CDP
DISCLOSURE INSIGHT ACTION

DOUBLING DOWN

EUROPE'S LOW-CARBON INVESTMENT OPPORTUNITY

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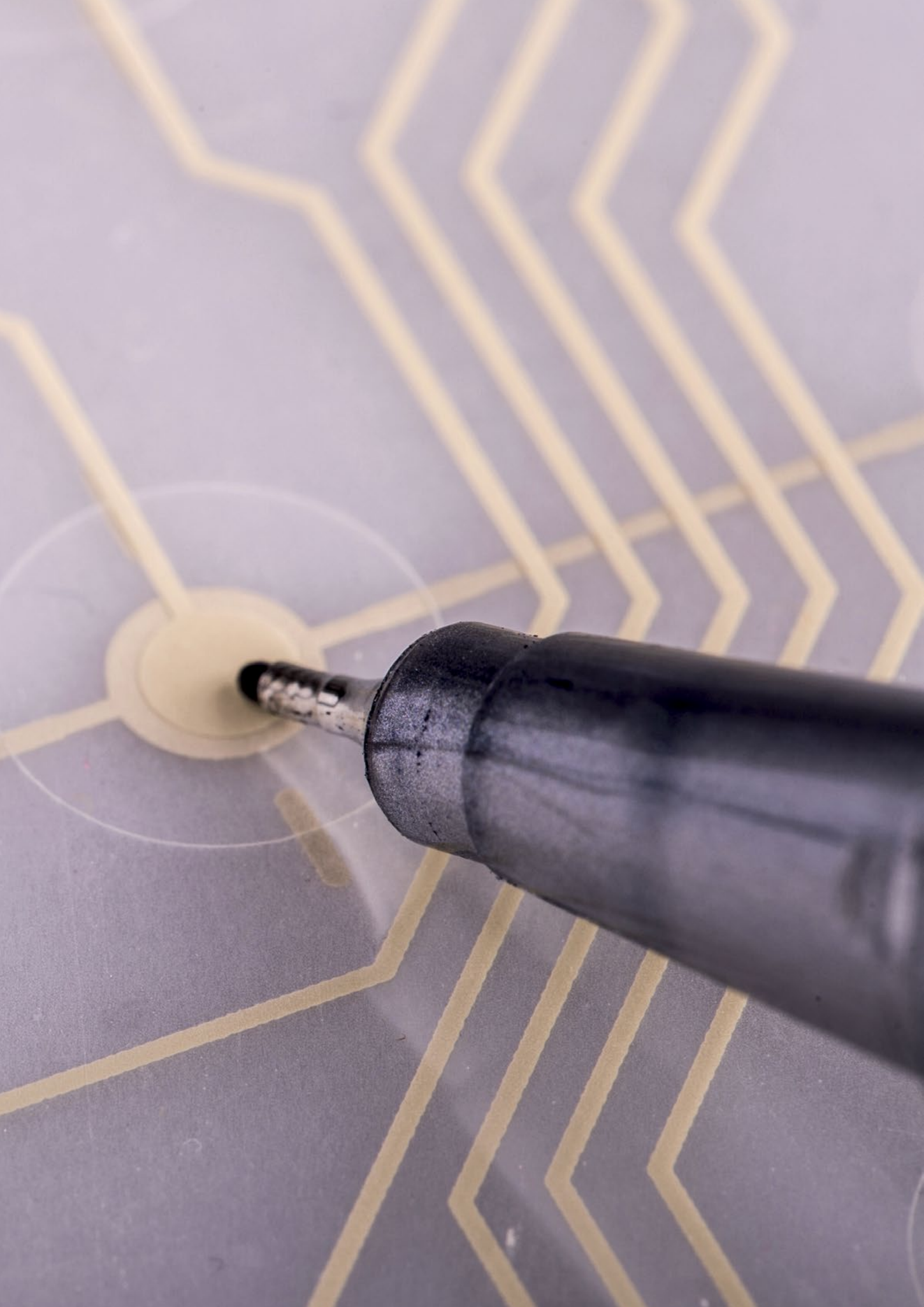
Written by

OLIVER WYMAN

CDP EUROPE REPORT



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FOREWORD FROM STEVEN TEBBE
MANAGING DIRECTOR, CDP EUROPE

2020 must be our super decade of climate action. EU leaders have agreed a new target for climate-neutrality by 2050: a clear signal to companies, investors and citizens of what the future of Europe will look like. Achieving this goal means that our economy needs to decarbonize at the rate of nearly 8% per year. This requires a fundamental transformation of our economic business model. The investment decisions taken by European companies and their owners will make or break whether we are successful – and they need to double down.

> From new green infrastructure projects to electric vehicle fleets and renewable power, companies see new business opportunities in developing low carbon products and services that amount to over 1.2 trillion euro.

Our only true north is science, and the scientific consensus is clear. We need to cut emissions by half by 2030 in order to have a reasonable chance of limiting global warming to 1.5 degrees, the more ambitious goal of the Paris agreement.

In 2019 however, greenhouse gas emissions rose once again to new record heights. Every year that we fail to decarbonize industrial processes, the window we have to get to net-zero is cut by two.

The consequences of failing to take much more substantive action will be catastrophic. The devastating impact of climate change, water insecurity and deforestation will always be loss of human life, which is no distant threat, as climate-related events around the world in the past year have demonstrated all too clearly.

But the impact is also economic. A warmer world will do incredible damage to our economy and society. The difference between even 1.5 and 2 degrees of warming is estimated at $15 trillion in damage – not far above the EU's whole GDP.

Five years on from the Paris Agreement, the world is slowly waking up to the urgency of the climate and environmental crisis. Citizens are telling their governments loudly that they will not accept willful ignorance of the science any longer. They are demanding concrete, decisive action.

We cannot afford to delay genuine action across the board any longer.

The European companies reporting to CDP and analyzed in this report will play an enormous role in whether the EU can achieve its climate neutrality target. These companies represent approximately 76 percent of Europe's market capitalization.

This report shows that some are taking the transition seriously. Investments in emission reductions activities reported in 2019 are expected to lead to 2.4 gigatons of lifetime emissions savings – that's equivalent to the annual emissions of Germany, the United Kingdom, Poland, Italy and France combined.

Many are already making significant investments in low carbon assets, infrastructure and research and development. In 2019 over €124 billion in new low carbon investments was reported, with the bulk coming from highly emitting companies in the transport, energy and materials sectors.

They're investing huge sums into renewable energy, grid infrastructure, electric vehicles, automation and digitalization, to transition their business models so that they can continue to exist in a net-zero emissions future.

But they need to double down on their ambition. Current levels of investment are roughly half of what we estimate will be needed for the European corporate sector to be consistent with a net-zero emissions pathway by 2050, which is a key part of the EU's new climate strategy.

There is a clear business case for them doing so. As our report shows, the need for an overhaul of the economy is also a major opportunity. From new green infrastructure projects to electric vehicle fleets and renewable power, companies see new business opportunities in developing low carbon products and services that amount to over €1.2 trillion. Not only that, but the cost to realize these opportunities is six times less, at €192 billion.

The information companies use to inform their investment strategies is in many cases the result of reporting to CDP. In 2019, more firms than ever before – 8,400+ representing over 50 percent of global market capitalization – disclosed to us, enabling them to comply with requests from financial markets across the world.

Our simple theory of change is that the disclosure of quality data leads to smarter decisions and informs investors, companies and governments of the actions they need to take. The process of annual disclosure enables new insights, based on data that never existed before.

And it allows the companies and the financial market to innovate in the way that they must to meet the climate challenge, the biggest humanity has ever faced. It is transparency about these corporate strategies that helps investors to drive capital towards the businesses with serious plans, who are investing in and leading the transition to business models which are low carbon, and not reliant on unsustainable water use or deforestation.

And CDP ensures that this data about what companies are doing is made comparable and shared with global markets. That is our purpose.

BUSINESS PERSPECTIVE: BERTRAND CAMUS, CHIEF EXECUTIVE OFFICER, SUEZ

> Our low-carbon solutions in waste and water business to the benefit of our municipal and industrial customers aim to help them avoid 20 $MtCO_2e$ of GHG emissions per year in 2030.

