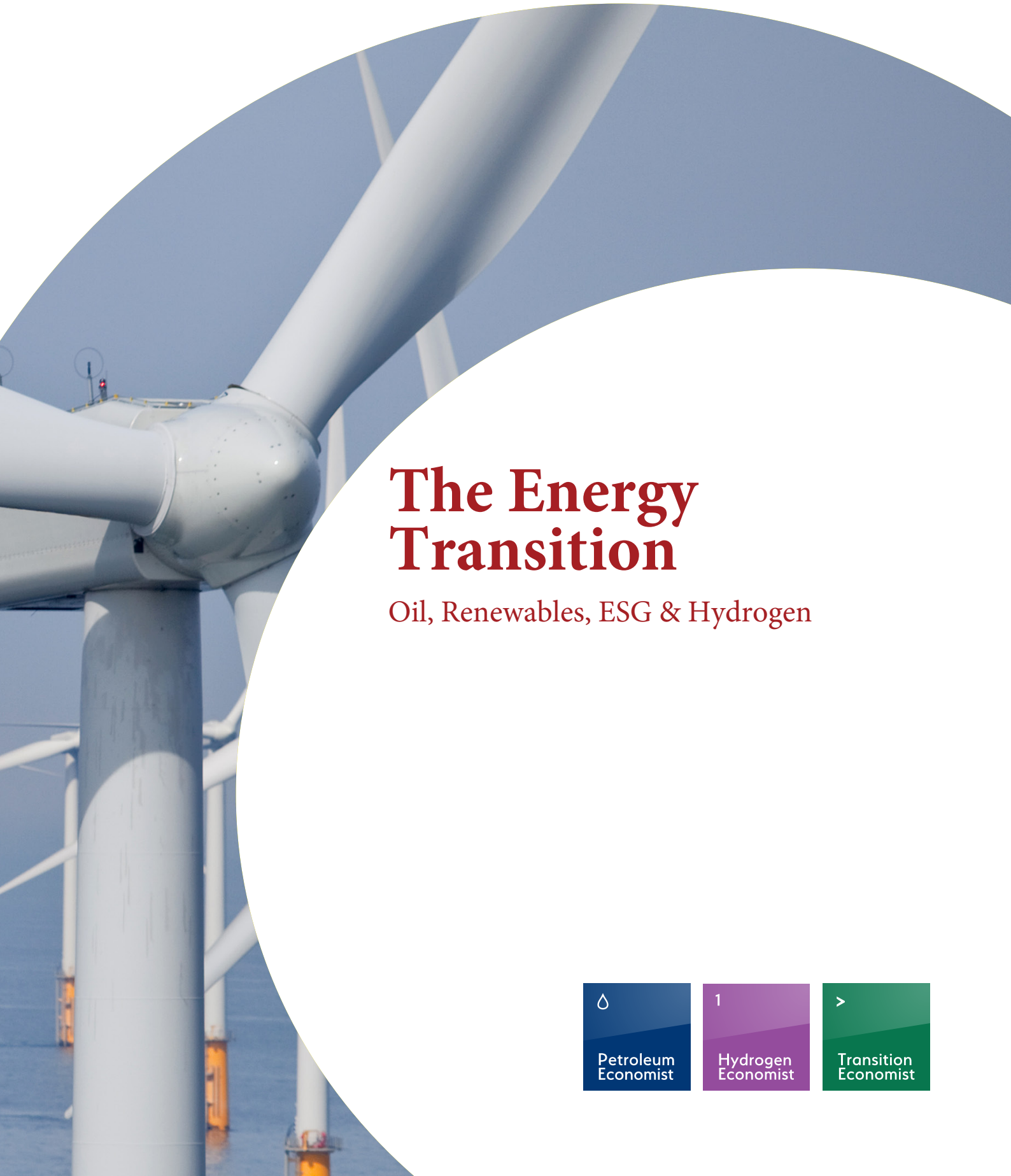


The Energy Transition

Oil, Renewables, ESG & Hydrogen

Petroleum Economist

Hydrogen Economist

Transition Economist

Contents

Foreword

The global energy transition is well underway, spurred on by legally enshrined governmental net-zero targets and having been given additional impetus by Russia's invasion of Ukraine. In 2022, clean energy investments were expected to exceed $1.4tn according to the IEA, with capital allocated to renewable energy sources—especially wind power and solar photovoltaic (PV)—leading the charge.

The energy transition is particularly capital-intensive because it, by and large, requires the reconstruction of a carbon-heavy energy ecosystem that has been gradually established over the course of the past century. Most investments will be in new technologies and assets that will replace their more polluting counterparts: from floating offshore windfarms through battery storage to green hydrogen electrolysers. At the heart of the new energy system sits electrification, which demands enormous investments in transmission connections to link often remote power production sites to growing demand centres.

Clean energy needs $4tn a year by 2030

While regaining momentum in 2022 following a lull coinciding with the global Covid-19 pandemic, worldwide clean energy investments are currently a far cry from the levels needed to achieve the ambitious climate targets that governments, investors and corporates have set for themselves. Annual spending on clean energy needs to rise nearly threefold to $4tn by 2030 to reach the pace required to meet these net-zero targets by the end of the decade and further down the line.

This tremendous capital requirement falls largely on the shoulders of the private sector, spending from which will account for around 70pc of the clean energy investments needed to finance the transition. While public spending is also increasing, the government's role is better suited to kickstarting clean energy initiatives nationally and stimulating deeper private-sector involvement.

ESG criteria in investing

The energy transition also goes hand-in-hand with the growing adoption of stricter environmental, social and governance (ESG) criteria that inform decisions taken not only by institutional investors but also by corporates. There has been a notable trend of certain traditional oil and gas companies—such as Shell, BP, TotalEnergies and Norway's Equinor—entering or extending their involvement in the green energy space. Meanwhile, various institutional investors—such as infrastructure and pension funds—are also dedicating more and more of their capital to decarbonisation projects.

This widening pool of investors in the energy transition raises questions: What motivates them? How are they spending their money? What technologies are they backing? This report will explore some of these themes, shining a light on the energy transition's emerging runners and riders and sharing market insight from a number of seasoned professionals. ■

Exponential renewable energy growth

The global situation

Early recognition of the need to accelerate climate change-mitigating actions means Europe has been leading the energy transition globally. European governments started dedicating state funds to pioneering renewable energy developments in the early 2000s, which has kickstarted the build-out of industry expertise and knowledge. Like the UKCS hydrocarbon basin before it, this learning has now in turn been exploited globally and fed into project structures and deal terms as market participants look for more opportunities globally.

