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Decarbonising the European Chemical Sector

An investor's perspective

ShareAction»

About ShareAction

ShareAction is an NGO working globally to define the highest standards for responsible investment and drive change until these standards are adopted worldwide. We mobilise investors to take action to improve labour standards, tackle climate change and address pressing global health issues. Over 16 years, ShareAction has used its powerful toolkit of research, corporate campaigns, policy advocacy and public mobilisation to drive responsibility into the heart of mainstream investment. Our vision is a world where the financial system serves our planet and its people.

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ShareAction is delivering a programme of engagement with the European chemical sector, to ensure that companies are taking credible steps to align with the goal of limiting global warming to 1.5C. Companies must act urgently to limit global warming to 1.5C in order to avoid the worst impacts of climate change, and ShareAction's previous research has shown that this transition is technically feasible and increasingly economically viable.

To build on this research, ShareAction has commissioned *The Sustainable Investor* to undertake research on the possible financial implications of a Paris-aligned transition in the chemical sector. The analysis is focused on how companies can create long-term financial value and competitive advantage.

The key questions to be investigated are:

- In the face of the upcoming technological, political, regulatory and social changes, are there financially viable pathways to a low-carbon operating model?
- Over what time scale might this transition occur?
- What investments do the companies need to make and when?
- What would be the impact on their key financial metrics and their ability to sustain acceptable levels of shareholder financial returns?

This report is prepared by Steven Bowen. He is a founder of *The Sustainable Investor* and an editor of their blogs and newsletters. Steven is an engineer, who has 30 years' experience in the financial and investing industry. His expertise covers corporate finance, debt financing and equity markets. He spent many years working on the buy side, including at HSBC Asset Management, Franklin and a small London-based boutique. Steven's focus is on creating long-term value and competitive advantage through constructive engagement with companies and their stakeholders.

Executive Summary

Executive summary

It makes financial sense to invest in the transition now

Globally, most governments have made a binding commitment to aim to limit global warming to 1.5C (Paris aligned). This commitment, and any adaptations they make, will form the basis for future regulation and legislation. This means companies need to align themselves with this goal. In a practical sense, they need to move as fast as is possible to decarbonise their operations, whilst remaining financially viable. For investors, the companies that are able to adapt the fastest will be best placed to maintain competitive advantage and to exploit future opportunities.

A Paris-aligned transition in the chemical sector means not only a shift to renewable energy and process electrification, but a more fundamental change to substitute fossil fuel feedstocks for emissions-neutral alternatives. The technical and process challenges this requires will be enormous, as will be the challenge of transitioning in a way that is financially viable. Chemical companies operate in a highly competitive and capital-intensive industry.

This report argues that there is a clear financial case for chemical companies to begin investing now, even before new technologies are demonstrated at scale, and before the cost of energy alternatives becomes attractive. The industry has a history of ‘learning (and hence winning) by doing’. Its processes are complex, and long-term competitive advantage is created by a series of often small process improvements, learnt over time. As the new technologies will take years to develop, pilot and then scale up, early movers will be rewarded. By contrast, delay will leave companies exposed to future financial risk from regulation, and from needing to invest significant capex later to catch up – which could lead to a loss of competitive positioning and long-term profitability declines.

Investors should therefore look to companies to produce credible, detailed transition plans – setting out the technologies they will explore, how and where investment will happen, the short term capex (the next 5 years) they will need, and the scope of their potential longer-term investment programme. Some European companies have already started this process. For all companies, pulling existing plans into a coherent strategy is becoming increasingly urgent.

Investors should look for companies to make three changes now

The building blocks that the industry needs to decarbonise are broadly known, but it is recognised that many are not yet available at commercial scale. Despite this, there are three actions that companies can begin to make now:

1 Switch to using renewable electricity as fast as practical. The historic trend in Power Purchase Agreement (PPA) prices suggests that in most regions this shift will result in input cost reductions and relatively short payback periods.

2 Electrify production processes to tackle scope 1 emissions. This should mean new plants are electrified as standard, to anticipate the scale up of electrified processes.

3 Begin to transition to alternative emissions-neutral feedstocks. The analysis in this report suggests that renewable hydrogen is the most commercially viable alternative in the long term. Based on the rate of technological improvement, its highly likely that renewable hydrogen will be cost competitive with traditional fossil fuel hydrogen with carbon capture (blue hydrogen), in most regions, before the end of this decade.

There is a lot of development work to be done and working backward on timescales, this means having pilot projects that can trial utilising new feedstocks up and running by around 2027, which in turn means starting construction by around 2025. This means preparation work must commence now. This timescale will give governments the clarity they need to target financial and regulatory support, which will be critical.

Investors will understandably be cautious about any new technology not yet proven at scale, but live examples of decarbonisation in heavy industries show how fast technologies can progress and scale with the right support. In the cases of green steel and green ammonia, as discussed in this report, expectations and forecasts have been revised upwards in only a few years. Further, the growth of renewables in the state of Texas illustrates that when financial benefits become clear, green solution roll out can be rapid.

Companies can navigate a financially viable transition

The financial analysis in this report considers the potential impact of Paris-aligned capex investments on the profitability of a selected European peer group: BASF, Linde, LyondellBasell and Air Liquide – all large-cap chemical companies.

This analysis shows that these companies can afford the low USD$ ten's of millions of capex needed in the short term to develop pilot programmes and the USD$50m to USD$100m needed later in the decade to advance project commercialisation. This can happen without material damage to their cashflows and their return on capital employed (ROCE), and it should not limit their ability to pay dividends.

Starting to invest now should provide the companies with the ability to time capex to avoid large financial shocks and give them the required flexibility to work though periods of lower profitability which, given the nature of the industry, will most likely come.

Transition in the chemical sector – an investor’s perspective

Transition in the chemical sector – an investor's perspective

Introduction

The purpose of this analysis is to assist investors in thinking differently about the future development of the chemical sector.

Historically, for many companies in the industry the best approach has been to progress conservatively, making small changes to their product offering, improvements to productivity, and fine tuning operational performance. However, sometimes external factors make this approach inappropriate. The factor could be a step change in customer demand, input costs, the regulatory environment or all three. The companies that anticipate these moments and act quickly can set themselves up for long periods of sustained competitive advantage.

The changes brought about by the transition to net zero are likely to become such a moment. The need to create new methods of production will dramatically change the industry. During this change, the companies that adapt the fastest will be those that offer the best chance of delivering long term value for investors. Those that wait face the risk of reduced profitability and a slow demise.

This transition period will be long, lasting perhaps a decade or more. This does not mean that delay - waiting for more certainty before making critical choices - is a sensible plan. The industry's processes are complex, and it will likely take many years to identify the best technologies and refine them to the point where they are both practical and profitable. From an investing perspective, the time for companies to start this transition investment is now.

The chemical sector will decarbonise – the question is how and at what speed

"In the Net Zero Emissions by 2050 Scenario, CO2 emissions start to decouple from production in the coming few years." – IEA Chemical Sector Tracking Report September 2022

Most companies and investors recognise that the chemical sector needs to transition to net zero, in line with the Paris Agreement. This will impact both feedstocks and production processes. The debate from an investor's perspective is about how quickly this happens and, perhaps most importantly, what path companies can take that will enable them to remain profitable as they transition. It is to no one's advantage if the industry faces financial collapse.

The transition will take a decade or more – this is not an overnight change

The commercialisation of these new processes at scale looks likely to start over the coming decade. This might seem to some investors to be a long way out, well beyond their normal financial forecast period. However, the capital-intensive nature of the chemicals industry, with its long-life assets and highly cost-sensitive demand, means this way of thinking is likely to be short sighted.

Long-term profitability is the best value indicator for the sector

In thinking about a value creation framework for the chemicals industry it is possible to get bogged down in the short-/medium-term cost dynamics, and supply/demand changes - and their impacts on margins. A lot of broker and investment bank research and commentary on the sector reinforces the view that this is all that matters in deciding when to invest or divest. While the short-term is important, the longer-term profitability and cashflow generation of a business creates the majority of value. In the case of a capital-intensive industry such as chemicals, with multi-decade asset lives, maintaining a long-term perspective is even more important.