2020: Time for enhancing ambition on low-carbon solutions

At the beginning of this new decade, facing the climate emergency requires both a raising of the level of ambition of climate commitments, and a strong scaling up of the implementation of low-carbon solutions. This was the solemn appeal launched by UNFCCC during COP25 to all stakeholders, including finance and business, who answered unanimously by raising climate change to the top of the agenda of the World Economic Forum in January.

I believe that the convergence of actions of public authorities and economic stakeholders targeting a low-carbon economy has never been as strong as now. As recent examples, I would mention the European Green Deal, presented by the European Commission last December, the Climate Finance Partnership targeting emerging countries signed in Davos a few weeks ago, or the very ambitious Pledge "Business Ambition for 1.5°C-our only future", launched last September by UN Global Compact and gathering now more than 190 large companies, including SUEZ, committing to reach a net-zero emissions goal by 2050.

As part of the launch of SUEZ new strategic plan "Shaping SUEZ 2030" in October 2019, I decided thus to enhance the ambition of our climate strategy. By upgrading our commitment in terms of GHG emissions reduction from 30 percent to 45 percent by 2030, as a first step in our alignment with the 1.5°C trajectory. And also by increasing the roll-out of our low-carbon solutions in waste and water business to the benefit of our municipal and industrial customers, aiming to help them avoid 20 $MtCO_2e$ of GHG emissions per year in 2030, which is twice the current level of our contribution.

Both commitments foster low-carbon innovation and build new partnerships with positive social impact. They also redirect even more than before SUEZ investment's policy on "100 percent sustainable" solutions, demonstrating a positive impact on our planet's natural capital - such as water, air and soil - thus on biodiversity and climate and also more broadly public health and quality of life.

As examples, I could highlight our willingness to transform all the assets that we operate in resource centers, contributing to the reduction of our own carbon footprint as well as that of our customers. It is already the case with the transformation of wastewater treatment plants into biofactories in Chile or Spain, where 100 percent of wastewater and biosolids are recycled and are both carbon neutral, providers of alternative water resources and energy positive.

Another issue, as untreated waste in emerging countries could represent up to 10 percent of their global emissions by 2025, is the systematization of methane capture and recovery in all the landfills that we already operate or intend to operate worldwide. SUEZ has already done so in Lebanon and Morocco, and several projects in other countries are currently being investigated.

Eventually, SUEZ is also planning a strong increase of the rate of its investments dedicated to other low-carbon technologies, ranging from production of biofuels, technologies used to produce and re-inject biogas, optimized plastics recycling and recovery systems to digital platforms.

As a foreword, I would like to thank CDP for the key role it plays since several years in accelerating collaborative solutions fighting climate change by putting the most relevant information at the disposal of the business, policy and investment community, in order to help it make the right decisions to build a more sustainable economic and financial ecosystem for the future generations.

EXECUTIVE SUMMARY

01.

In 2019, 882 European companies responsible for over 2.3 $GtCO_2e$ of emissions reported €124 billion of new low-carbon investments to CDP.

Low-carbon investment was driven by companies in the high-emitting materials, energy and transport sectors, accounting for 5, 38 and 50 percent respectively.

Capital investments comprised €59 billion, driven by electric utility investments of €45 billion in renewables, infrastructure and enabling technologies such as demand-side response programmes and digitalization. Research and development (R&D) investments amounted to €65 billion, of which €43 billion was reported by transport original equipment manufacturers (OEMs), primarily for investments in electrification and autonomous vehicle technologies. Overall transport sector R&D accounted for 46 percent of all low-carbon investment reported to CDP in 2019.

Transformation of the power system and the electrification of road transport therefore dominated low-carbon investment, comprising over 70 percent of total investment between them.[1]

02.

More investment in transformational breakthrough technologies is needed – particularly in the materials sector.

The materials sector accounted for only 5 percent of low-carbon investment despite being responsible for 35 percent of reported scope 1 and 2 emissions. Companies in the cement, chemicals, metals & mining and steel industries need to develop breakthrough technologies if they are to decarbonize in line with the EU's ambitions, but new investments in technologies such as carbon capture, utilization and storage (CCUS) and hydrogen were small. For example, CCUS attracted 0.2 percent of total low-carbon investment in 2019 across all sectors, and hydrogen only 0.1 percent.

Minimal new investments were also reported for advanced biofuels and synthetic fuels, alternative materials and circular economy processes.

03.

Low-carbon capital investment must double to place the European corporate sector on track for net-zero emissions by 2050.

The European Commission has proposed new emissions targets of 50-55 percent below 1990 levels by 2030 and 'climate neutrality' by 2050. This report uses CDP data on low-carbon capital investments and associated emissions reductions to estimate the annual capital investment required for companies to be on this pathway. It finds that total low-carbon capital investment among the reporting companies would need to more than double, from €59 billion in 2019 to around €122 billion a year.

While this is a significant increase, in the context of overall capital expenditure, low-carbon investment would still remain a modest share: growing from 12 percent to 25 percent of capex.

04.

The business case for low-carbon investment is clear: companies expect to avoid 2.4 $GtCO_2e$ while contributing over €40 billion to their bottom line.

Emissions reduction initiatives offered attractive economics. Companies anticipated more than 2.4 $GtCO_2e$ of cumulative emissions reductions over the lifetime of their initiatives – more than the annual emissions of Germany, the United Kingdom, Italy, Poland and France combined – at an average profit of €17 per tonne of CO_2e, reflecting the fact that emissions reduction initiatives typically yield cost savings in excess of the initial investment. In total, this represents a contribution to companies' bottom line of more than €40 billion over the investments' lifetimes. The most profitable emissions reduction initiatives were investments in energy efficiency processes, yielding average profits of more than €27 per tonne CO_2e, but significant abatement profits were also anticipated from investments in transport electrification and low-carbon energy.

Companies also identified €1.22 trillion of new revenue opportunities from low-carbon goods and services – more than six times the investment needed to realize them.

05.

Closing the low-carbon investment gap requires action on multiple fronts.

In the public sphere, policies must address the unfavorable economics of immature low-carbon technologies, enable companies to overcome threats to existing revenue models, and provide sufficient, long-term certainty for large transformational investments in capital intensive breakthrough technologies. Increased public financing is required to de-risk private investment and support the development of new infrastructure.

Reforms to improve transparency of climate-related data will help underpin efforts to incorporate climate risks into financial regulatory frameworks and develop transition risk modelling among financial institutions, ultimately helping to align capital allocation decisions and loan pricing with prevailing climate policies and regulations.

This is a bold and far-reaching agenda, but all of it falls within the scope of existing initiatives: *The European Green Deal*, *The European Green Deal Investment Plan* and *The Action Plan on Sustainable Finance*. Much will rest on the ambition, reach and effectiveness of the policies implemented under each.

Action on policies and regulation must be matched by action in the private sector, where the decisions to lend and invest will be taken. Among corporates, low-carbon investment decisions will be supported by emissions reduction commitments aligned with the EU's target of net-zero emissions by 2050, and the integration of climate into financial planning, strategic planning and corporate governance frameworks. Among financial institutions, continued innovation in green financial products is needed, in particular to ensure the transition financing needs of 'brown' sectors are met.

EUROPE'S LOW-CARBON INVESTMENT CHALLENGE

To avoid the worst impacts of climate change, global temperature rise must be limited to no more than 1.5°C, requiring global carbon dioxide emissions to decline to net-zero by 2050.[2] Accordingly, a growing number of national and sub-national governments, companies and investors have adopted targets to reach net-zero emissions by 2050 **(see Exhibit 1)**.[3]

In June 2019, together with a global coalition of organizations, CDP launched the 'Business Ambition for 1.5°C' campaign – an urgent call to action to companies to align with limiting global temperature rise to 1.5°C above pre-industrial levels. So far, 190 companies, representing a $3.6 trillion market cap, have pledged to set 1.5°C-aligned climate targets and reach net-zero emissions by no later than 2050 with interim reduction targets through the Science Based Targets initiative (SBTi).[4]

Europe is well represented in this endeavour – 53 European companies currently reporting to CDP have joined the 'Business Ambition for 1.5°C' campaign, and the new European Commission has immediately initiated proceedings to enshrine in law the target of climate neutrality (net-zero greenhouse gas emissions) by 2050 as part of its Green Deal **(see Box 1)** and member states have endorsed the target.[5]

Box 1: Europe's Green Deal

The new European Commission's Green Deal sets out an ambitious agenda to place the EU on track for 'climate neutrality' – net-zero greenhouse gas emissions – by 2050. Key elements include legislation to bring the 2050 goal into law and ensure policy coherence with the target; and increasing the EU's 2030 emissions reduction target from 40 percent below 1990 levels to 50-55 percent.

