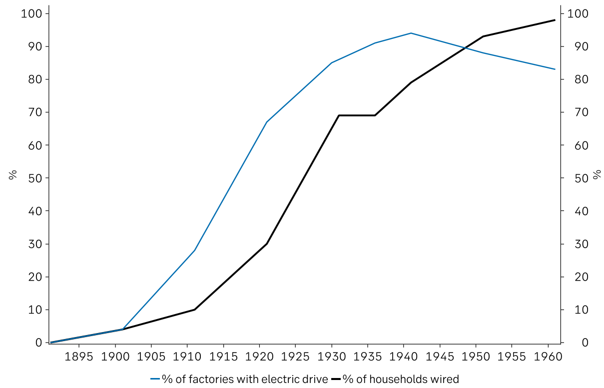
[7] Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study
[8] Long waves of economic development and the diffusion of general-purpose technologies: The case of railway networks

[9] "As time goes by" (p. 233) Original: Ayres (1989) Technological Transformation and Long waves.

Industry leaders like Andrew Carnegie (steel), John D. Rockefeller (oil), Cornelius Vanderbilt (railroads) and J.P. Morgan (finance) amassed wealth on an unprecedented scale in the Gilded Age by building integrated companies of a whole new scale. By the early 1890s, two decades of falling prices culminated in a series of banking crises.

The banking crises of the early 1890s marked the mid-life crisis after two decades of deflation, and steel prices stabilised after the formation of the steel cartel in 1898. Britain was overtaken by the US and Germany during the third industrial revolution, which culminated with the Belle Epoque of the early 1900s before another round of war and inflation (the Great War).

Figure 48: Electricity



Source: Freeman and Louca[10], SEB

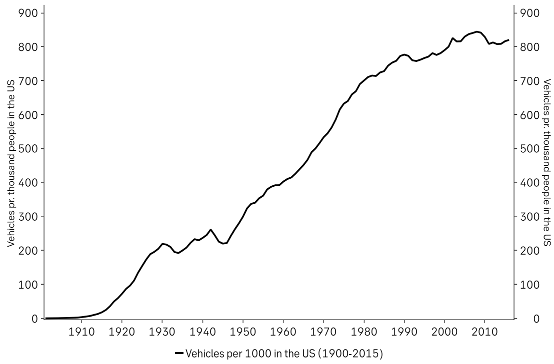
The investment boom in the 1880s was accompanied by a wave of financial innovation, most importantly the modern corporation, the stock market and the investment banks that operate it. The new capital markets were instrumental in raising capital for the huge investment projects of the age and also for the consolidation of industries into dominant monopolies. However, although the banking crisis in 1893 ranks among the three worst in US history, the financial system was relatively insignificant and perhaps as a result of this, the 1890s secular stagnation turned out to be relatively mild.

Market volatility continued, and the crash of 1907 led to the creation of the Federal Reserve. Real returns were high for both stocks and bonds in the early stages of the steel and oil revolution. From the late 1860s to the late 1880s, US equities delivered an estimated annual real return of almost 10%, while falling prices helped Treasuries to a real return of more than 5%. Bonds continued to see above trend returns until the end of the century, but equity returns slowed to just above zero from the late 1880s to the late 1890s. Bond returns levelled off from the late 1890s, but equity returns staged a rebound lasting a just over a decade.

The age of mass production, communication and autos
The next industrial revolution also had a long incubation phase. The key ingredients for the new economic system were Tesla's electric engine (1889), which allowed power distribution to be de-centralised in factories, the internal combustion engine (first petrol version: 1884) that would transform transportation and on the communications front Marconi's wireless radio (1897). Major companies like Ford, Siemens, GE and AT&T were established by the start of the 20th century.

Similar gains were realised for other types of manufacturing. Mass communication helped create a market for radio and later TV provided a marketing platform. During the "Roaring 20s", observers again entertained hopes of a new era of prosperity after the desperation of the 1910s.