Asia-Pacific

The Asian market is the world's biggest magnet for clean energy investments today, with China leading the annual investment tables at $380bn spent in 2021, according to IEA. The Chinese market, however, can be challenging for foreign investors to enter, with recent tensions in Sino-Western relations adding to investor nervousness about inbound PRC investment opportunities and JVs with Chinese SOEs.

The world's lowest levelised cost of energy for solar PV installations is available in India, making the country an interesting target for clean energy investors in search of the most affordable renewable energy installations. Along with India offering an ever-growing domestic demand for power generation, low-cost solar power production can also act as an attractive electricity source to feed P2X projects such as electrolysers for green hydrogen production, which in turn have an important role to play in decarbonising energy-intensive industrial processes such as steel production.

The growth of a green hydrogen market also brings Australia to the fore. Aside from having excellent wind and solar resources, Australia has set ambitious targets for exporting clean fuels that it can produce using domestic renewable energy capacity. The Australian government has spent more than A$1.2bn on the national hydrogen industry, with the aim of becoming one of the world's biggest hydrogen exporters by the end of the decade.

North America

In North America, and particularly the US, existing oil and gas infrastructure lends itself extremely well to developing carbon-capture, utilisation and storage (CCUS) technology. Combining carbon-capture with a very large chemical industry creates an ideal partnership for clean biofuel production, a major lever in decarbonising hard-to-abate sectors where electrification and/or hydrogen are currently not technically viable. The continent also boasts some of the world's best offshore wind sites, and its large swathes of uninhabited land offer room for onshore wind and solar resources.

The Inflation Reduction Act, introduced this past summer, is the US' first ever climate bill and is expected to result in $369bn in clean energy investments that will add 550GW of capacity and cut carbon emissions by 40pc, according to the White House. To investors, this expansion in tax credits for clean energy technologies is transformational to enabling further spending.

Solar PV & wind

One of the fundamentals of the energy transition is to tap nature's freely available green energy resources. The energy

contained within sunlight and wind will never run out, while fossil-based oil, gas and coal reserves are finite. It is therefore not surprising that solar PV and wind technologies are, and will remain, firm favourites among clean energy investors as proven technologies which, through mass adoption, have benefitted from cost reductions.

The IEA estimates that more than $600bn will have been spent on these more mature green energy technologies in 2022. The unlocking of finance for the supply chain has helped to create impressive cost reductions for solar panels and wind turbines, allowing many more investors—down to the private homeowner—access to these technologies. Since 2009, the cost of installing utility-scale solar PV farms has shrunk by a factor close to five, mainly thanks to more affordable solar module prices.

With annual clean energy investments required to almost triple by the end of the decade, solar PV and wind power capacity will continue to grow enormously as a proven and scalable generation technology. The IEA's global net-zero pathway stipulates that combined world solar PV and wind power capacity will need to reach 1,000GW to account for around 40pc of global electricity generation by 2030.

Offshore wind

Offshore wind deserves particular attention within this section because of its huge potential and because it is a technology well-suited to the emerging breed of transition investors. Rapid industrialisation of the offshore wind supply chain has brought down the technology's cost curve to such an extent that building a windfarm on open water is now cost-competitive without subsidy. The most recent allocation of strike prices in the UK's renewable energy auction even showed that offshore wind is being priced as more cost-effective to build than solar or onshore wind.

By the end of this decade, global capital expenditure on offshore wind is expected to more than double to $102bn, according to consultancy Rystad Energy. In the offshore wind sector, Europe remains the driving force, with nearly half of the forecast 2030 capex allocated to European projects. Most notably, big oil and gas companies are becoming major players in the field thanks to their extensive offshore experience and large balance sheets suited for financing hugely cost-intensive windfarms out at sea. Their involvement in the energy transition will be analysed more thoroughly in chapter 3 of this report.

Floating offshore wind

Offshore wind energy also has its limits in its traditional form. Although monopiles are now being built in depths of 60m, fixed-bottom offshore wind engineering in greater depths would be hitting the edge of economic viability. Therefore, the industry is now firmly setting its sights on floating offshore windfarms, which are free of geophysical constraints around suitable foundations and can therefore be positioned to capture ideal wind conditions. Accordingly, the first trials are showing some of the best offshore wind performance rates ever measured.

In Europe, around 80pc of all offshore wind resources is located in waters beyond 60m in depth, where fixed-bottom projects are unable to compete economically with floating alternatives. It is

Expert view on floating offshore wind

Chris Andrew, partner at Allen & Overy in the projects energy and infrastructure team

"Floating offshore wind is one of the areas where the integrated energy companies are in a position to push forward and accelerate the industry, because they have an advantage in being more familiar with the deep offshore geography. They are also going to bring know-how, relationships and balance sheets. There is still uncertainty about the availability of debt funding for floating wind as it transitions from pre-commercial to commercial, and therefore the sector may favour developers who are less reliant on third-party funding."

therefore no surprise that some of the first floating offshore wind turbines are being tested in this region. Equinor's Hywind Scotland—the world's first ever commercial floating offshore windfarm—achieved an average capacity factor of 54pc over the course of its first two years of operations from 2017-19, a record among the UK's offshore windfarms and much higher than the industry average of 40pc.

Battery energy storage

The vast build-out in renewable energy sources such as the abovementioned technologies brings many challenges, among which is the intermittency of their electricity production. Being dependent on the natural forces of wind and sunlight means that renewable energy systems cannot always match times of peak demand and need to be complemented by other energy sources or energy storage capacity that can bridge the production gaps.

Battery energy storage systems (BESS) have seen significant growth and development in recent years, with Tesla's Megapack utility-scale BESS—which can save 3MWh of energy, enough to power 3,600 homes for one hour—bringing the technology to people's attention. The European Association for Storage of Energy estimates that the continent of Europe needs 200GW of energy storage capacity by 2030 to complement the amount of renewable energy required to hit legally binding targets, with this figure rising to 600GW by 2050.

Scale-up investments

BESS technology is one of the most promising tools to ensure the electricity market can successfully integrate the exponential rise in renewable energy capacity expected over the coming decades. The sector requires enormous investments to allow more established forms of battery energy storage, such as lithium-ion or vanadium-flow batteries, to scale up further and to prove their potential. Developers also require more funding to make the technology as safe as possible, with standards continuously improving with experience.

A growing base of investors is already ploughing more cash into the sector, with BlackRock recently spending US$700mn on acquiring Australian energy storage company Akaysha Energy, including the commitment to build out over 1GW of battery storage assets in the country. Masdar, the UAE government-owned renewable energy company, has recently invested in Arlington Energy in the UK as it sees the BESS rollout as strategic and complementary to its existing renewable portfolio.