The Green Deal also identifies the need for wide-ranging reforms to the European Taxation Directive and the taxation of international transport fuels, the Emissions Trading Scheme (ETS) and fossil fuel subsidies in order to ensure better carbon price signals. Policies and investment would be targeted at the circular economy and low-carbon transport and energy infrastructure such as rail and waterways, smart transport networks, smart grids, hydrogen networks, carbon capture, storage and use, and electricity storage. A raft of accompanying reforms to help mobilize low-carbon finance and investment are also anticipated, as part of the EU's *Action Plan on Sustainable Finance* and the *European Green Deal Investment Plan*.

Source: EC (2019) 'The European Green Deal' COM(2019) 640.

Exhibit 1: Selected Net-Zero Commitments

73 countries	14 regions	398 cities	190 businesses	18 asset owners
France	Brussels-Capital Region	Barcelona	Carlsberg	Allianz
Norway	California	Cape Town	Enel	AXA
Sweden	Catalonia	Copenhagen	L'Oréal	Aviva
Switzerland	New York	Los Angeles	Royal DSM	Swiss Re
United Kingdom	Queensland	Melbourne	Signify	Zurich

Note: Information is as of January 29, 2020.
Source: UNFCCC, UN Global Compact, C40 Cities Climate Leadership Group, Net-Zero Asset Owner Alliance, Oliver Wyman analysis

EUROPE'S LOW-CARBON INVESTMENT CHALLENGE

The European Commission has estimated that **overall investment in 2030 needs to be between €176 billion and €290 billion a year higher** than it would be under current policies.

Achieving this goal will require a significant increase in low-carbon investment. At the global level, the Intergovernmental Panel on Climate Change (IPCC) estimates an immediate investment requirement of $2.4 trillion per year in the energy system, implying an annual funding shortfall of more than $500 billion.[6] For Europe, the European Investment Bank (EIB) estimates that energy-related investment must double from current levels[7], while the Commission has estimated that overall investment in 2030 needs to be between €176 billion and €290 billion a year higher than it would be under current policies.[8]

Recognizing this investment challenge, the EIB recently agreed to phase out financing for unabated fossil fuels and become the world's first 'climate bank', and the Commission has proposed to dedicate at least 25 percent of the EU budget to climate as part of its *European Green Deal Investment Plan*, which aims to mobilize €1 trillion of investment over 10 years. Most of the low-carbon investment needed to put Europe on track for net-zero by 2050 must come from the private sector, so the extent to which European companies' low-carbon investment plans are compatible with this objective is a critical question. CDP's reporting data allows us to undertake a bottom-up analysis of how companies are responding to the low-carbon investment challenge, the specific low-carbon initiatives in which they are investing **(see Box 2)**, and whether corporate investment patterns are consistent with the net-zero goal.

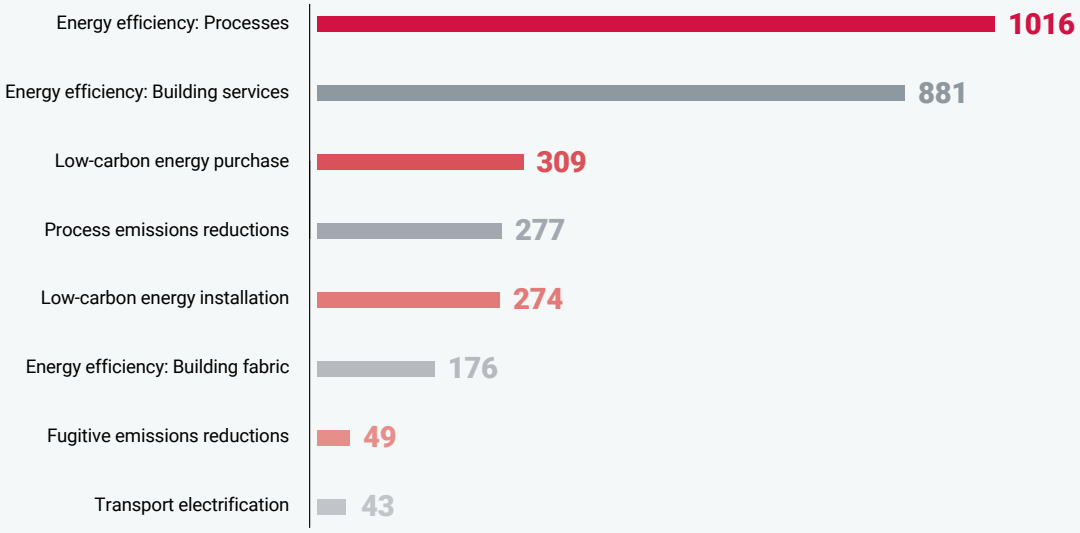
Box 2: Investing in low-carbon initiatives

CDP reporting guidance asks companies to provide basic information on any emissions reduction initiatives undertaken, but companies in CDP's high-impact sectors (materials, energy, transport and agriculture) are asked to provide more detailed information, including for investments in research and development (R&D).

Across all sectors, some of the most commonly disclosed low-carbon investments are in emissions reduction initiatives such as energy-efficient processes and building services. Among high-impact sectors, the most commonly reported low-carbon investments are in renewable energy (by electric utilities and oil & gas companies) and energy efficiency measures in the value chain (by oil & gas companies).

Exhibit 2: Most commonly reported emissions reduction initiatives

By number of reported initiatives, 2019



Source: Oliver Wyman analysis, CDP reporting data

EUROPEAN CORPORATE LOW-CARBON INVESTMENT: SCALE, NEEDS AND BENEFITS

Total current and planned low-carbon investment[9] among the 882 European companies reporting data to their investors was €124 billion in 2019.[10] Of this, 93 percent was reported by companies in the high-emitting materials, energy and transport (MET) sectors, which together accounted for 84 percent of scope 1 and 2 emissions.[11] **Exhibit 3** shows the top 10 companies ranked by their scope 1 and 2 emissions with their associated low-carbon investments: it is not the case that those companies with the largest carbon footprints necessarily make the largest low-carbon investments.

Geographically, low-carbon investment was concentrated primarily among reporting companies domiciled in Germany, Spain and Italy **(see Exhibit 4)**.

Exhibit 3: Top 10 companies ranked by emissions with associated low-carbon investments

CDP reporting companies, by sector, 2019

Rank	Company name	Total carbon emissions* $MtCO_2e$	Low-carbon investments € millions, 2019
1	ArcelorMittal	188	246
2	ENEL SpA	96	135
3	HeidelbergCementAG	84	4
4	Royal Dutch Shell	82	162
5	ENGIE	69	182
6	Total	44	271
7	Eni SpA	44	78
8	A.P. Moller -Maersk	39	893
9	CRH Plc	38	0.01
10	Endesa	32	4

Materials Energy Transport

*For each company, total carbon emissions are calculated as the sum of gross global scope 1 and 2 emissions.
Based on Oliver Wyman's data handling methodology, analysis in this report only includes reported low-carbon investments where the investment start date falls within the respective company's reporting year.
Source: Oliver Wyman analysis, CDP reporting data.