The cost of inaction or delay could be high

There are well-known examples of companies that saw change coming but failed to respond adequately until it was too late, creating the foundations of their own demise (Nokia in mobile phones, Kodak in cameras and Blockbuster in video rental). It is for this reason that a chemical company's long-term transition plan should be a material concern for investors now. Investors need plans that are comprehensive and credible: not just broad signals of technologies a company may explore, but how and where investment will happen, the short-term capex (the next 5 years) they will need, and the scope of their likely longer-term investment programme.

Disruption is coming; chemical companies need to respond proactively

In common with other high emitting sectors, the chemicals industry faces an uncertain long-term future. On one hand investors can expect resilient demand for its end products. It's also likely that the competitive dynamics will remain the same - it is a very cost-driven industry. On the other hand, production processes will have to change, and these changes will be dramatic. This can materially disrupt the industry and affect which companies are best positioned to create value in the long term. Future winners could be different from those that are successful now.

The transition will need considerable government support

As with other heavy industries, the chemical industry transition will need considerable government support. Some of this will be financial, directly funding R&D and pilot project capex, but the industry will also need regulatory support. Examples of this include carbon pricing, contracts for difference on input costs such as renewable hydrogen and renewable electricity, and the EU Carbon Border Adjustment Mechanism. The good news is that various governments are already moving on this, with the most recent development being the US Inflation Reduction Act (IRA).

One of the drivers of this support is to align with the Paris Agreement, but two other key motivations are retaining well paid jobs and improving energy security. This means we should expect an increase in support for decarbonisation, with an increasing probability that we are entering into a period of green subsidy wars, as countries and regions seek to match subsidies provided elsewhere.

What is important for investors is not just that this support exists, but that it is properly aligned with credible transition plans. This makes it even more important that companies start their planning now. By doing so, companies and their shareholders can better influence how government assistance develops.

A challenging transition requires early action

The challenges involved in this transition are not to be underestimated, especially for an industry that has long had a focus on cost management and process efficiency. Trialling and adopting new processes and feedstocks will require material capital commitments and involve organisational realignments. By starting now, companies can protect their long-term value creation potential.

Addressing scope 3 emissions is key

The bulk of the sector's emissions are at scope 3, from the fossil fuel feedstocks it uses. This is where the real opportunity – and the real challenge – lies. The industry needs to find financially viable alternatives to fossil fuels as a feedstock.

Figure 1: Energy demand from industry sectors, including chemicals and chemical feedstocks

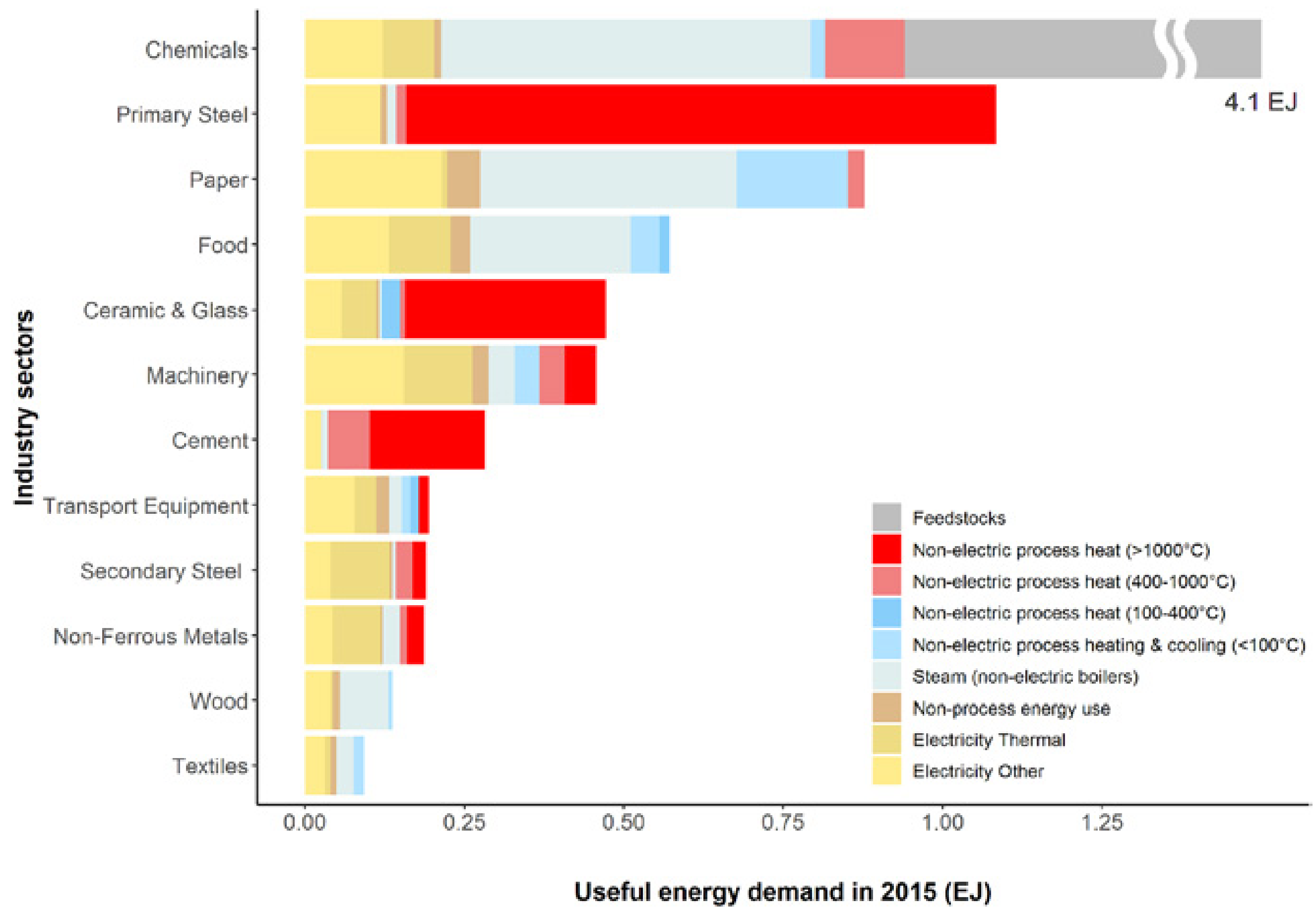
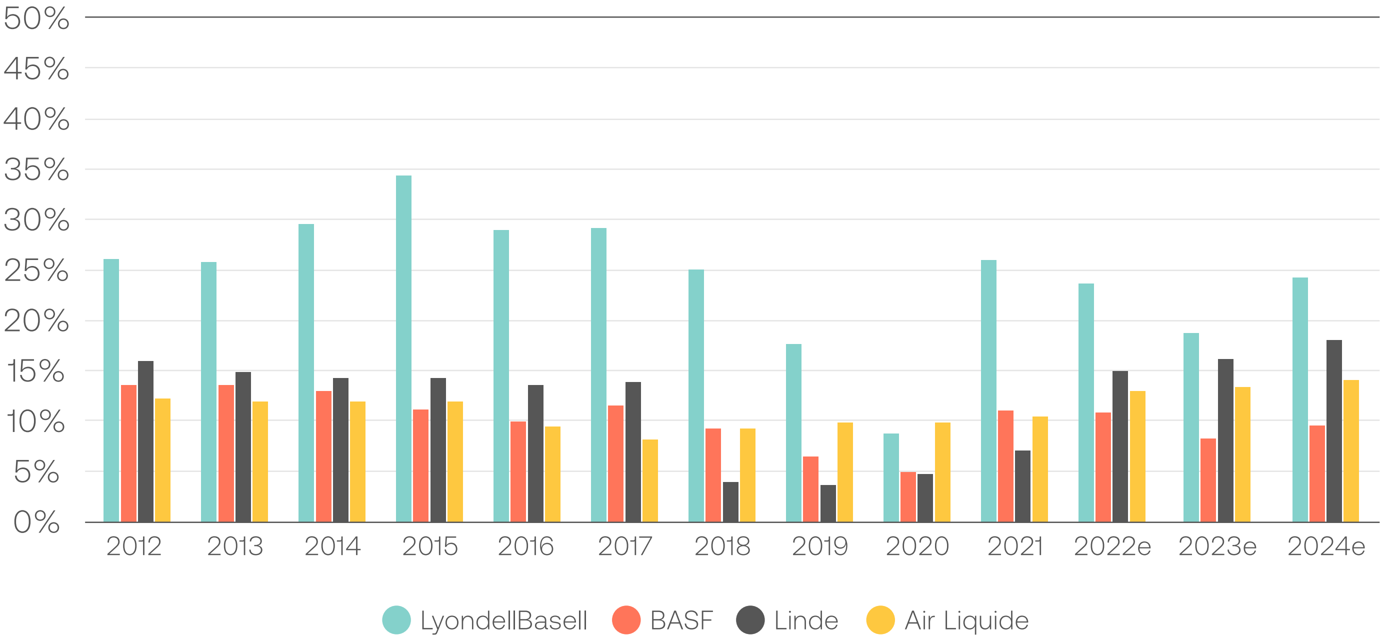


Figure 1. Distribution of industry UE demand for the year 2015 in the EU27/UK. See supplementary figure A.1 for a variant of figure 1 without chemical feedstocks and figures A.2 and A.3 for a visualisation of the energy distribution at FE level.