Investors outside of the traditional electricity sector are key to pushing this established energy transition landscape to the next level. The scaling-up and maturing of technologies are crucial to reaching the width and depth required by global climate change targets. ■

The deal environment

The flow of private-sector capital and deal-making in the transition space has accelerated over the last five years, despite continued policy and regulatory risk, and the perceived lower returns on renewable power compared with fossil fuel energy.

Recent increases in the cost of capital and pressures on cost and supply chains in the wake of the global pandemic have interrupted sentiment slightly, but the long-term transition play remains intact. In fact, recent concerns over energy security and energy affordability in Europe have only strengthened the long-term case for renewables and storage technologies.

Big Oil

The European energy majors have piled into the transition sector with multiple acquisitions as they look to green their portfolios as quickly as possible by buying small and medium-size pure-play renewables operators across the full range of technologies and sectors.

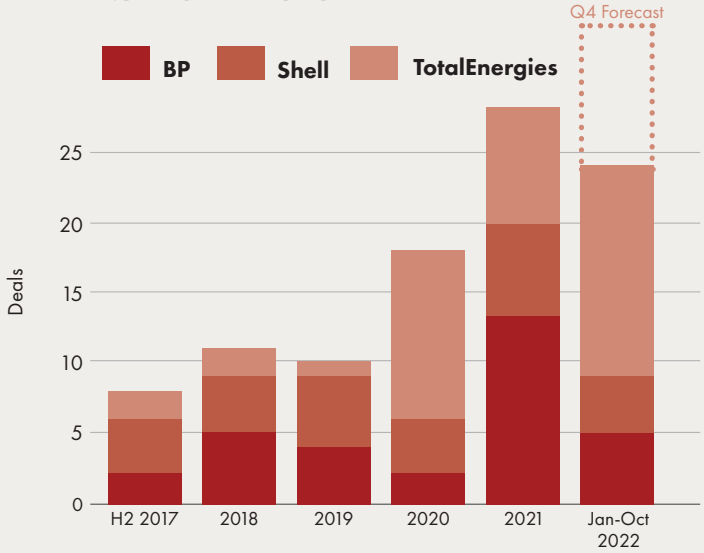
Transition capex

The European energy majors' exponential growth in renewables deal-making looks set to continue despite gathering macroeconomic headwinds. Armed with balance sheets bolstered by elevated oil and gas prices, acquisitions will continue at pace as the share of capex earmarked for the transition rises sharply through the middle of this decade.

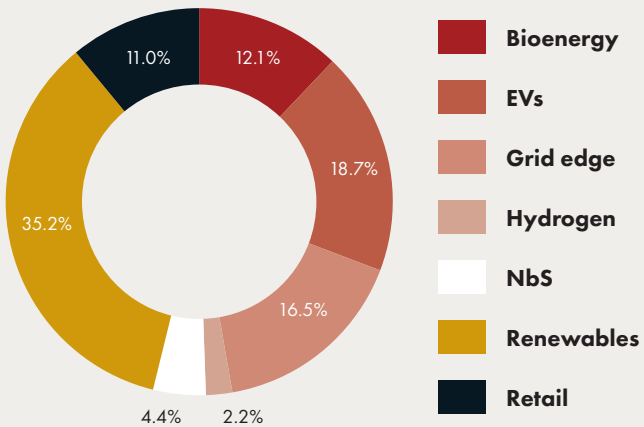
Six of Europe's largest energy companies will collectively spend nearly $27bn on low-carbon investments by 2025, around 35pc of their total investments in that year, according to recent guidance.

Shell will spend $12bn in 2025, followed by BP with $5bn and then Equinor and TotalEnergies with $3.3bn and $3.25bn, respectively. Shell is targeting 50pc of total capex on low-carbon investments in 2025, BP is targeting 40pc, and Equinor and Eni each aiming for 30pc.

Energy majors ramp up transition deals in the 2020s



Transition investment by sector (BP, Shell, TotalEnergies)



Source: *Infrastructure Investor*

The energy majors' deep pockets and project development pedigree enable them to get involved in much more pioneering—and therefore risky—projects that, by assuming early-stage development risk, have the potential to result in higher returns. This can give strategic investors an advantage over institutional investors, for example, which are traditionally more risk averse and require the fulfilment of a raft of conditions ahead of FIDs. It also places them in a more advantageous position than smaller energy company rivals, which are typically reliant on more costly third-party financing.

Funds

The energy majors' growing appetite for transition deals is more than matched by that of the funds and other institutional investors as fundraising for the transition continues at pace.

Brookfield closed its Global Transition Fund to institutional investors in June 2022 with $15bn raised, making it the world's largest private fund dedicated to the transition. As of June 2022, about $2.5bn of the fund had already been deployed or allocated to projects—including the acquisition of US and German solar power and battery developers with a combined development pipeline of about 25GW.

Private capital is increasingly aware of the pivotal role and opportunity that the energy transition presents. "With the global carbon budget being rapidly run down, now

Top 5 Energy transition funds in market as of 10 March 2022

Fund Name	Head Office	Fund Manager	Target Size ($ billion)	Region Focus
Brookfield Global Transition Fund	Canada	Brookfield Asset Management	7.50	Multi-regional
Copenhagen Infrastructure Energy Transition Fund I	Denmark	Copenhagen Infrastructure Partners	2.45	Multi-regional
Mirova Energy Transition 5 Fund	France	Mirova	1.09	Multi-regional
EIG Energy Transition Fund	United States	EIG	0.75	Multi-regional
ECP Energy Transition Opportunities Fund	United States	ECP	0.50	North America