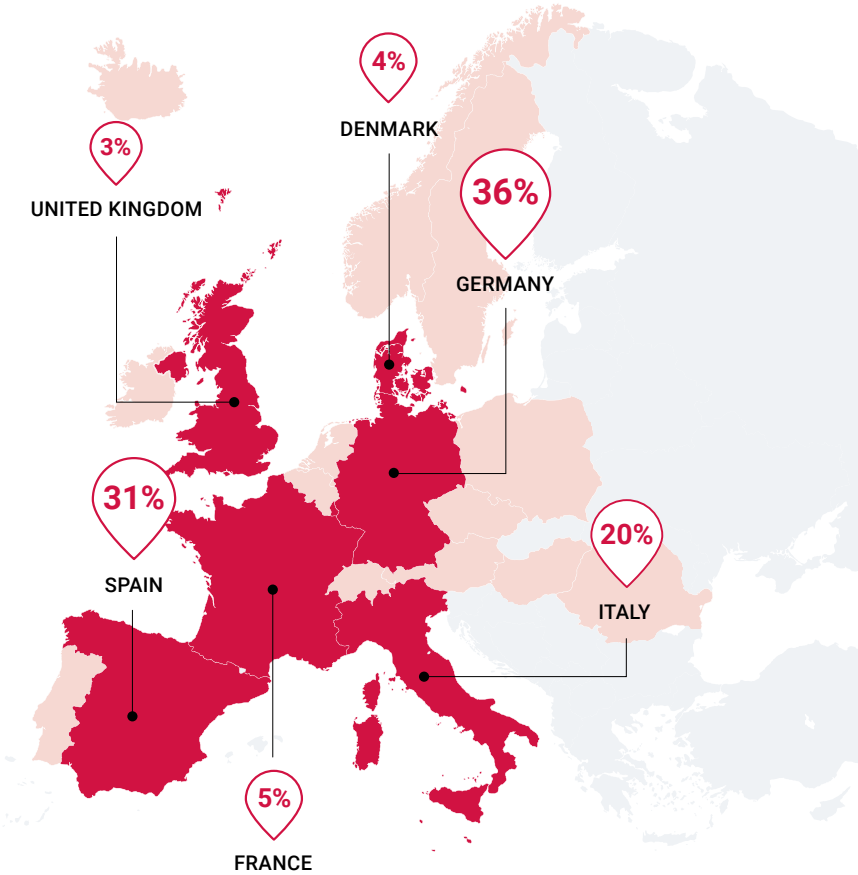
Exhibit 4: European countries by share of reported low-carbon investment

Top European countries by low-carbon investment

Rank	Country	Number of reporting companies	€ billions, 2019
1	Germany	69	44.4
2	Spain	48	37.9
3	Italy	42	24.3
4	France	79	6.0
5	Denmark	14	4.5
6	United Kingdom	194	4.0

Note: The rest of the European countries highlighted in light Ruby had low-carbon investments share less than 0.5 percent of the total reported figures
Source: Oliver Wyman analysis, CDP reporting data

European countries by share of low-carbon investment



Scale of low-carbon investment

Total reported new low-carbon investments fell in 2019 compared to the previous year. Adjusting for changes in the reporting sample so that only companies reporting in consecutive years are considered, low-carbon investment fell by 31 percent, from €172 billion in 2018 to €118 billion in 2019 on a like-for-like basis. This decline occurred across the board **(see Exhibit 5)**, however, in absolute terms, the largest falls were among companies in the MET sectors, where declines were amplified by large, one-off investments reported in 2018 that inflated 2018 results relative to 2019. The significant variability introduced by the timing of large low-carbon investment announcements means several years of data are needed to confidently identify trends, and changes from one year to the next should be interpreted carefully. Below we examine the most significant developments in each of the MET sectors.

Materials

The materials sector comprises the cement, chemicals, steel, and metals & mining sub-sectors which are characterized by high energy use and emissions from industrial processes that cannot be easily electrified. Consequently, these industries are often described as 'hard to abate'. They are also a significant source of carbon: industrial sectors are responsible for around a fifth of EU emissions.[12]

The 60 percent decline in materials sector low-carbon investment, from €16 billion to €6.4 billion on a like-for-like basis, was driven primarily by the chemicals sub-sector. This was explained mainly by BASF's reporting of over €10 billion of investments in energy efficiency, material efficiency and low-carbon solutions in 2018, compared to (a still very significant) low-carbon investment of €2.1 billion in 2019.

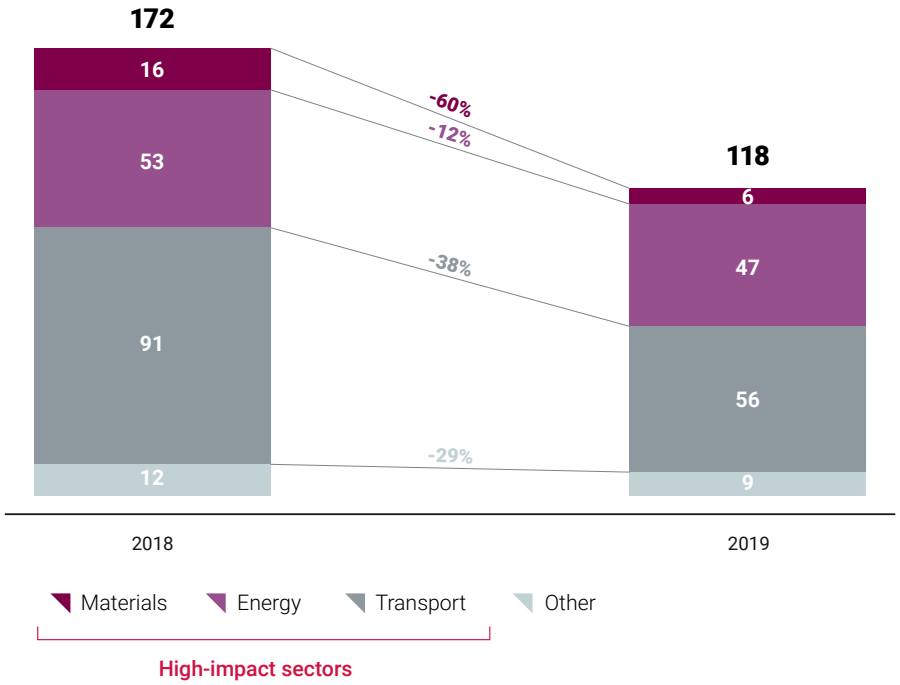
Energy

The decline in energy sector investment of 12 percent on a like-for-like basis is comparatively modest. It was driven by declining renewable investment among electric utilities. Overall investment in renewables by electric utilities fell €27 billion (65 percent) from 2018 to 2019, although the scale of this decline may be overstated by EDF's reporting of a €25 billion solar investment plan in 2018. Removing this initiative gives an underlying decline of 10 percent.

Despite the decline in renewables investment, the number of reported renewable investments by electric utilities actually increased (from 12 to 19), meaning the average project cost fell from €3.4 billion to €750 million (or from €1.4 billion to €750 million if EDF's 2018 investment is stripped out). This indicates that project sizes have dropped significantly. One possible explanation for this could be fewer (large) wind projects and a rise in (smaller) solar PV installations.[13]

Exhibit 5: Reported low-carbon investment among European companies on a like-for-like basis

€ billions, by sector, 2018 – 2019



Source: Oliver Wyman analysis, CDP reporting data

Transport

The largest decline in low-carbon investment occurred within the transport sector, where current and planned investments declined by 38 percent on a like-for-like basis, representing a net €35 billion decline. *Prima facie*, this is concerning for the EU's decarbonization objectives, as transport already accounts for over a quarter of EU emissions, and its emissions are rising. However, it is hard to draw firm conclusions because a small number of large R&D announcements dominate the data, which makes it impossible to identify underlying trends.

The decline was driven primarily by original equipment manufacturers (OEMs), which account for 91 percent of transport sector low-carbon investment reported to CDP in 2019 – mainly in the form of R&D **(see section on *Investment Patterns in High-Emitting Sectors*)**. In 2019, transport OEMs reported €35 billion less low-carbon investment. A €22 billion fall in investment in light duty vehicles (LDV) is mainly explained by a significant €18 billion investment in R&D for electric and autonomous vehicles by Renault accounted for in the 2018 reporting period. There was no new low-carbon R&D in heavy duty vehicles (HDV) reported in 2019, but €13 billion was reported the year before, comprising a single R&D investment from Volkswagen in efficiency technologies.