Figure 49: Diffusion of cars, USA



Source: Oak Ridge National Laboratory[11], SEB

The car was invented in 1884 but it was not until Henry Ford's Highland Park moving assembly line model T factory was completed in 1913, that the full potential of the new technologies was realised. The real price of a Ford model T declined by 80% between 1910 and 1920, kick-starting the American love affair with cars and creating huge profits for Henry Ford.

After the 'Roaring 20s', the financial crisis and mass unemployment of the 1930s depression marked the mid-life crisis of this technology system, which saw the US

[10] "As time goes by" (p. 230) Original: Ayres (1989) Technological Transformation and Long waves.

[11] Source: Oak Ridge National Laboratory, Transportation Energy Data Book: Edition 35, ORNL-6990, Oak Ridge, TN, September 2016.

emerge as an undisputed technology leader. After two decades of stability and prosperity after WWII, the technological potential was exhausted and another period of inflation and (cold) war followed.

Like the Gilded Age, the 'Roaring 20s' saw financial innovation support the boom. The corporate sector had raised debt to finance increases in capacity, leaving it vulnerable to a setback, while mutual funds, mortgages and instalment loans extended the reach of finance to households.

This meant a bigger backlash when the bubble was exposed. The global bank sector collapse of the early 1930s helped propel the vicious debt-deflation of the Great Depression. Real returns were high for stocks and bonds during the investment boom. US equity returns in the 1920s were close to 20% annualised, while Treasuries had a real return of almost 5%. Bond returns remain high until the early 1940s, but equity returns collapsed in the early 1930s and did not recover the gain until the late 1940s.

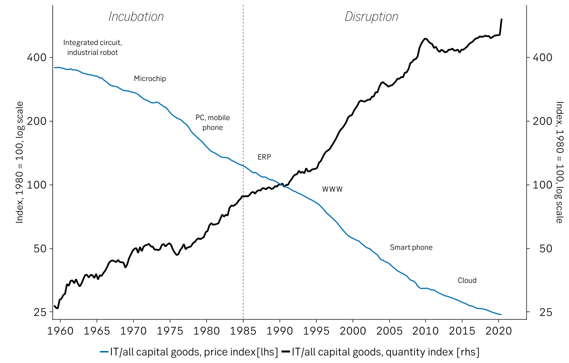
After WWII, Treasury returns entered a 40-year period of negative real returns. Stocks initially recovered, posting double-digit real returns from 1946 to 1966 only to turn negative in the following 15 years of rising inflation.

The age of IT and the internet
Following the pattern of earlier cycles, the IT revolution also followed a long gestation period. However, since the 1980s, IT has transformed all parts of the economy. In manufacturing, IT enabled the automated assembly line and the global supply chain system that allowed the assembly line to spread out geographically. In the service sector the automation of basic tasks, bureaucracies and logistical systems drove an organisational transformation.

Mega-cities with more than 10 million inhabitants are now becoming common. New communication tools allow people to share information on a scale never seen before. It is no surprise that such breath-taking possibilities has fed dreams of a new era of prosperity and stability. The IT revolution has also been driven by inventions from a generation earlier.

Key inventions like the Texas Instruments integrated circuit (1959), the Unimate industrial robot (1961) and Intel's 4004 microprocessor (1971) were made long before IT entered general use. Companies like Intel (1968), Samsung (1969), Foxconn (1974), Microsoft (1976) and Oracle (1977) were also in place before digitalisation took off.

Figure 50: IT

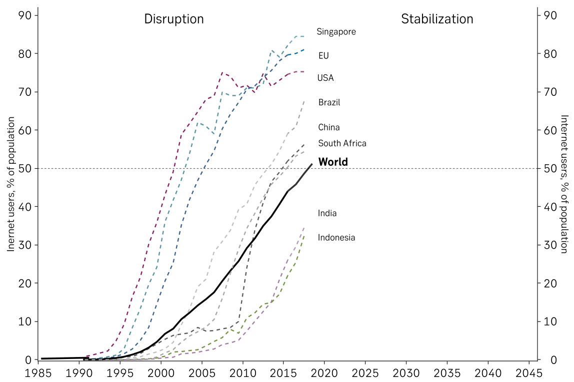


Source: Macrobond, SEB

However, it was not until the launch of the personal computer and mobile phone (1981) that the economic transformation began in earnest and investment really took off.