Source: *Infrastructure Investor*

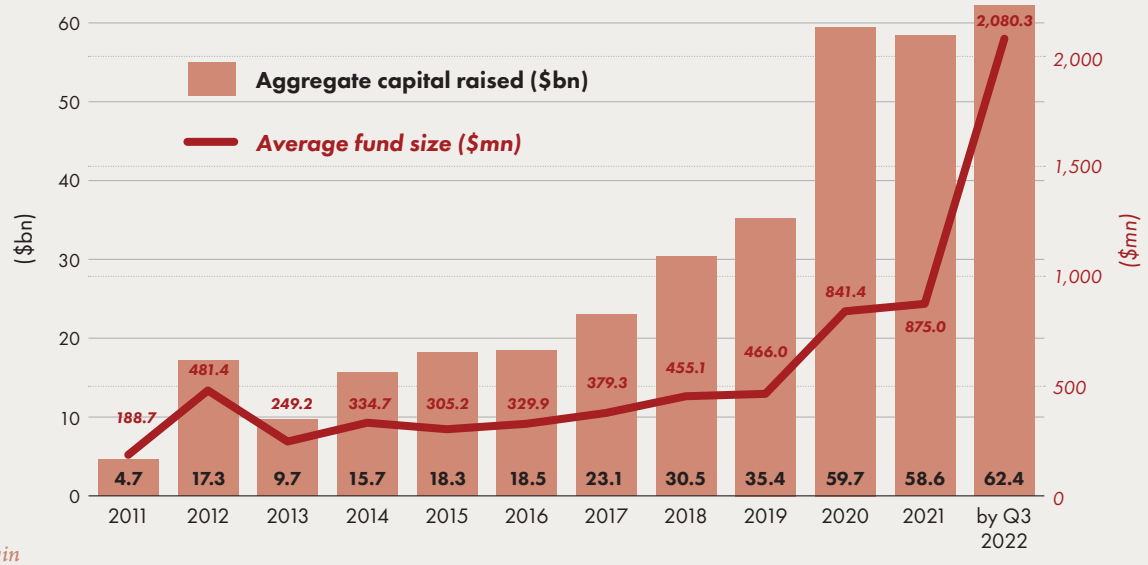
is the time for comprehensive, determined action. That means deploying capital across the economic spectrum from scaling clean energy generation to transforming traditional utilities and providing sustainable solutions for heavy industries like steel and cement," says Mark Carney, Brookfield's vice-chair and head of transition investing. The readiness of capital to enter the transition is well illustrated by recent fundraising in the emerging low-carbon hydrogen sector.

Hy24—a joint venture between French asset manager Ardian and investment firm FiveT Hydrogen—closed its Clean H2 Infra Fund in October 2022 after raising €2bn from more than 50 industrial and financial investors over the preceding 12 months. The closing total was about €500mn more than previously forecast.

Copenhagen Infrastructure Partners (CIP) reached final close on its new CI Energy Transition Fund in August 2022. The fund was oversubscribed and closed at €3bn, making it the largest dedicated clean hydrogen fund to date. The fund achieved commitments from investors across Europe (45pc), the Nordics (25pc), Asia-Pacific (20pc) and North America (10pc) with a 50/50 split between existing investors in CIP funds and new investors.

The fund's investor base comprises approximately 65 institutional investors—primarily pension funds, life insurance companies, sovereign wealth funds, asset managers and family offices.

Global unlisted renewables-focused fundraising, 2011 – Q3 2022



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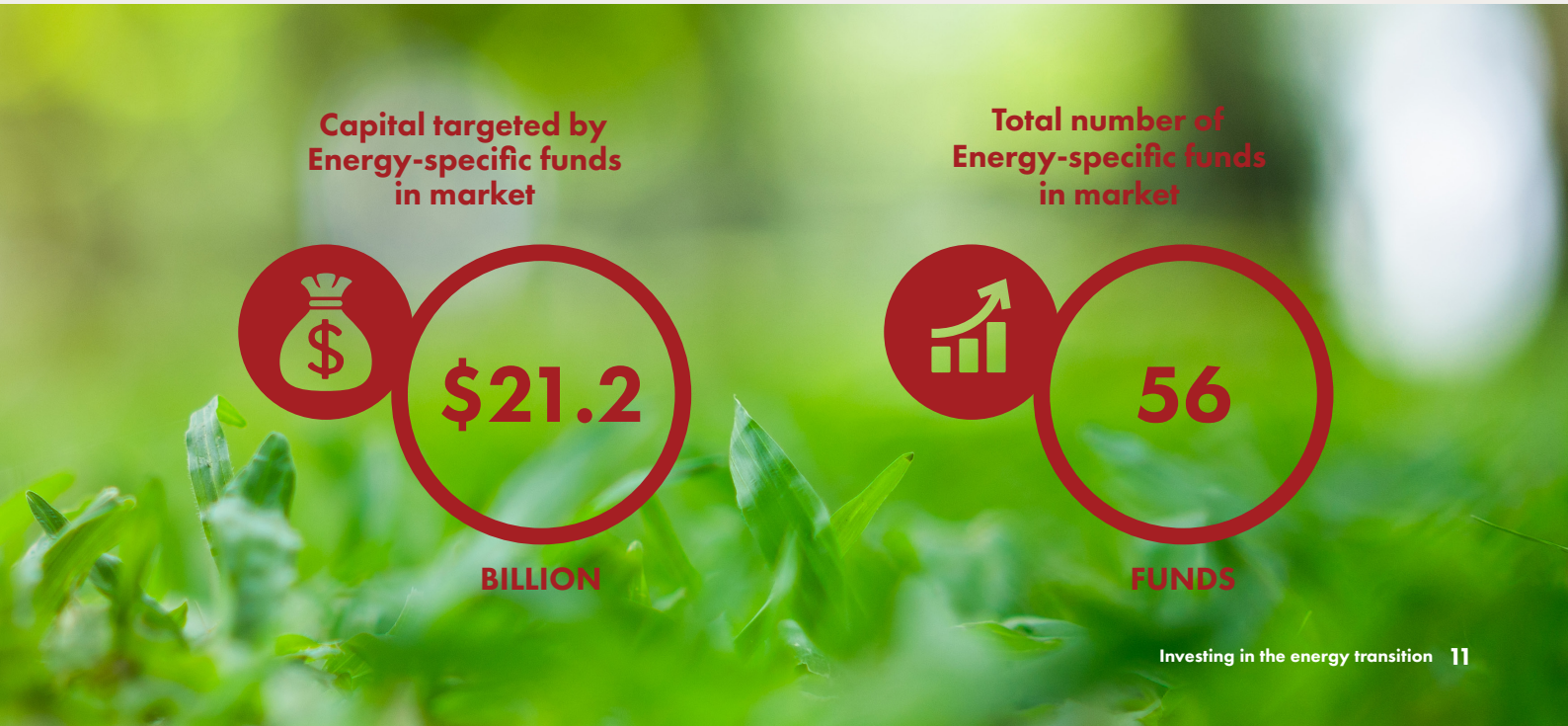
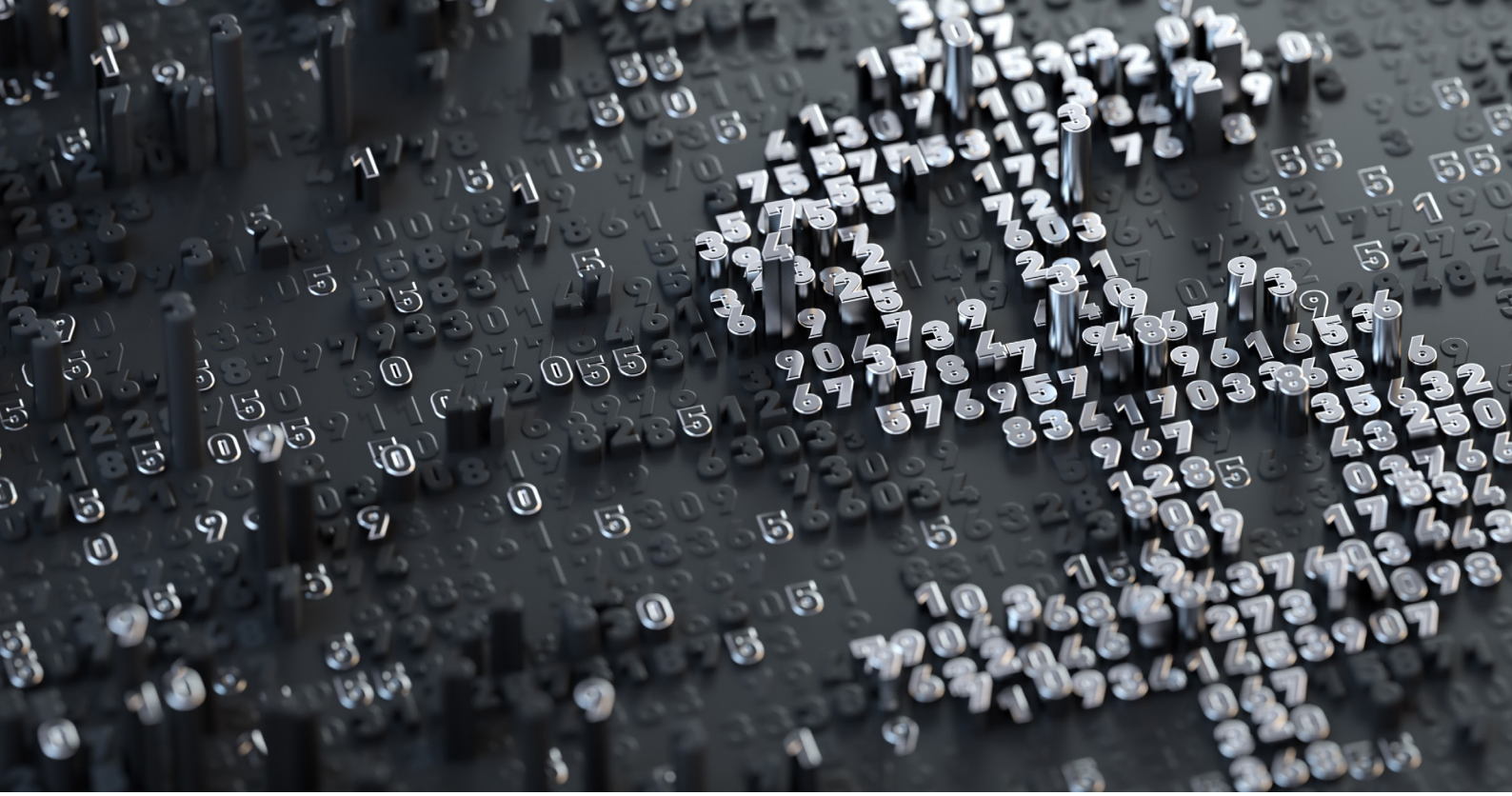