Total current and planned low-carbon investment among the 882 European companies reporting data to their investors was

€124 billion

in 2019.

EUROPEAN CORPORATE LOW-CARBON INVESTMENT: SCALE, NEEDS AND BENEFITS

The net-zero investment gap

It is widely accepted that levels of low-carbon investment will need to increase significantly if Europe is to achieve its goal of net-zero emissions by 2050, although existing estimates of the investment needed do not identify a specific investment requirement for the corporate sector.

Here, we use data reported to CDP on companies' emissions reductions initiatives – specifically upfront capital investments and associated emissions reduction – to develop sector-level relationships between upfront capital investment and annual carbon abatement. For each sector (materials, energy, transport and other) we estimate two investment relationships – one for initiatives with net negative costs (-ve), and one for initiatives with net positive costs (+ve). The former is assumed to apply to investments that should occur 'within the baseline' of current policies and trends – i.e. investments that are economically rational on the current pathway. The latter is assumed to apply to investments that need to occur 'beyond the baseline', in order to close the gap between the current trajectory and a 'net-zero by 2050' pathway. These investments are inevitably more costly, as they are likely to be associated with more expensive, less mature technologies that will require additional policies and support to become viable at scale.

The investment relationships are applied to estimates of required sector-level annual abatements, within baseline and beyond baseline, for a pathway that achieves emissions reductions of 55 percent below 1990 levels by 2030 – the upper end of the EU's newly proposed mid-term target assumed to be compatible with net-zero by 2050. For baseline emissions reductions, we use the European Commission's Baseline 2016 scenario which closely tracks historical emissions.

We assume a linear pathway from 2020 to 2030, and that all sectors decarbonize at the same overall rate. This gives estimates of required annual low-carbon capital investment 'within baseline' and 'beyond baseline' at the sector level, which can then be aggregated across sectors to give a total annual low-carbon investment requirement for CDP reporting companies **(see Exhibit 6)**.

For European companies currently reporting to CDP, the estimated annual low-carbon capital investment requirement consistent with a net-zero by 2050 pathway is around €122 billion a year – slightly more than twice the low-carbon capital investment reported to CDP in 2019 of €59 billion. This is broadly consistent with other available estimates for economy-wide investment needs.[14] Doubling low-carbon capital investment from current levels represents a major step change, but from a relatively low base: total capital expenditure (capex) for the 2019 CDP reporting sample is around €497 billion. So, put another way, getting on track for net-zero by 2050 would mean increasing low-carbon investment's share of overall capex from 12 to 25 percent.

This estimate does not include investment in R&D, which also needs to increase significantly. It is reasonable to suppose that, for most sectors, low-carbon R&D should at least double from current levels based on the EU's target of a 50 percent increase in overall R&D intensity and the fact that low-carbon R&D needs to account for a disproportionate share of this increase.[15] However, data limitations mean this additional calculation cannot be performed reliably.[16]

The results for capital investment needs rest on a number of assumptions and should be treated as indicative only. But while the numbers are approximate, the broader conclusion, that low-carbon capital investment will need to increase significantly if the EU's new climate ambitions are to be met, is robust. Below we consider some examples of the challenges that will need to be overcome if low-carbon investment is to increase on the scale needed.

Low-carbon capital investment **needs to increase from 12% to 25%** of capex to place companies on track for net-zero emissions by 2050.

Step 01

Segregate Data

For each sector, divide investments into -ve and +ve cost sets

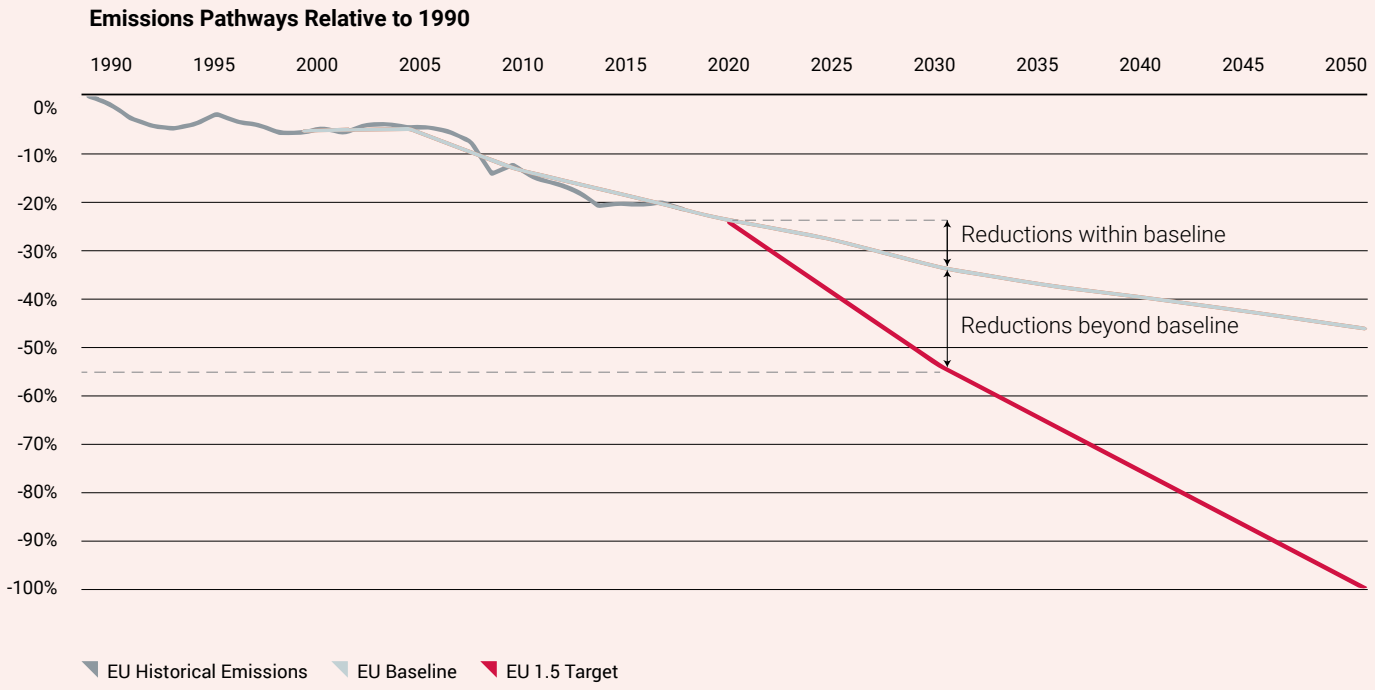
Step 02

Calculate Sector Investment Relationships

For each sector, calculate median investment per tCO_2e for -ve and +ve cost initiatives

EUROPEAN CORPORATE LOW-CARBON INVESTMENT: SCALE, NEEDS AND BENEFITS

Exhibit 6: Using CDP data to estimate low-carbon capital investment needed for net-zero by 2050



Step 03

Estimate Abatement Requirements

For each sector, estimate annual emissions reductions i) within baseline, and ii) beyond baseline for 55 percent below 1990 levels by 2030

Step 04

Estimate Investment Requirements

For each sector, apply median investment per tCO_2e for -ve investments to within baseline annual emissions reductions, and for +ve cost investments, apply to beyond baseline annual reductions

Step 05

Calculate Total Annual Investment Requirement

Sum within baseline and beyond baseline investment requirements across sectors

Source: European Commission, Eurostat, Oliver Wyman and NERA analysis

Materials: in need of breakthrough

Historically, companies in Europe's industrial sector have prioritized investment in energy efficiency, which has improved 38 percent since 1990.[17] However, a consequence of this success may be fewer opportunities for efficiency in the future, as conventional processes reach the limits of optimization. Ultimately, reaching net-zero emissions in the materials sector relies on the development of transformational 'breakthrough' technologies such as carbon capture, utilization and storage (CCUS) and hydrogen.