Source: Silvia Madeddu et al. (2020), 'The CO2 reduction potential for the European industry via direct electrification of heat supply (power-to-heat)' *Environmental Research*, Lett. 15, 124004.

The overriding industry consideration is cost. The industry is highly competitive, with most end-customer buying decisions based on price rather than product quality (which is broadly standardised to fit end customer production needs). European company returns on capital employed (ROCE) have generally been muted with input costs, especially energy, being generally higher than in other global markets. The relatively expensive price of renewable electricity vs gas, in part reflecting different tax treatments, is clearly a barrier that governments need to remove if the electrification of the chemical industry is to accelerate.

Figure 2: Return on capital employed trends for four major chemical companies



Source: *Sharepad* – data as of 27 January 2023

By and large the companies in the industry are price takers. This means that they will only invest in new technologies where the competitive economics make business sense (either due to cost advantage or where premium priced "green" demand exists) or when governments are prepared to provide financial support. Demand volatility makes matters more challenging. The industry often suffers from periods of oversupply when operating margins can be materially depressed. Together, these factors reinforce the need to find transition pathways that do not destroy the financial viability of the sector.

Compelling reasons to act now

Despite these challenges, there are compelling reasons why chemical companies should be starting to invest in emissions-neutral production processes:

- In many jurisdictions regulation is getting tougher, with carbon pricing being the most obvious factor. Investors should only expect this trend to accelerate.
- End customer demand for cleaner and greener industrial products is growing. The most obvious example is in green steel where nearly all major automotive original equipment manufacturers (OEMS's) have plans to transition. But opportunities also exist in plastics and in new markets such as green shipping fuel.
- Progress on reducing the costs of the alternative technologies is starting to accelerate. As a result, the alternatives are becoming more competitive, and processes are moving from pilots to demonstrations and then, in the future, on to full commercialisation at scale.

Waiting for a clearer path is a false logic

For companies and their investors, there could be a strong instinct to wait for more acceptable costs and technological readiness. In many industries waiting to be second or even third mover may be a good plan – to let someone else make the mistakes, go down the blind allies, and spend capex that could be eventually written off.

There are two reasons why this approach could lead to a bad outcome for investors in the Chemical sector. First, this is a highly capital-intensive industry, with new chemicals plants costing USD$billions to build. Given the long life of assets, plants built or upgraded now will easily be operating into the 2040s. This makes the risk of stranded assets in the 2030s and beyond very real, with plants operating what turn out to be old technologies.

Second, and perhaps more importantly, there are real benefits of being first mover in this industry. Getting new technologies to work efficiently together at the scale of a chemical plant takes time and experience – first movers could get an operational head start of five or more years on slower-to-adapt peers. On top of this, developing a new site, including design and permitting, is a long process. Needing to catch up with capex can expose a company to many years of lower operating profitability, impacting cashflow, ROCE and the ability to pay dividends. At a more extreme level, this could reduce the ability of the company to fund future decarbonisation R&D, which could cause a company to fall even further behind its competitors.

The faster a company can get up the learning curve on how to operate new processes most efficiently, the more competitive they will likely be. The more complex the technical challenges, the more important it is that companies begin soon. Waiting is probably the worst option in terms of long-term value creation.

There are three main viable actions to decarbonise production

First, use more renewable electricity. Replacing existing electricity consumption with renewable alternatives is the easiest win and the one that chemical companies should utilise the most rapidly. Both Europe and the United States have active plans to decarbonise their electricity generation networks. In terms of cost, renewable electricity is already the cheapest source of supply in many jurisdictions, and the gap should continue to widen. Making this transition, with Power Purchase Agreements where these are needed, should be a simple economic decision.

Second, process electrification. Recent research has identified that electrically powered technologies could cover the whole temperature spectrum relevant to most industrial thermal processes. However, as the report highlights, when looking at the chemical industries' specific requirements, there is a "high level of technological uncertainty", which means that further R&D is needed. Unpublished analysis by Silvia Madeddu et al. suggests that for electrification to become more widely applied in the chemical industry, a much closer working relationship between the equipment suppliers and their industrial customers will be needed. Again, this is another process to start now.

Third, switch from sourcing raw materials via fossil fuels to emissions-neutral sources. This is the most challenging of the transitions, but it's also the one that delivers the best payback in terms of GHG emissions reduction, and the approach that will best position chemical companies for future competitive advantage. Technically it means that, rather than producing high value chemicals – olefins (and polyolefins) and aromatics – via steam cracking, they are instead produced with methanol, via alternative methanol-to-olefins (MTO) and methanol-to-aromatics processes (MTA). Emissions-neutral green methanol can be made with renewable hydrogen and CO2 as inputs.

Sourcing CO2 for this process that will be emissions-neutral is not straightforward. There are various options, including waste-to-feedstock via chemical recycling, direct air capture, and point source capture from other industrial processes. All of these entail trade-offs, and several are still at an early stage of development. Plus of course, for some, cost is a big issue. The earlier the R&D starts, the sooner the industry will be in a position to profitably roll out alternatives.

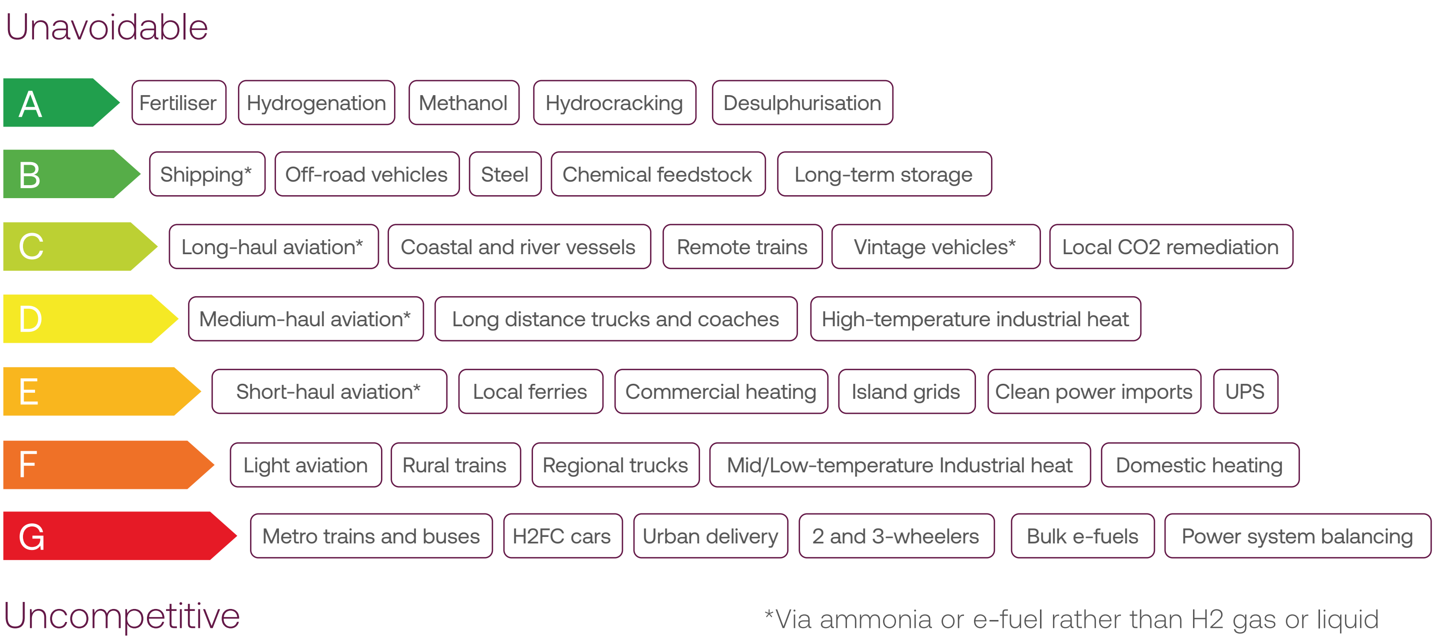
Renewable hydrogen likely to beat carbon capture

Alongside renewable hydrogen – hydrogen made with electrolysis, powered by renewable energy – 'blue' hydrogen gets a lot of attention as an alternative technology. This is simply conventional hydrogen production by steam reforming of natural gas, plus carbon capture. The analysis presented here leads to the view that this will be, from an investor's perspective, an inferior solution to the use of renewable hydrogen as a feedstock. While it's a known technology in other oil and gas applications, the technical and cost challenges of adapting it to new processes are material. And more to the point, it does not resolve the upstream emissions from natural gas extraction. Hence, this analysis expects most regulatory frameworks to end up, in the longer term, aligned with a renewable hydrogen and green methanol based approach.