Energy majors

For decades oil and gas majors were assessed on their ability to discover and develop new oil and gas resources and to bring them to end-customers. These business models are starting to change with the rising risks surrounding climate change, which are threatening the economics of some of the traditional value chains. The increasingly unfavourable optics of being perceived as 'Big Oil', as well as the growing impact of ESG regulation that favours low-carbon solutions and rising prices for carbon emission allowances, are driving a change in behaviour.

There has been a visible difference in approach between Europe-based oil and gas majors and their American and Asian peers. EU-steered ESG regulation, deepening investor pressure and legally binding decarbonisation targets have pushed traditional integrated oil companies (IOCs)—such as Shell, BP, Equinor, TotalEnergies and Eni—to reshape their future paths more quickly than their counterparts in other jurisdictions.

The IOC to IEC shift

These companies are transitioning from being integrated oil companies to becoming integrated energy companies, adapting to the reality of what producing and consuming energy will mean in the future: electrification.

Financial and operational strengths

Transitioning IOCs bring a wealth of benefits as new investors into the energy transition. Throwing their financial and operational weight behind low-carbon investments will add maturity to the sector and clear the way for other investors to feel more comfortable entering the developing energy transition space.

Energy majors' operational and technical experience in working with highly complex energy engineering infrastructure and their long track record of operating offshore are an obvious advantage in their bid to delve more deeply into energy transition projects, especially as offshore wind power development is moving further and further from the coast. It is these companies that can apply their experience with deepwater exploration, production and management.

Global reach

Along with the technical and operational know-how, energy majors have vast international reach, with most being present in all large energy trading hubs. Decades of experience of working globally has allowed them to develop deep-rooted relationships with key stakeholders in government, regulators, small and large private entities, and other local decision-makers across several continents. Leveraging these relationships as renewable technologies migrate to new jurisdictions will make the energy majors with the relevant in-country experience more sought-after transaction partners.

Offshore wind as a new frontier

The offshore wind sector is one of the main areas where the energy majors' leap into electricity production is most obvious. "Energy majors' future vision of themselves will not work without a significant offshore

wind component," says Chris Andrew, partner in the projects energy and infrastructure team at Allen & Overy, and offshore wind expert.

Of the energy majors being discussed in this report, Equinor and Shell are currently the only ones with operational offshore wind assets in their portfolios and experience in delivering projects. BP, TotalEnergies and Eni are all working hard to build up project pipelines, bidding in licensing rounds in Europe, Asia and the US and farming into projects that are in the planning stages. For example, Eni last year paid Equinor and British utility SSE €163.9mn for a 20pc stake in the 1.2GW Dogger Bank C offshore windfarm in the UK, currently the largest under construction in the world.

BP bullish on offshore wind

"It is true that we do not have a big history in offshore wind, and we do not underestimate the specifics of offshore wind environments… [but] we do know how to work in challenging offshore environments, how to put together complex supply chains, work closely with local partners and governments, and operate sustainably within communities," BP's senior vice-president for offshore wind, Matthias Bausenwein, said recently.