For example, the European Commission's modelling of net-zero emissions scenarios implies significant deployment of CCUS, anticipating the capture of up to 606 $MtCO_2e$ a year by 2050 – roughly equivalent to 70 percent of current industrial emissions. To put this in perspective, there are two large-scale operational carbon capture and storage (CCS) facilities in Europe (both in Norway) that between them capture about 1.5 $MtCO_2e$ a year for geological storage. This means that achieving net-zero by 2050 on the pathways modelled by the European Commission would require the scale-up of carbon capture capacity by a factor in the range of 200 to 400 times over the next thirty years.[18]

But while developing CCUS and hydrogen is a top priority for management in materials companies, high technology costs coupled with uncertainties about future regulations and parallel developments in other sectors makes large, long-term capital investments risky. As a result, investment in these technologies remains comparatively small and focused on R&D **(see Box 3)**, while companies prioritize capital investments with shorter time horizons over which they can have more confidence in carbon prices and regulatory developments **(see Exhibit 9)**.

The risk is that, without more confidence in future carbon prices, regulatory developments and demand for low-carbon materials, these technologies will remain stuck at the R&D stage.

Ultimately, the development of both CCUS and hydrogen depends on more than the carbon price, though this is important. Scaling these technologies is contingent upon investments in other sectors and other parts of the value chain – for example, to provide sufficient renewable electricity for hydrogen production or develop new markets for carbon. It also requires the development or repurposing of infrastructure for storage and transport of the gases. According to the disclosures of cement producer LafargeHolcim, CCUS requires not only large investments to install carbon capture technology on direct operations, but significant investments elsewhere 'along the value chain' in tandem with a 'widespread multi-disciplinary collaboration, including stronger regulations and effective carbon pricing.'

Box 3: CCUS and hydrogen in the materials sector

Breakthrough technologies such as carbon capture, utilization and storage (CCUS) and hydrogen could, in theory, help heavy industries such as cement, steel and chemicals achieve deep decarbonization. Indeed, the future viability of companies in these sub-sectors may come to depend on the commercialization of these technologies: client work undertaken by Oliver Wyman indicates that, in some cases, continuing with current technologies could mean compliance costs approach the level of company operating income under ambitious regulatory and carbon-pricing scenarios.

Technically, CCUS could avoid up to 100 percent of industrial plant emissions, depending on the scale at which it is deployed. However, investment costs are high: to ensure full abatement, installations would need to have enough capacity for complete capture during peak load, but this would necessarily mean under-utilization at other times of operation. Current carbon prices are not high enough to overcome this cost, while future prices are uncertain due to questions surrounding further reform of the ETS and in particular the availability of free allowances. This uncertainty about future prices makes planning difficult.

Selling captured carbon for utilization in downstream applications such as production of alternative fuels and materials could improve project economics, but this is subject to further uncertainties about how and when these markets might develop, which may often depend upon investment decisions taken in other sectors.

Another possible breakthrough technology is hydrogen, which can replace fossil fuels as a source of industrial heat and potentially also be used as a reducing agent instead of metallurgical coal. Voestalpine, Salzgitter, ArcelorMittal and SSAB are all pursuing hydrogen technology for example. However, hydrogen faces similar challenges of high costs and uncertain demand. For example, Salzgitter recently described its hydrogen-based steelmaking process as "technically feasible but economically unviable" without significant capital subsidies and regulations to make the resulting zero-carbon steel competitive.

Additionally, the production of zero-carbon hydrogen in sufficient volumes would require huge amounts of renewable energy for electrolysis of water, creating considerable uncertainty about the future availability of hydrogen. For example, according to one estimate, it would require 30TWh of new renewable energy per year to produce enough hydrogen to fully convert Voestalpine's steelmaking – almost half of Austrian electricity demand.

Source: Oliver Wyman analysis, Clean Energy Wire *Can Salzgitter cut Germany's CO_2 emissions with low-carbon steel project?*, May 2019, and Handelsblatt, *Wasserstoff statt Koks: Die Zeit der Hochofenroute neigt sich dem Ende zu*, June 2019.

Energy: policy and regulatory challenges

The underlying 10 percent decline in electric utility renewables investment identified in the *Scale of low-carbon investment* section is corroborated by economy-wide data. Bloomberg New Energy Finance found European clean energy commitments fell 7 percent in 2019, whilst the latest International Energy Agency data suggests that European investment in renewables fell 14 percent in 2018.[19]

Policy and regulatory factors may explain some of this fall. In Europe, fiscal pressures in a number of member states, changes to the European State-Aid Guidelines and the increasing competitiveness of renewables have prompted governments to cut subsidies and shift to competitive auctions in recent years, which have begun to yield subsidy free projects. Whilst this is undoubtedly a triumph for renewable technology, the absence of price support in subsidy-free projects leaves developers exposed to merchant risk in electricity markets, which may deter investment **(see Box 4)**.

Permitting problems have also held up investments in onshore wind, most notably in Germany, where the shift to auctions means project developers need a permit in order to bid. But obtaining permits has become more difficult, with the process for new onshore windfarms lengthening from less than 10 months to over 2 years, leading to a pronounced slump in development and undersubscribed auctions.[20] Onshore wind developments are often unpopular in densely populated Europe. In 2018, 12 member states made no wind installations.[21]

European energy taxation rules also fail to create incentives for clean energy investment and create uncertainty in how renewable energy may be taxed, potentially hindering investment. The Energy Taxation Directive of 2003 was developed with fossil fuels in mind so does not contain clear provisions for the taxation of other fuels, meaning there is no guarantee that low-carbon fuels will receive favorable tax treatment. Furthermore, a lack of provisions on energy storage raises the possibility of double taxation of electricity that is stored and resold – in 2018, at least six EU member states are known to have taxed stored electricity twice.[22]

The absence of price support in subsidy-free projects leaves developers exposed to merchant risk in electricity markets, which may deter investment.

Box 4: Merchant risk in unsubsidized renewable projects

Continued declines in renewable costs and government efforts to reduce subsidies have seen competitive auctions delivering lower and lower subsidies. This is now reaching its logical conclusion with the removal of subsidies by some governments and the emergence of zero-subsidy bids where the developer is no longer guaranteed a price. Notable recent examples include Germany, the Netherlands, Denmark and the United Kingdom for wind, and Spain, Portugal and Italy for solar.

These projects will see investors assume merchant risk. Whereas feed-in tariffs and auctions for subsidies provided investors with reliable returns by shielding them from price risk, this is not the case in subsidy-free projects. Investor returns will depend on the electricity prices they receive in wholesale markets, which are likely to become more volatile as decarbonization proceeds: as more renewables come onto the grid, the risk of pronounced declines in electricity prices during surges in renewable generation grows – an effect known as 'price cannibalisation'. On occasion, renewable generators may even find themselves selling into the market during periods of oversupply and negative prices, in effect paying customers to take energy. Periods of negative prices have been observed in a number of European markets including the United Kingdom, Germany and Denmark for example.

In a subsidy-free future this could create investment headwinds, as more renewables means more merchant risk. Dispatchable renewable projects which include a battery storage component offer one solution, but their viability depends on a host of factors not least the technology, location, market and regulatory context, and the first examples have only just begun to emerge around the world.

Developers can seek to manage merchant risk through insurance and hedging, or they can look to guarantee revenues by signing Power Purchase Agreements (PPAs) with utility or corporate buyers. However, developers are struggling to find buyers willing to enter into purchase agreements of more than three years given price uncertainty, when ideally they would be securing revenues for three to five times as long in order to access bank financing.

This leaves an open policy question for governments looking to withdraw renewables subsidies while simultaneously scaling up renewables investment. It may be that subsidies are still required, but in a new guise: linked to the timing of generation instead of just volumes.

Source: Oliver Wyman analysis

EUROPEAN CORPORATE LOW-CARBON INVESTMENT: SCALE, NEEDS AND BENEFITS

Transport: disruption of commercial vehicle manufacturers' revenue model

Although transport OEMs have made large investments in low-carbon R&D related to electric drivetrains and automation, electric vehicles have a small market share and road transport emissions continue to rise. This is particularly true for commercial vehicles, where the development of zero-emission vehicles threatens the revenue model of incumbent HDV manufacturers **(see Box 5)**.