But, it is important to be clear: while the renewable hydrogen supply pipeline is growing, it is not yet available at the commercial scale and at the right price to service industry demand. This makes chemicals different from, say, transport (where electric vehicles are already scaling up) and of course electricity generation (where solar and wind are already cheaper than new fossil fuel-based generation in many regions).

As renewable hydrogen production increases, its use as a chemical feedstock should be a priority over other uses such as power and heating for any government looking to decarbonise their heavy industry.

Figure 3: Priority uses for renewable hydrogen

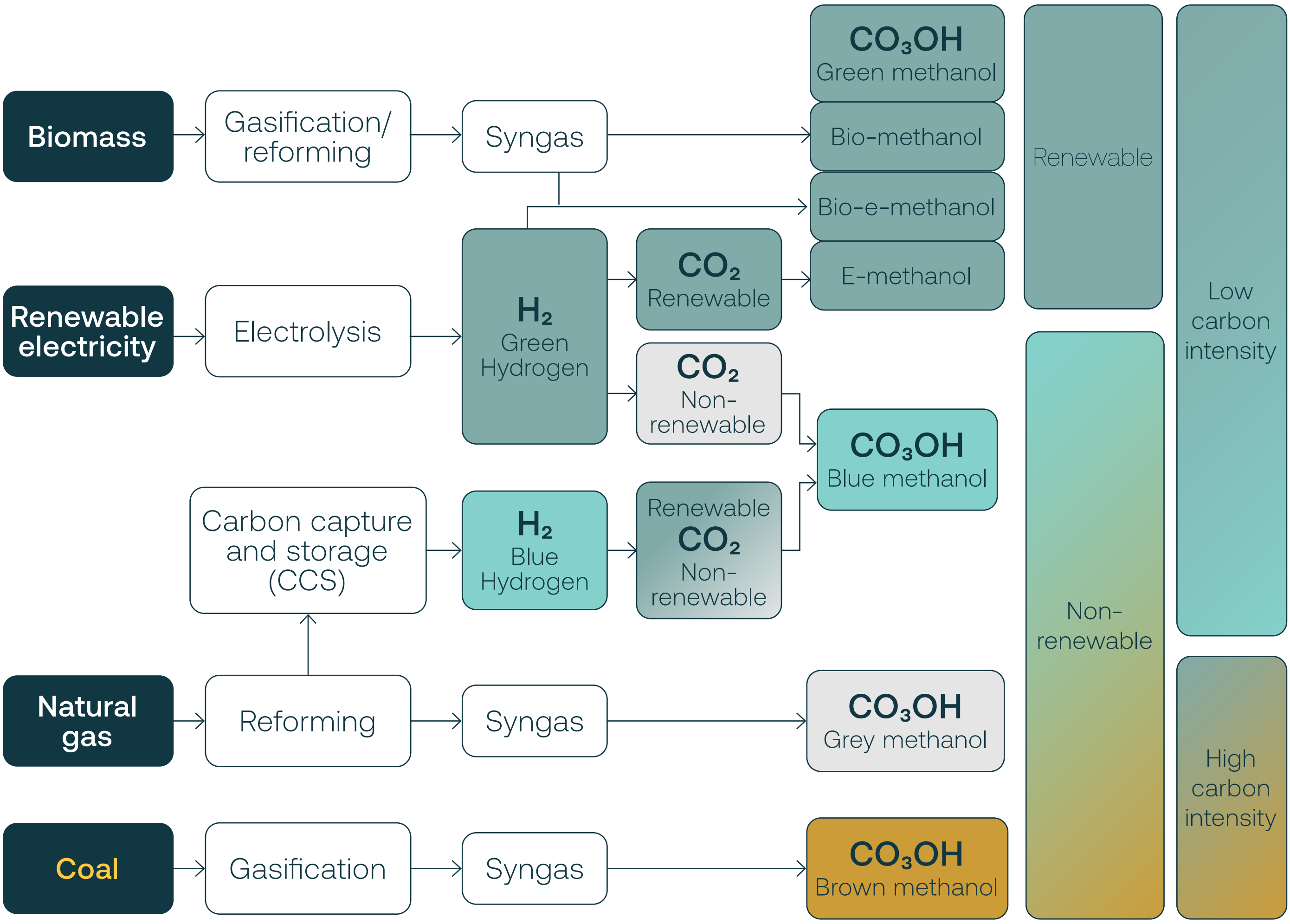


Source: Liebreich Associates (2022). (Concept credit : Adrian Hiel/Energy Cities)

Methanol-to-olefins (MTO) is already a proven and commercially viable technology

While it's not yet widely used in Europe or the US, it's already extensively used in China, as part of the high-emitting coal-to-methanol-to-olefins process (the high emissions are a consequence of the feedstock, not the process). However it is not a Chinese technology; the technology is licenced to the Chinese projects by Honeywell UOP, a US based specialist that provides refining, petrochemical and gas processing technologies. Their first major plant outside of China, in Nigeria, is planned to start operations in 2024.

Figure 4: Innovations in green methanol production



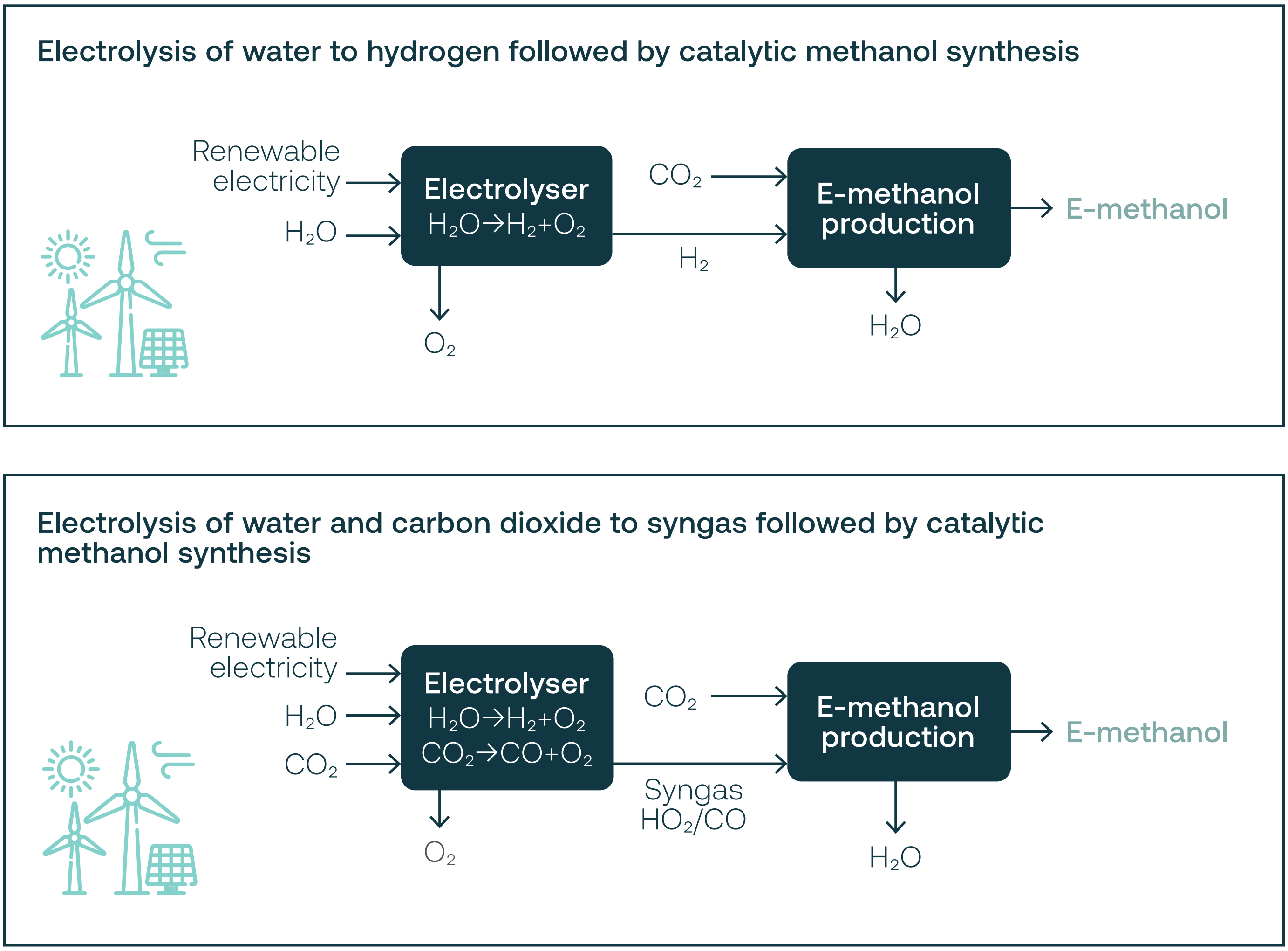
Source: IRENA (2021), *Innovation in renewable methanol*.