Offshore wind will be an important cornerstone of BP's new shift to low-carbon energy production. By 2025, it plans to allocate more than 40pc of its investments to cleaner forms of energy, including renewables and hydrogen. Demonstrating its belief in its abilities, BP earlier this year submitted a bid for the 1.4GW Hollandse Kust West Dutch offshore windfarm without a partner, unlike its rivals.

Inside view on IOCs transitioning

Mark Warren, lead legal counsel at Equinor

"We are no longer oil and gas majors: we are energy majors. We are very committed to the journey to reach net zero. It makes business sense. One of the challenges we have had in this transition is moving from a pure balance-sheet finance model to a project finance model.

That requires a different approach to negotiating contracts and to navigating technical risks. Lenders are traditionally much more risk averse, so we are having to de-risk projects as much as possible right from the start. That has been a 180-degree shift in our outlook on how we develop our projects from top to bottom. That has been a challenge and continues to be a challenge.

We will also continue to extract oil and gas because it is still in demand and will continue to be for decades. Continuing to produce it will keep consumers' costs low—that is the reality of the situation. The right thing to do in this context is to produce oil and gas in a low-carbon way. One of our ambitions at Equinor is to reduce our carbon intensity by 40pc by 2030 and ultimately reach net zero in 2050. We are doing this, for example, through electrification of our oil and gas platforms."

Collaboration

Energy majors have also started making use of each other's complementary strengths to develop offshore wind projects. Norwegian company Equinor, for example, has joined forces with BP in the US, bringing in BP as equity partner in the under-development Empire Wind and Beacon Wind offshore windfarms. Equinor said it chose BP for its experience with the political and regulatory landscape of the US market.

Institutional money

Research published by the International Renewable Energy Agency shows that, over the past two decades, around 20pc of institutional investors have spent money on renewable energy by investing in funds. However, this percentage is expected to increase significantly as climate risks, financial regulation and shareholder pressure require institutional investors to increasingly build ESG criteria into investment cases.

A small number of investment firms have been active in the renewable energy space for longer than the energy majors, and in fact it was the UK government's Green Investment Bank—now owned by financial services firm Macquarie and named the Green Investment Group (GIG)—which kickstarted institutional capital flow into the offshore wind market in the UK.

Large investors commit

A significant share of the $4tn needed by the end of the decade to finance the energy transition will come from institutional sources. Like GIG, many institutional investors have committed to increasing their capital allocations to the energy transition. Goldman Sachs has committed to spending $750bn by 2030 on financing, investing and advisory services to help the climate transition and to encourage growth. BlackRock estimates that assets under management of sustainable mutual funds and exchange-traded funds will rise by close to $2tn by 2028, and its CEO Larry Fink has famously claimed that the next 1,000 unicorns—or startups that are valued at $1bn or more—will be in climate tech.

Sustainable energies

In view of the need to support the scaling-up of the climate tech sector, Canadian asset manager CPP Investments' Sustainable Energies group, for example, is looking to grow its venture capital and grow its equity investments in that sector. "We see a lot of great opportunities happening in the climate tech and energy tech spaces. These are both attractive standalone investments but also important learnings for other businesses in our portfolio that are more mature and that can harness that innovation," says Bill Rogers, head of Europe & Asia at Sustainable Energies group of CPP.

Expert view on institutional investors

Chris Archer, co-head EMEA at Green Investment Group

"The world is working to accelerate its transition to net zero, and investors are looking for opportunities to align their portfolios with that. Macquarie Asset Management (MAM) is the world's largest infrastructure manager and investor and works with institutional investors, many of whom want to deploy capital across the transition.

Earlier this year the Green Investment Group joined MAM to provide those investors with broader and deeper access to opportunities. GIG is very focused on core renewables—wind, solar and offshore wind—where we feel investors can get very good risk-adjusted returns and deploy large volumes of capital. It is a great space for a pension fund or insurance company to invest.

But we also see huge opportunities for our clients in the next wave of the energy transition, in being one of the first movers to scale up spaces like hydrogen, biofuels, EV-charging or energy storage."

One of CPP's largest investments was the C$2.25bn acquisition of a 49pc stake in Canadian energy infrastructure firm Enbridge's North American onshore renewable power assets and two offshore wind projects in Germany. The two companies have also established a 50/50 joint venture to pursue offshore wind projects in Europe. This is a good example of an emerging trend of institutional money teaming up and backing existing developer platforms that have the track record of obtaining and developing projects but that do not always have the balance sheets needed to fund the build-out phase.