No transport OEM companies reported low-carbon investments in HDV technologies in 2019; in 2018, one company reported a €13 billion HDV R&D initiative focused on vehicle efficiency. Given the small number of companies reporting HDV investments, short time frame and lumpy nature of R&D investments, conclusions should be drawn carefully, but the data provide little evidence of new investment in zero-emission trucks.

As well as prompting thirty major corporations to call for new regulatory obligations for HDV and LDV manufacturers, the lack of available zero-emission commercial vehicles has even led a freight forwarder to invest in developing its own solutions: in 2019, Deutsche Post DHL reported that it makes annual R&D investments to continually improve its electric van – the StreetScooter – a vehicle it developed in response to the dearth of suitable zero-carbon vehicles available from LDV manufacturers.

Box 5: The challenge of zero-emission trucks

HDV emissions account for about a quarter of EU road emissions and have grown 25 percent since 1990. Without deployment of zero-carbon technologies, this growth is likely to continue given projected increases in road freight and limits to how far improvements in vehicle efficiency can go. Accordingly, road transport is attracting increasing attention from European policymakers concerned about its implications for overall emissions goals.

The unavailability of low-carbon trucks also has implications for the emissions reduction efforts of companies that rely on road transport in their distribution and supply chains. Frustrated with the current situation, thirty major European companies including Metro, Unilever and ABInBev recently wrote to the European Commission calling for regulations to obligate HDV and LDV manufactures to ensure a proportion of their vehicle fleets are zero-carbon by 2025 and 2030.[23]

But the switch to zero-emission drivetrains threatens the existing business model of HDV manufacturers. As the primary determinant of vehicle performance, conventional drivetrains are a critical source of differentiation for OEMs, but a switch to electric drivetrains means much of the value associated with this competitive differentiation shifts to battery manufacturers, as it is the battery that largely determines vehicle weight, range and cost.

A switch to electric drivetrains also threatens after-sale revenues. Electric drivetrains have a tiny fraction of the components, so spare parts sales are likely to dry up significantly. Finally, rapid adoption of electric trucks could increase total cost of ownership, as the sale of used trucks to overseas markets in Eastern Europe and Asia, which lack the necessary infrastructure, is likely to be difficult. This will limit residual value and make it harder for HDV manufacturers to pass the cost of new technology on to customers.

Oliver Wyman has estimated that these disruptions to the current business model of European HDV manufacturers could put up to 10 percent of revenues at risk.

Nevertheless, it seems increasingly likely that European HDV manufactures will have to significantly increase their sales of zero-emission HDVs to meet growing customer demand and comply with future regulations. They will need to manage these risks by adopting agile R&D strategies targeting differentiation and customer acceptance; generating new downstream revenue streams through, for example truck-as-a-service offers; and moving towards circular economy concepts of vehicle remarketing based around retrofitting and approaches for component reuse and recycling.

Source: Oliver Wyman (2018) 'Truck Manufacturers: Business Model Risks from Alternative Drivetrains'.

Benefits of low-carbon investment

Many of the low-carbon investments undertaken generate significant emissions reductions and financial benefits. Of the €124 billion of total low-carbon investment reported in 2019, companies provided data on expected emissions reductions and cost savings for €24 billion of investments in specific emissions reduction initiatives. This was expected to result in around 2.4 $GtCO_2e$ of cumulative emissions reductions over the investments' lifetimes – more than the annual emissions of Germany, the United Kingdom, Italy, Poland and France[24] combined – representing an average required investment of around €10 per tonne of CO_2e avoided.

The true average cost of avoiding a tonne of CO_2e was even lower, however, because many low-carbon investments offer significant cost savings not included in the investment amount. Overall, companies expected to achieve €65 billion of cost savings over the lifetimes of their investments, representing a net €41 billion contribution to bottom line and an average marginal abatement profit of €17 per tonne of CO_2e. In **Exhibit 7**, marginal abatement costs (investment required to avoid a tonne of CO_2e net of monetary savings) are shown against emissions reductions for the average low-carbon initiative in each sub-sector.

The chart is skewed significantly to the left – for most sub-sectors, the average emissions reduction initiative has a negative cost (i.e. it generates a profit over the investment lifetime). This reflects the prevalence of efficiency investments and the improved economics of renewable energy. For example, the average electric utilities initiative was expected to deliver over 12 $MtCO_2e$ of emissions reductions – reflecting the sub-sector's focus on large capital investments – at a profit of €19 per tonne CO_2e. Among these investments, utilities companies reported significant monetary savings associated with installations of wind and other new low-carbon equipment as well as from energy efficiency.

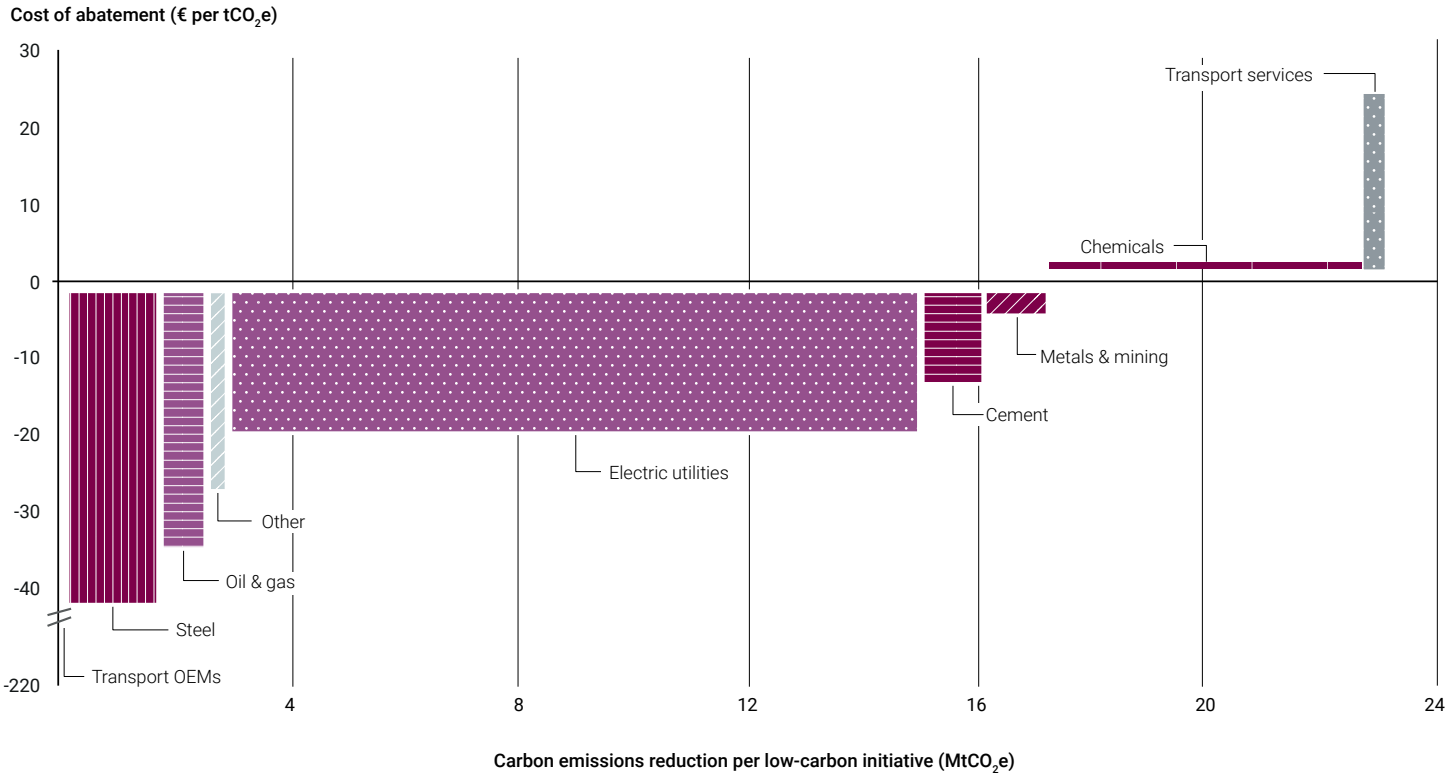
Where emissions reductions came at a cost, this was often modest. For example, the average chemicals sub-sector low-carbon initiative avoided 5.5 $MtCO_2e$ of emissions reductions at a net cost of less than €1 per tonne – a tiny fraction of recent carbon prices on the ETS, which hovered between €20 and €30 per tonne in 2019.[25]

On the one hand, the significant amount of emissions reductions being achieved for low or negative abatement costs reveals the favorable economics of much of the low-carbon investment taking place, particularly for investments in energy efficiency. **Exhibit 8** lists the most attractive initiatives by marginal abatement cost, and energy efficiency investments top the league table with profits in excess of €20 per tonne CO_2e.