Given this, the most material technical challenge is therefore to produce emissions-neutral methanol to be the input to the MTO process. Currently methanol is produced primarily with fossil fuels, with 65 percent based on natural gas reformation and 35 per cent based on coal gasification (the lower two technologies in the chart above).

Green methanol production for MTO requires cheap renewable hydrogen

The technology to create methanol from renewable hydrogen and CO2 already exists, but renewable hydrogen needs to be cost competitive to make this economically viable.

Figure 5: Green methanol production flow diagrams



Source: IRENA (2021), *Innovation in renewable methanol.*

The main driver of this is not cheaper electrolysers but cheap renewable electricity. Most analysis suggests that the cost of renewable electricity needs to fall to below $20/MWh before renewable hydrogen is broadly cost competitive. The renewable hydrogen is likely to be generated using solar electricity, with best estimates being that, in many countries, cost targets will be met toward the end of this decade. Putting all of this together, sources such as IRENA can see a pathway to affordable green methanol in around ten years, which can then be used as a feedstock for the MTO and MTA processes.

Figure 6: IRENA cost projections for green methanol

		Estimated costs in		
		2015-2018	2030	2050
Cost of green hydrogen (USD/t H_2)		4,000-8,000	1,800-3,200	900-2,000
Methanol through CO_2 from combined renewable sources				
Cost of CO_2 (USD/t CO_2)		10-50	15-70	20-150
Cost of methanol (USD/t MeOH)	With no carbon credit	820-1,620	410-750	250-630
	With a credit of USD 50/t CO_2	730-1,540	320-660	160-550
	With a credit of USD 100/t CO_2	640-1,450	240-580	70-460

Source: IRENA (2021), *Innovation in renewable methanol*.

Constructing enough renewable hydrogen electrolysers and renewable electricity sources to meet demand will take time. New renewable electricity capacity is being added in Europe but there are competing demands for this. After these supply barriers are overcome, companies will still face the challenge of making the entire end-to-end process work efficiently. Pilot plants will allow companies to refine these processes. This will all be challenging; but the lessons from green steel, which we highlight below, show that with the right will from companies and governments, and the correct level of financial and regulatory support, fast progress can be made.

In order to move forwards and be competitive, chemical companies need to start working on these technologies well before all of the factors are aligned. If 2030 is when renewable hydrogen reaches cost parity, then pilot plants should be well advanced by 2026/2027. In turn, this means that companies should be identifying technologies, partners, sites, and the required nature of government assistance, within the next one to two years.

Some alternative technologies offer false solutions

There are a number of other approaches to the decarbonisation transition that companies are exploring. While some may have short-term financial merit, potentially offering a technology bridge, in the longer term they will not get the industry to where it needs to be: a business model that allows companies to create competitive advantage that in turn leads to sustainable profitability. All of this must happen within the constraints of upcoming regulation, government assistance and changing end-consumer demands.

Biomass – The use of biomass raises questions around scalability and feedstock availability. In the IEA NZE scenario biomass is used in a number of applications including as a fuel for shipping, heavy road freight and aviation. It is not clear what the sustainable biomass supply will be in the long run, with the IEA analysis suggesting that "*another early priority is for governments to assess national sustainable biomass feedstock potential as soon as possible to establish the quantities and types of wastes, residues and marginal lands suitable for energy crops*". Recent Research "*finds little consensus between models on where biomass could be cost-effectively produced*". All of this suggests that further analysis is needed, making the potential supply situation very different from that for renewable hydrogen, where the raw materials are easily available. Additionally, there is considerable debate around just how sustainable some biomass harvesting actually is. In 2023 ShareAction will publish a report on whether biomass should be used as a chemical feedstock.

Carbon capture – While the current enthusiasm for carbon capture utilization and storage (CCUS) is high, as evidenced by elements of the recent US Inflation Reduction Act, the history of CCUS deployment has largely been one of unmet expectations. The IEA is a supporter of the technology, arguing that "net zero plans makes CCUS a necessity, not an option". But even they accept that the pathway to a technical solution is not clear. It is the view of this analysis that the costs and technological challenges will mean that CCUS will ultimately be reserved for the hardest of decarbonisation challenges – which is not (yet) the case for the chemical industry.

Use of plastic waste to create a feedstock – While waste-to-feedstock chemical recycling can have a role to play, there is uncertainty around the extent to which this can be sufficiently scaled and whether it can align with expected regulation around whole cycle emissions.

Electrically heated steam crackers – As highlighted earlier, over time, the electrification of most industrial processes is possible, although their near and midterm application in the chemical sector looks challenging. One example of where effort is being focused is the electrification of steam crackers and reformers that may continue to use fossil fuels as the feedstock. In 2021 BASF, SABIC and Linde announced a joint agreement to develop and demonstrate solutions. The construction of a demonstration plant started in September 2022, at BASF's Verbund site in Ludwigshafen, Germany, with production targeted to start in the second half of 2023. From an investing perspective, this is potentially only a bridging solution, rather than a source of longer-term competitive advantage.

Progress in other heavy industries shows what can be achieved in chemicals

To reiterate: the challenges of this transition should not be underestimated, it will take time to solve them, and the sector is in part dependent on factors beyond its control to make progress. Notwithstanding this, the progress being made in the decarbonisation of steel and ammonia indicates that change can happen much faster than initially thought. There is also an interesting read across in the transition toward renewables in Texas, traditionally considered to be one of the homes of the oil and gas sector.

Case study – green steel

Less than five years ago the consensus on green steel was that "investments in zero-carbon alternatives still come at prohibitive commercial risk". The traditional blast furnace/blast oxygen furnace process (BF/BOF) was used for around 90 per cent of primary steel production, while lower carbon production using direct reduced iron and electric arc furnaces (using natural gas or traditional fossil fuel derived hydrogen) accounted for only seven per cent.

Back then, there were few green primary steel projects underway, with the most prominent being the Swedish Hybrit project, a joint venture involving SSAB, LKAB, and Vattenfall, with funding from the European Union. Their aim was to create the full value chain to enable the production of fossil free iron and steel, with full commercialization by 2036.

Progress has been faster than initially expected. In July 2021 the consortium rolled their first steel produced using Hybrit technology, the customer was the Volvo Group. The next big milestone is to have converted the SSAB blast furnace at Oxelösund to the new technology by 2025. There are now 35 green steel projects planned in Europe, and six have targets to start production by the end of this decade.