Investments meeting ESG criteria

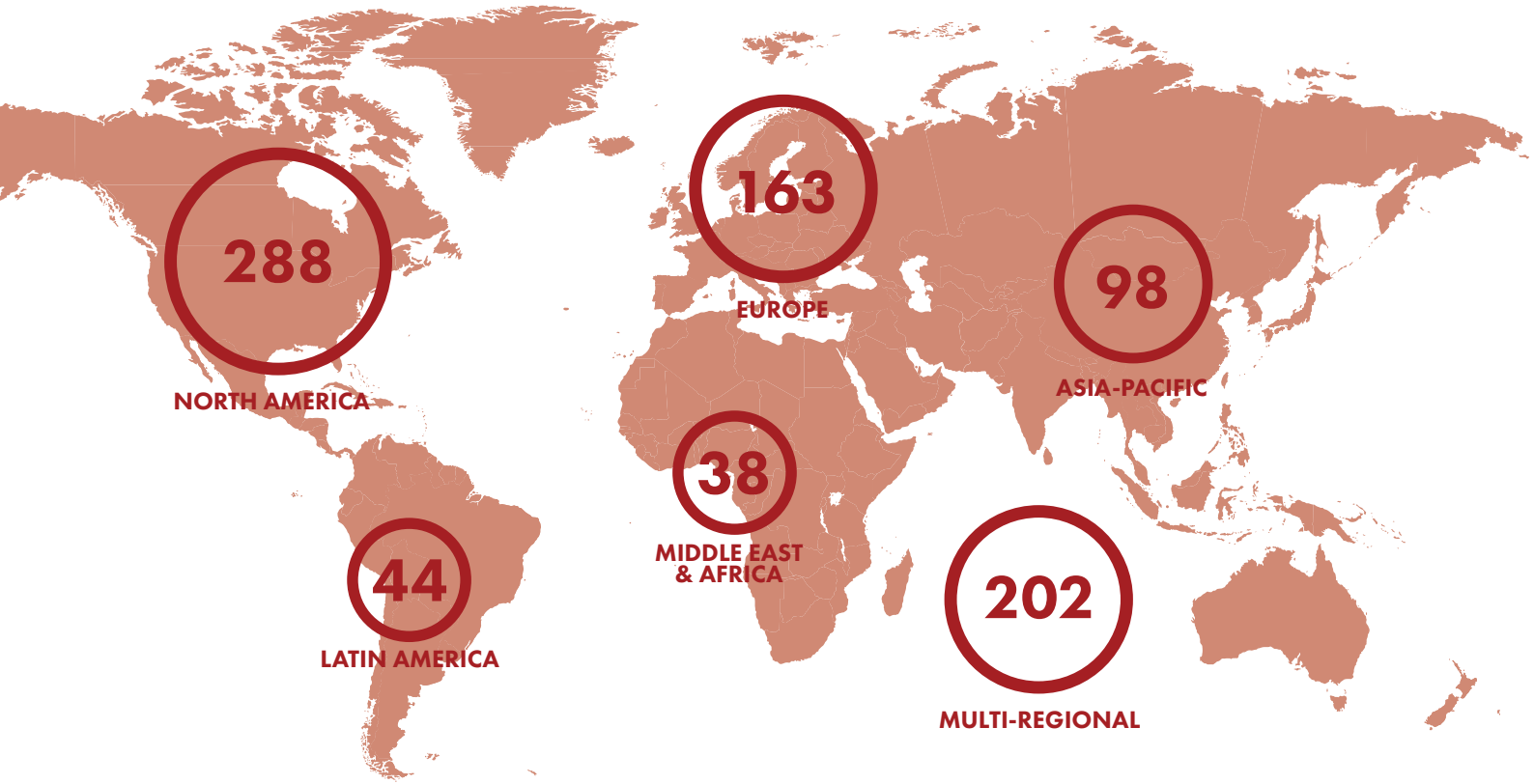
Clean energy investment is expanding hand-in-hand with the increasing integration of ESG criteria into investment cases. According to the OECD, the equivalent of 80pc of the companies making up the world's market capitalisation in 2020 were being rated on ESG criteria. Environmental risks assessed as part of ESG ratings include exposure to climate change, water security, environmental health and biodiversity loss. These are measured by metrics such as carbon emissions, energy efficiency ratings, water scarcity, and air and water pollution.

"It is really important for us as active shareholders to understand whether we are supporting companies that have an active carbon abatement policy. It is also an important part of our due diligence. When we are investing in a company, we always assess it against different climate change scenarios," Bill Rogers says.

Carbon pricing

One of the main hurdles that remains in place and makes institutional investors nervous is uncertainty about carbon pricing. Although the 2015 Paris Agreement to limit global warming to well below 2°C is a worldwide initiative, the regional methods to discourage carbon emissions by giving them a price tag vary greatly, with the politics and accusations of protectionism in applying a carbon price to certain nations' products and not others being a major stumbling block in finding a consistent approach. GIG's Chris Archer says a carbon price encompassing all developed markets would be the clearest market-based signal for investors to reduce carbon emissions. ■

Number of fund managers with energy-related investment appetite, as of 10 March 2022



Source: *Infrastructure Investor*

New investment opportunities

Finding one of the next 1,000 climate tech unicorns predicted by Fink is what all energy transition investors are hoping for. Two particular clean energy technologies that warrant special attention are green hydrogen and CCUS. Both technologies are proven but are constantly improving with technical and engineering advances. They have enormous potential to significantly reduce carbon emissions, but they require scaling-up, successful demonstration projects, and heavy investments to illustrate their true potential.

Green hydrogen

Switching to electrification to decarbonise energy production and consumption is not suitable in every situation. Particularly in hard-to-abate sectors such as heavy industry, including steel production and international ship transport, the search for a molecule-based alternative to fossil fuels has created a rush into hydrogen. The world's most common element is typically found as part of another compound, meaning it needs to be split and then extracted as pure hydrogen that can be used as a fuel. There are various methods to retrieve hydrogen, and so far fossil fuels have been the main base for production. However, fast-developing electrolysis technology offers the chance to use renewable electric power to create green hydrogen, making it an attractive decarbonisation alternative where direct electrification is not applicable.

Hydrogen's LNG DNA

This molecule-based fuel puts energy majors in a particularly advantageous position to develop green hydrogen projects.

"They are drawing analogies between hydrogen and the rush into LNG 10-20 years ago. Companies that have established LNG businesses and understand gas shipping and liquefaction have a much greater advantage," says Oliver Bacon, counsel at Allen & Overy and a specialist in advising clients in the energy and chemicals sectors. "What is interesting is that, in the early-stage hydrogen deals that we have seen, a lot of the commercial-legal language and the structures have their DNA in gas-style documents that those majors will be very familiar with," he adds. Thinking within energy majors on whether their transition should be electron- or molecule-focused will be impacted by the above sentiment, with energy majors such as Chevron considering molecule-based opportunities such as hydrogen and biofuels as a more natural fit for their existing skillset.

Infrastructure benefits

Next to the commercial knowledge, energy majors own or have access to existing infrastructure that can potentially be repurposed for the production, transport and storage of hydrogen. Their global footprint allows them to tap resources where hydrogen is most economical to produce and to make use of their extensive logistical infrastructure to bring it to demand centres. Being able to sell hydrogen to existing customers who are switching from fossil fuels to hydrogen as a feedstock is another major element working to their advantage.

Energy majors' hydrogen switch

As a first stage of green hydrogen project development, some energy majors have already committed to using this alternative fuel in their own energy-intensive industrial sites. Shell, for example, recently took FID on building Europe's largest green hydrogen plant in Rotterdam. From 2025, a 200MW electrolyser will source green power from Shell's part-owned Hollandse Kust Noord offshore windfarm and produce green hydrogen for the energy major's nearby oil refinery. The decarbonised fuel will partially replace grey hydrogen—produced from fossil fuels without carbon abatement—currently being consumed by the refinery, and it could in future supply heavy-duty trucks as commercial road transport adopts hydrogen as an alternative fuel.

Shell's example also shows how quickly energy majors can act to start bringing green hydrogen to the market, not least thanks to their strong cashflow positions.

"Decarbonisation is an existential threat to traditional oil and gas majors, so they have an even stronger motivation to leverage their existing assets, know-how and balance sheets to pursue opportunities in areas like hydrogen and CCUS. For many of these players, in addition to the combination of political, public and investor pressure, the imperative to secure a position in the potentially lucrative energy markets of the future helps to focus attention on trying to deliver projects more quickly," says Rachel O'Reilly, counsel at Allen & Overy, who advises clients on investments in low-carbon energy projects in the UK and Europe.