This is the first revolution to take place at a truly global scale, with population-rich Asian countries joining Western economies in the race. Financial innovation was at hand to transform such dreams into virtual reality. Capital markets were deregulated across the world in the 1980s in response to the stagflation crisis.

Figure 51: Internet



Source: Macrobond, SEB

Junk bonds, sub-prime mortgages, credit cards and hedge funds were among the new instruments that helped feed the huge reallocation of capital. It allowed consumers to spend even though normal incomes were stagnating as a result of soaring inequality.

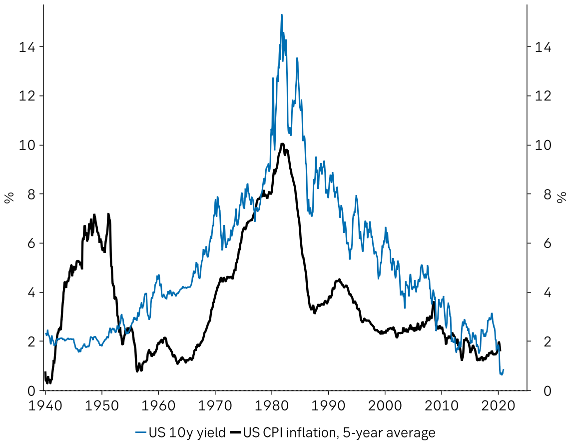
After the investment mania of the 1980s and 90s, the past 20 years have seen signs of financial stress, so far culminating with the financial crisis in 2008. Like in the mass production revolution, soaring asset prices and debt fanned the boom, but also increased financial risk.

From a market perspective, the IT revolution also showed a familiar pattern. Bond yields started falling in 1982 continued falling for the next four decades.

As in the 1930s, the low trend return has been the result of huge moves on both sides, with equities twice recovering losses in excess of 50% within a few years, aided by aggressive monetary stimulus.

Where do we go from here?
Looking at the earlier technology cycles, we can get an idea about what the next decades will look like in the IT revolution. The long pendulum swing towards deflation that characterises the disruptive 'gilded age' eras had led to the familiar side effects of pollution, power and poverty, and monetary policy can no longer balance saving and investment. This is setting the stage for the long reflation of the 'golden age', and the conditions for such a move are falling into place.

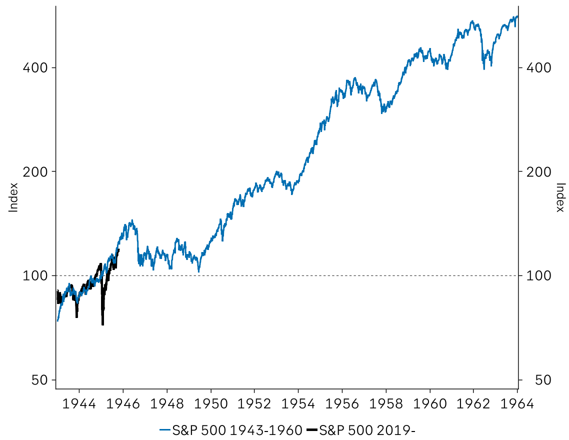
Figure 52: Bond yields below inflation again



Source: SEB

Today, bond yields are thus clearly below inflation for the first time since the 1940s, while government spending and intervention is on the rise. A long period of negative real yields and high public spending will ultimately result in higher inflation. The political awareness of threats to environmental, social and financial stability is clearly on the rise, and the pandemic of 2020 swept away the formal restrictions on their ability to act.

Figure 53: Stocks flat in first part of reflation in the 40s



Source: SEB

This in turn is likely to lead to a secular low for bond yields. Given that we start with extremely high debt and valuation levels, the result, like in the 1940s, is at first likely to be a multiple compression and deleveraging. In the first part of the value rotation, the stock market is likely to go sideways. Multiple compression is likely to balance out However, once valuation has normalised and debt has been reduced, equities are likely to enter a secular bull market.

This report was published on 28 January 2021.

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