Government support has played an important role. In January 2020 the European Union (EU) launched its Green Steel for Europe project offering EUR€700 million in R&D support – just a year after a BCG report stated that "*investment uncertainty is just too great*". Later, in July 2021, they announced plans to phase out free carbon allowances for the steel industry.

Now, in 2022, nearly all European steelmakers have announced plans to replace their old, high carbon emitting blast furnaces with direct reduction iron and electric arc furnaces. Most will still be fuelled by natural gas, and the electric arc furnace is a proven technology, but it is highly significant that a profitable transition to green steel has advanced far quicker than anticipated and now looks possible as soon as the end of the decade.

Case study – green ammonia

Conventional ammonia plants rely on hydrogen produced through steam methane reforming with natural gas as an input. Through the haber-bosch process, hydrogen is mixed with nitrogen obtained from ambient air at high temperatures and pressure to obtain ammonia. Amongst other applications, ammonia is a key input to synthetic fertiliser.

Back in 2018, the consensus view was that by 2030, five-to-ten per cent of EU ammonia would be made with blue hydrogen while about 10 per cent would be made with renewable hydrogen. At the time, many analysts seemed to expect carbon capture to gradually become the technology of choice.

Roll forward to 2022, and IRENA now expects renewable ammonia production will dominate new capacity additions after 2025, with only ten carbon capture projects announced. A number of green ammonia projects have been announced that will move the technology beyond the pilot stage, including a planned 57kt plant, for Iberdrola and Fertiberia, in Spain. Yara and Engie Australia have recently announced that they expect to shortly start construction on their Yuri renewable hydrogen project, which will provide feedstock into the Yara ammonia operations on the Burrup Peninsula.

While progress in green ammonia has been slower than for green steel, there is already a viable transition pathway emerging. If forecasts on the cost of producing renewable hydrogen come to fruition, many more plants can be expected to be announced later in the decade.

Case study – renewable electricity generation in Texas

Texas is the home of the US oil and gas industry. Given this, many investors are surprised to find that Texas leads the US in wind installations, with 30.5 GW, and comes second for solar energy, with 8.6 GW. This is due in large part to the economic case for Texas' renewables. The initial push into wind was part of move to improve the economy of West Texas by creating interconnector corridors to bring abundant and cheap wind generation to the more densely populated eastern half of the state.

A recent study estimates that the widespread adoption of renewables reduced state wholesale electricity costs by about USD$27.8 billion between 2010 and August 2022, with total savings for 2022 estimated to exceed USD$11 billion. The analysis also indicates that renewables provided a valuable price hedge against the volatility of natural gas and coal prices.

As well as the direct financial benefits, there were also positive impacts on water use and healthcare. Without renewables, power plants would have consumed an additional 244 billion gallons of water from 2010 to August 2022, adding water stress to regions that are often in drought. Further, emission reductions have saved Texans between USD$10.2 billion and USD$76.4 billion in total in lower healthcare and other environmentally related costs.

The growth of renewables in Texas illustrates that when the financial benefits are clear green solutions will scale, even in places where the political and regulatory environment is not immediately supportive. Wind-generated electricity was a "step into the dark" when the first Texas utility scale wind farm was built in 2005. In the same way, new processes and feedstocks for the chemical industry should be viewed with a longer perspective - as an opportunity for the companies and governments that are willing to make the first steps.

Financing a Paris-aligned transition

It is clear that chemical companies must produce credible and coherent plans to align their businesses with the regulation and legislation that governments will introduce to meet the targets set out in the Paris Agreement. Going further, they must do this to ensure their long-term profitability. This will mean a staged transition away from conventional processes and fossil feedstocks to emissions-neutral alternatives. As has been shown, delaying this transition will likely cost valuable time, putting companies behind their competitors.

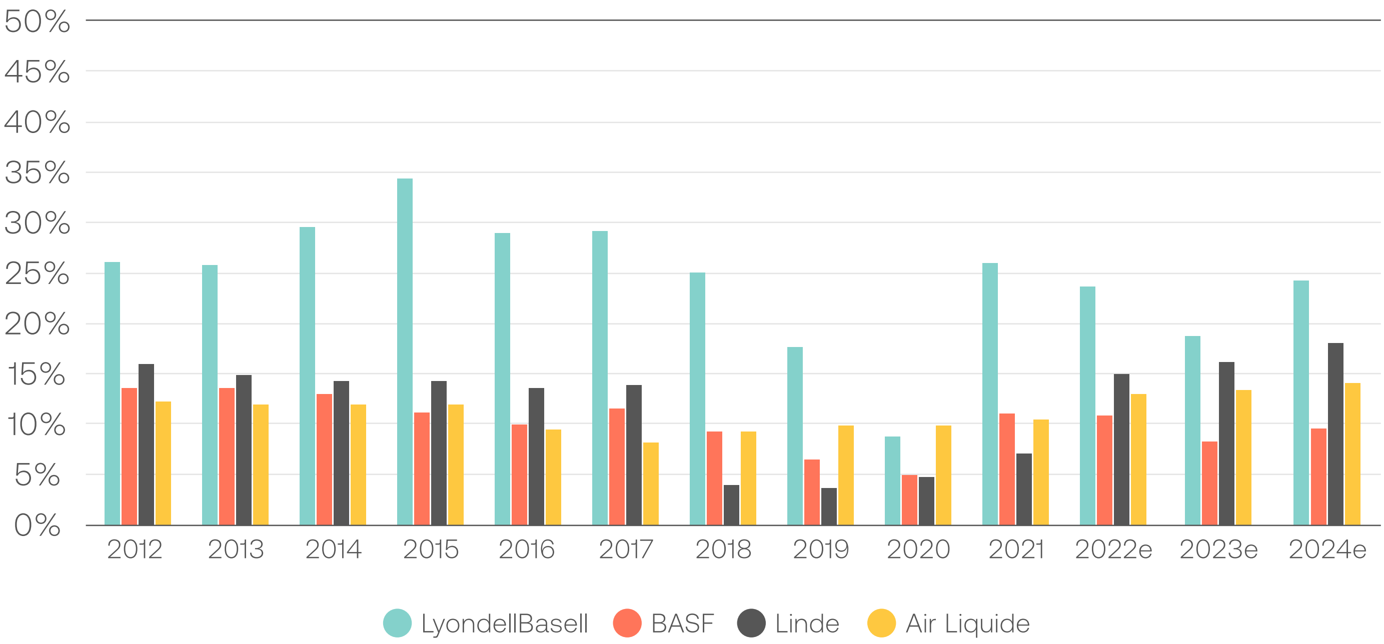
Our financial analysis has looked at the impact of likely Paris-aligned capex on the profitability of a selected peer group: BASF, Linde, LyondellBasell and Air Liquide – all large-cap European chemical companies.

What the transition means for companies' finances

Starting with first principles, by investing capital (both tangible and intangible) companies create future returns (return on capital invested – ROCE), generating cashflows that can be either reinvested back into the business or returned to shareholders via buybacks and dividends. In a capital-intensive industry such as chemicals, these metrics provide a good foundation for assessing how changes in future capex requirements will likely be reflected in value creation and hence share prices. Put simply, it is a combination of a company's forward cashflows and its investment requirements (capital additions) that will determine if the ROCE can be maintained above the weighted cost of capital – to be value creating rather than destroying.

As highlighted earlier, the industry generates moderate returns on capital. Excluding LyondellBassel, the average ROCE over the last decade has been 10.6 per cent, ranging between 6.6 per cent in the toughest years up to 14 per cent in stronger periods. So broadly 10 per cent +/- 400bps. Consensus expectations (from Sharepad) as of 27th January 2023 suggest that ROCE will continue to steadily improve, increasing off the lows of 2019 and 2020.