The hydrogen space has already seen a number of noteworthy deals including energy transition investors and, with major economies in Europe, Asia and America committing to hydrogen as part of their clean energy targets, more deals are certain to follow.

Lack of regulation

There remain a number of challenges that are leaving some investors doubtful about the nascent hydrogen market. One of the main hurdles is the regulatory framework, which has not been extensively clarified in any jurisdiction. This includes how to classify green hydrogen—what criteria allow it to qualify as green? And how can its status be proven? Speeding up hydrogen regulation is one of the main requests the investor community has and is a step that would allow many to pull the trigger on FIDs.

Inside view on deal-making in renewable energy

Oliver Bacon, Counsel at Allen & Overy

The exponential growth of the renewable energy sector has given rise to its own structures, market positions and deal behaviours that need to be navigated when transacting in the space. Below are a couple of examples that illustrate how the energy M&A landscape has developed.

1) The rise of the energy platform deal:
Platform structures, where an initial acquisition is used as a launchpad for further bolt-ons and market entries, are a familiar model for private equity. The entry of funds into the energy deal space; the opportunities presented by new energy technologies; and the build-out of renewables capacity has seen variations of platform structures being increasingly deployed in energy deal-making. On the one side of these deals, we often see a smaller organisation with development expertise and a number of 'pre-shovel' potential projects. On the other side, you will often find a financial investor that sees, through correct management incentivisation and capital injections, the opportunity to rapidly grow the target business. Strategic investors are often equally interested in these early-stage development platforms, which they will view as an opportunity to quickly scale up their capacity and know-how in a new renewable subsector or market. The most attractive platforms have often resulted in bidding wars between the strategic energy majors, with their offer of global energy clout and asset development experience versus the financial investor's offer of carried equity and the promise of a 'hands-off' investor that will allow management to get on with its work.

2) Energy venturing:
In these types of deals, energy majors and fund investors participate in early-stage funding rounds in interesting energy tech businesses. The majors, in particular, seem to be on the hunt for scalable technological solutions and, once they are proven, are typically looking for the right to acquire the company's intellectual property or fold the entire company into their existing corporate structure. Institutional investors, on the other hand, will be more focused on committing a small stake, protecting their interest, and maintaining a laser focus on a profitable future sale. Accordingly, exit and pre-emption rights are hot topics on the negotiation of these structures.

An example of this type of deal is the investments made into Hydrogenious, a Germany-based startup that has developed liquid organic hydrogen carrier technology. It has attracted investments from Chevron, Japan's JERA and Dutch multinational Royal Vopak, and is expanding rapidly across the globe. The energy majors, nearly all of which have set up corporate venturing arms to make these types of investments in energy tech and smaller transition-focused startups, have made a series of recent investments into hydrogen startups, including Eni Next leading a $3mn funding round for Thiozen, a US-based startup developing technology to produce hydrogen from high-volume industrial waste and water.

Deal-making in the energy venture space is relatively new for a number of the majors and has involved a shift in a corporate mindset that traditionally measured inorganic investment opportunities based on the hydrocarbon reserves or the modelled returns that would be delivered. In contrast, energy venturing investment decisions will often be made based on the results of the technical IP diligence and a view on the ability of the management team to execute on the target's business plan.

Questions about demand

A second concern is that, unlike many other developing markets, there is currently no established consumer base for green hydrogen. Many energy-intensive industries are trialling the use of hydrogen or have made decarbonisation commitments that could translate into switching to the fuel, but firm commercial agreements are few and far between. "One of the many novel challenges for hydrogen is that neither the production nor the demand side of the market are established. That uncertainty about whether there will be a price competitive and liquid enough market for hydrogen in 10-20 years' time is by far the biggest challenge for early mover projects, on both the demand and supply side. Supply side projects taking FID in the shorter term will likely be shaped by being able to secure offtakers with either a stable need for the product, or a willingness to take a strategic view on a long term market position, but beyond that only time will tell," says Rachel O'Reilly of A&O.

CCUS

Energy majors' existing experience and many of the other benefits that leave them well-suited for investing in the hydrogen sector also apply to CCUS—especially their access to existing infrastructure and geological assets, which give them a major advantage over smaller players in building out world-leading CCUS projects in the name of decarbonisation.

Quite often these types of assets, such as depleted oil and gas fields—both onshore as well as offshore—are coming towards the end of their operational lives under their original purpose. The prospect of repurposing them by applying CCUS technology is also a major economic benefit to the companies owning the assets that potentially offset the significant decommissioning costs.

Carbon price link

So far, investments in CCUS globally have been weak, despite their proven relevance for meeting climate goals. Annual CCUS spending has consistently accounted for less than 0.5pc of global investments in clean energy and efficiency technologies, according to the IEA. One key drawback to the economic viability of capturing and storing carbon has been a weak carbon price. However, prices for European carbon allowances have more than doubled in the past 18 months, reaching a record high of close to €100/t in 2022. Furthermore government investment incentives and renewed commitment to reducing carbon emissions are injecting fresh momentum into the CCUS market, with more than $27bn committed to advanced-stage CCUS projects globally.

Most notably, the Inflation Reduction Act has made investing in CCUS substantially more attractive in the US, raising the amount and availability of tax credits for such projects and allowing smaller plans to also qualify.

The first CCUS pilot projects are starting to demonstrate their value, giving new types of investors more and more confidence to start entering the space. The Northern Lights CCS project in Norway being developed by Equinor, Shell and TotalEnergies, for example, recently signed the world's first commercial agreement for cross-border transport of carbon. From early 2025, Norwegian chemicals company Yara will ship 800,000t of liquefied CO_2 from its Sluiskil plant in the Netherlands to the Northern Lights offshore carbon storage site. Offtake deals such as these vastly improve a CCUS project's financial viability and make their business cases much more attractive to other investors.

Expert view on CCUS investments

Bill Rogers, head of Europe & Asia at Sustainable Energy Group, part of CPP Investments

"Some of the support mechanisms in the US have started the TLC required for investors, and that is why you are seeing this CCS market movement in North America. At Sustainable Energy Group, we are making $10-20mn investments into new carbon-capture developers in North America. An example of a company we have invested in North America is Wolf Midstream, a firm that manufactures midstream oil and gas pipelines. We have backed that team to use their existing pipeline knowledge and capabilities to work with emitters and users of carbon on constructing a carbon pipeline. A facility that is emitting carbon will capture it and ship it through the pipeline we have developed to where it is re-used."

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