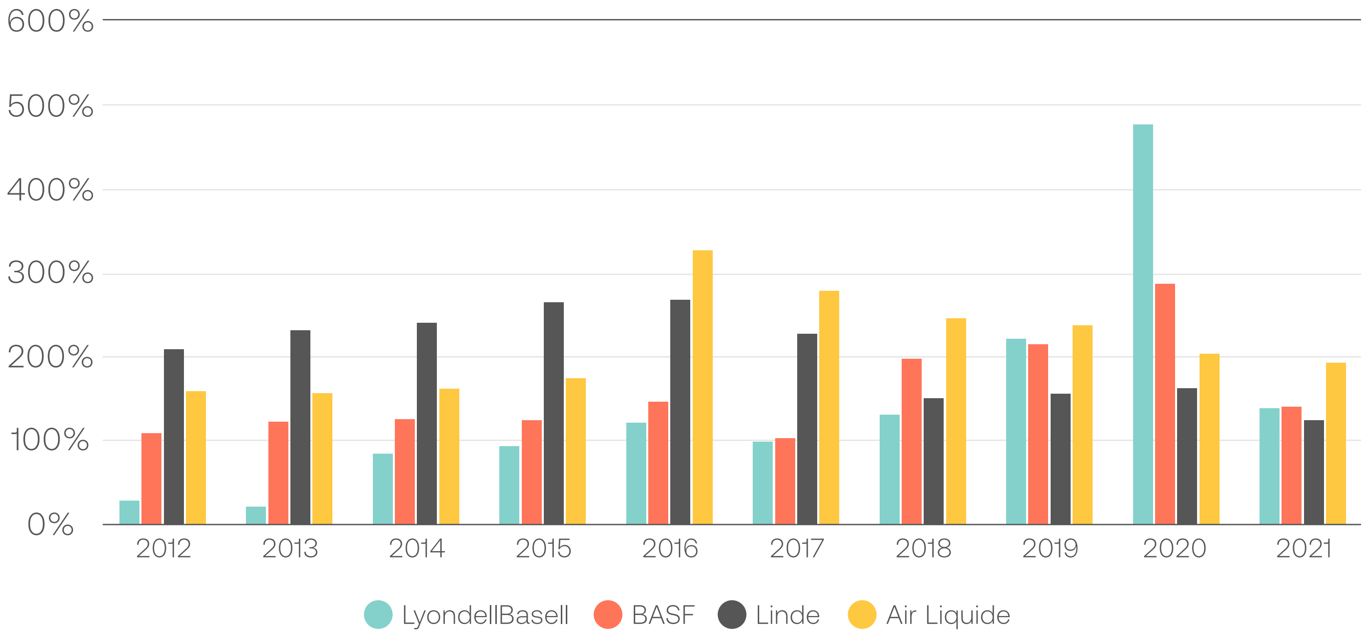
Figure 7: Return on capital employed trends for four major chemical companies



Source: *Sharepad* – data as of 23rd January 2023

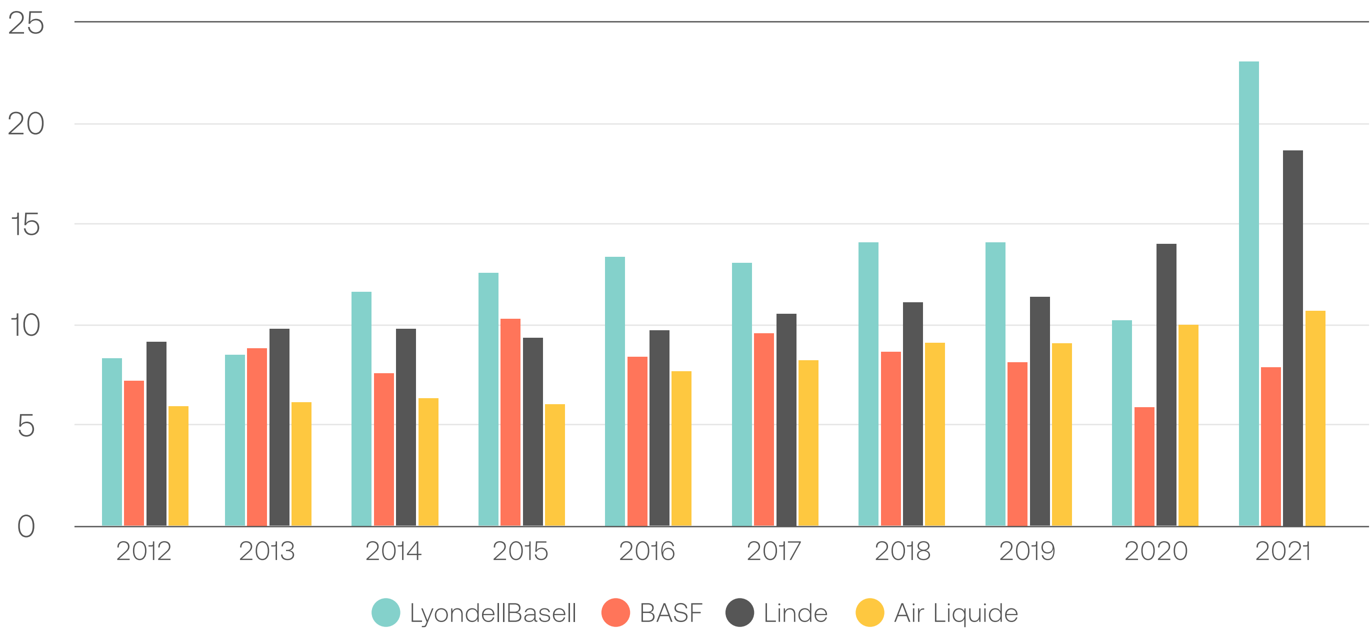
It is notable that none of the companies like to carry high levels of debt for anything other than short periods, which is unsurprising given the often-volatile nature of input costs and end demand/pricing. So, new capex for the transition should not be materially additive to the debt load. Further, a material proportion of cashflow per share – typically close to half - gets absorbed by capex, leaving around 30 per cent of free cashflow available for distribution as dividends. What this means in practice is that any extra capex required for the transition needs to be manageable in the context of maintaining distributions to shareholders, either via dividends or buybacks.

Figure 8: Net debt over earnings before interest, taxes, depreciation, and amortization for four major chemical companies



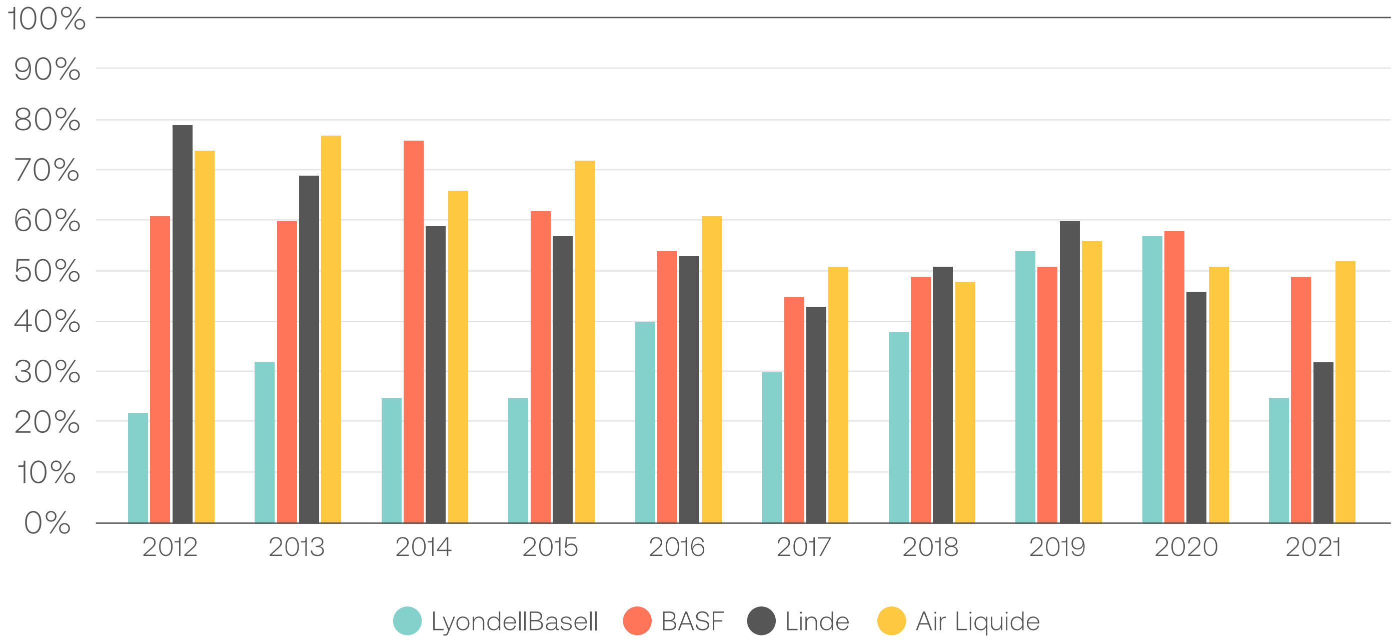
Source: *Sharepad* – data as of 23rd January 2023

Figure 9: Cashflow per share for four major chemical companies



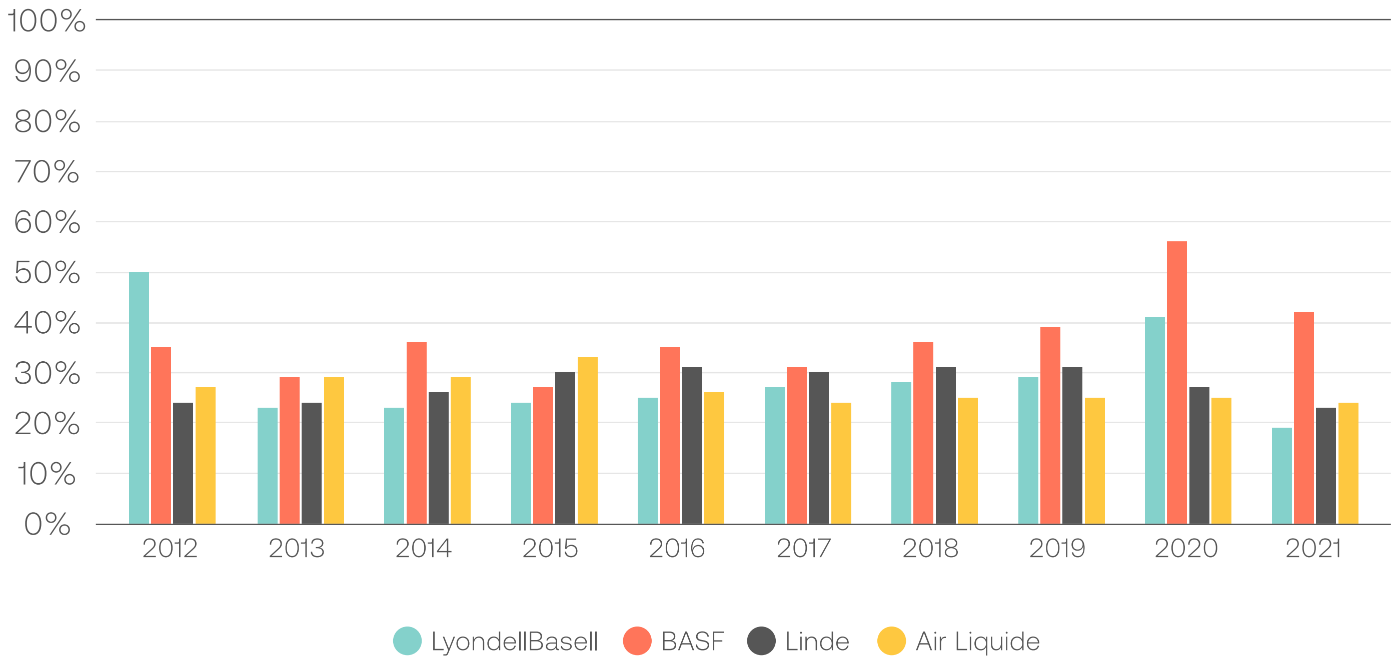
Source: *Sharepad* – data as of 23rd January 2023.

Figure 10: Capital spending per share over cashflow per share for four major chemical companies



Source: *Sharepad* – data as of 23rd January 2023

Figure 11: Cash dividend paid per share over cashflow per share for four major chemical companies



Source: Sharepad – data as of 23rd January 2023

Identifying future decarbonisation capex requirements – the analysis

To be clear, it is not possible to say exactly how much capex will be needed and when. As this report has highlighted, there are a large number of unknowns, and an important element of the work over the coming five years will be to identify the most financially favourable technologies and to begin the process of piloting them. The capex forecasts for the chemical sector here are based around two sets of analysis - the timing of investments already made in the green steel transition, and the plans set out by industry bodies such as the VCI in Germany. This gives the analysis a European focus.

The initial investments in the Swedish green steel programmes took place over a five year period, from 2018 to 2022. The early capex draw was limited, and it was only in the last year of this period that material capex was required. As a result of progress made, the industry is now at a tipping point, with the shift to full scale commercialisation. Very recently, one of the most advanced of the full scale production plants, the H2 green steel project in Northern Sweden, received (conditional) debt and credit guarantees for the EUR€3.5 billion needed. This included EUR€1.5 billion from the export credit agency Euler Hermes and EUR€1 billion from the Swedish National debt office. In parallel, the B Series equity issuance raised EUR€260 million from eight organisations, including Kobe Steel. The earlier A round, in May 2021, raised EUR€86 million.

The VCI report envisages a longer process. Their analysis (published in 2018) forecasts that the bulk of the extra capex required by the German chemical industry, which they put at around EUR€230 million per year would take place post 2030. However, this analysis was made before recent financial support, in part prompted by the current European energy crisis, was announced by the German government. Given this, this analysis considers that it is reasonable to assume that even under the VCI scenarios, that change will happen faster than they first anticipated.

Looking specifically at Germany, many researchers see a “golden opportunity” for making a big leap in industry decarbonisation during this decade, because companies will have to replace or modernise many existing plants over the coming years as they reach the end of their lifetimes. In the case of the chemicals industry, more than half of all primary production requires material capex between now and 2030.

Our capex assumptions, starting slowly and ramping up

Therefore, in this analysis capex is scaled up starting at around USD$25 million per year in the short term (the next two-to-three years) to investigate and develop pilot programmes and then around USD$100 million needed per year toward 2026 to start to commercialise successful technologies. This analysis assumes that this spending would be shared with partners, and that the various European governments would also provide financial support.

To put this capex requirement in context: on average the four companies being analysed spent between USD$1.8 billion (LyondellBasell) and EUR€4.2 billion (BASF) per annum in the last decade, and this is forecast to rise to around USD$2.0 billion and EUR€4.8 billion per year over the next three years. The USD$100 million per annum for the early spending on commercialisation amounts to less than five per cent of projected capex, assuming no support from partners and governments.

If the pilot programmes are successful then a major step up in capex will likely be required, timing wise most probably around the end of this decade. Given the age of a lot of assets (see above), a material portion of this could be considered to be a replacement of upgrade/maintenance capex that would already be required. It is possible that new plants constructed would be proposed as relocations, moving production to where inputs are available and costs (mainly renewable electricity) are lowest, although investors should expect that such a move would be resisted by the governments of northern Europe.

Additionally, this analysis assumes that the capex above generates no additional profit until beyond the end of this decade. This is true R&D, aimed to position the companies for the future, not to generate short-term profit uplift. It also assumes no savings from switching to renewable electricity, despite this being cheaper in many markets. This is all consistent with the argument that the chemical companies need to spend the next seven-to-eight years building up expertise in these areas, and that the real payback is in the future.

The midterm impact on chemical company financials is limited

When the impacts of this additional capex profile on these companies' financials is modelled, it shows that it results in only small changes to future cashflows, ROCE and dividend cover. The cost of undertaking this investment, at around two-to-three per cent of typical forecast capex, is low. This is especially true when the risk of companies getting behind in important technological transitions is considered.

Taking all of these factors and analysis into account, this analysis suggests that it is financially viable for most European chemical companies to begin to transition to Paris-aligned processes. This assumes a high level of support from the various governments, both financial and regulatory.

To conclude, financing the transition, at least over the next five years, is possible without materially impacting cashflows

These investments will not only make chemical companies' operations consistent with the Paris Agreement, they can also be value-creating in the longer term. Some of the benefits will come from what can be thought of as relatively easy changes, such as switching to renewable electricity. The largest challenge will be replacing fossil fuels as a feedstock. Assuming that appropriate government support is forthcoming - and this appears increasingly likely – the industry will need to make major investment decisions toward the end of this decade. To position themselves for this, companies need to start investing in the required technologies now.

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ShareAction is a NGO working globally to define the highest standards for responsible investment and drive change until these standards are adopted worldwide. We mobilise investors to take action to improve labour standards, tackle climate change and address pressing global health issues. Over 15 years, ShareAction has used its powerful toolkit of research, corporate campaigns, policy advocacy and public mobilisation to drive responsibility into the heart of mainstream investment. Our vision is a world where the financial system serves our planet and its people.

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