On the other hand, the preponderance of negative cost initiatives indicates that a lot of low-carbon investment is in what might be

Exhibit 7: Average sub-sector emissions reduction initiatives

By marginal abatement cost and amount of emissions reductions, 2019



Note: Only low-carbon investment-related emissions reduction initiatives were included in the calculation
Source: Oliver Wyman analysis, CDP reporting data

EUROPEAN CORPORATE LOW-CARBON INVESTMENT: SCALE, NEEDS AND BENEFITS

Exhibit 8: Top emissions reduction initiatives

By marginal abatement cost, 2019

Initiative type	Marginal abatement cost € per tCO_2e	Low-carbon investment € millions, 2019
Energy efficiency: Processes	- 27.5	5,075
Energy efficiency: Building fabric	- 23.6	1,218
Transport electrification	- 18.3	67
Low-carbon energy installation	- 16.6	11,138
Energy efficiency: Building services	- 11.3	3,480
Process emissions reductions	- 6.2	1,332
Low-carbon energy purchase	- 4.6	856

Source: Oliver Wyman analysis, CDP reporting data

Investments are expected to deliver **2.4 $GtCO_2e$** of lifetime emissions savings while adding net €41 billion to bottom lines.

European companies see **€1.22 trillion** of new low- carbon business opportunities.

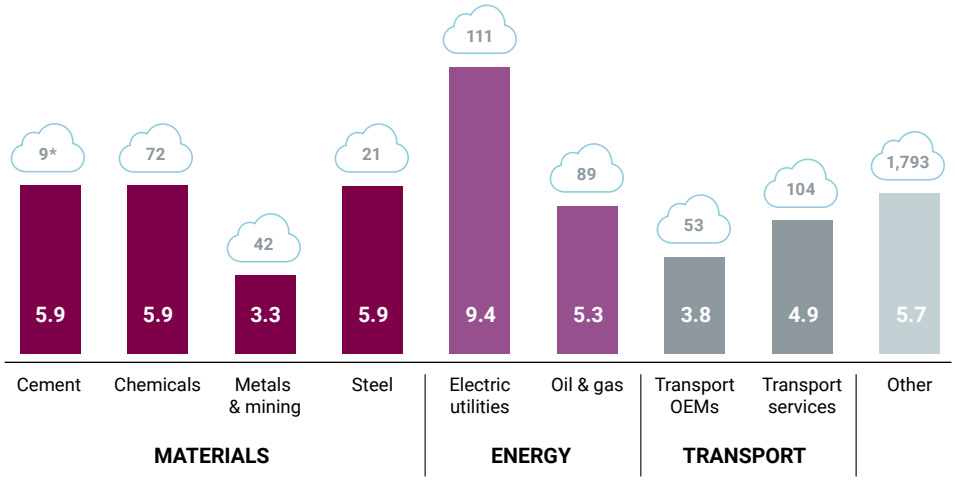
considered low-hanging fruit. For example, 85 percent of anticipated emissions reductions are expected to cost no more than €8.10 per tonne CO_2e, well below 2019 ETS prices[26] and even further below the carbon price a group of leading economists has identified as necessary for a 1.5°C pathway, which is in the region of €70 per tonne rising to €90 by 2030.[27]

Low-carbon investments have typical payback periods of 3 to 6 years **(see Exhibit 9)**. It is notable that the longest payback periods are evident in the electric utilities sub-sector, where policies such as contracts for difference provide long-term price support for renewable projects, enabling developers to invest over durations that might be considered too risky and uncertain in other sectors. In the materials sector, where long-term capital investments are also needed – for example to install CCS or build plants based on new production technologies – uncertainty over future prices and regulations often results in companies prioritizing short-term capital investments in practice.

Companies are making low-carbon investments not only to reduce emissions and costs, but also to realize new revenue opportunities from low-carbon goods and services. In 2019, European companies identified €1.22 trillion of new revenue opportunities from low-carbon goods and services that would cost €192 billion to realize. In transport, for example, Volkswagen AG expects that by 2025 battery-electric vehicles will comprise up to 25 percent of expected annual sales, representing a financial opportunity of €59 billion. In energy, electric utility E.ON SE foresees 7 to 10 million electric vehicles in Germany by 2030, representing a €12 billion opportunity from charging infrastructure, hardware and software solutions. In materials, mining company BHP similarly anticipates a €12 billion opportunity due to expected demand growth for copper, which is used in a variety of low-carbon technologies. None of which is to say that the only opportunities are to be found in high-impact sectors. Construction company ACS Actividades de Construccion y Servicios, for instance, sees an €11 billion opportunity in green building and infrastructure projects.

Exhibit 9: Average payback period for investments in emissions reduction initiatives

No. of years, by sub-sector, 2019



*Number above each sub-sector refers to the number of emissions reduction initiatives reported
Source: Oliver Wyman analysis, CDP reporting data

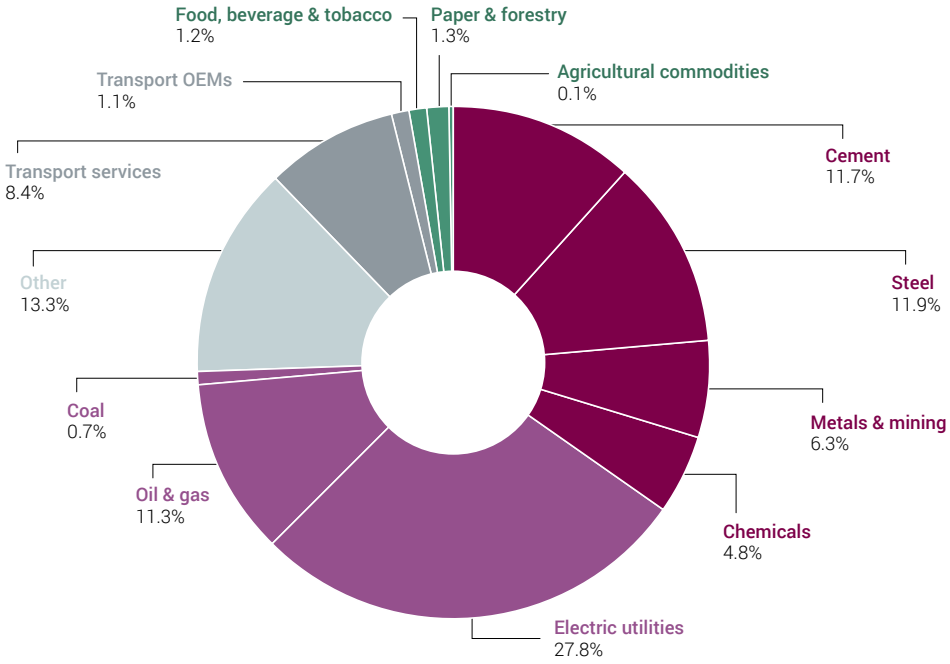
INVESTMENT PATTERNS IN HIGH-EMITTING SECTORS

Reporting companies from the three MET (materials, energy, and transport) sectors account for more than 80 percent of reported scope 1 and 2 greenhouse gas emissions: energy (901 $MtCO_2e$), materials (787 $MtCO_2e$) and transport (214 $MtCO_2e$) **(see Exhibit 10)**. Consequently, the low-carbon investment decisions made by companies in these sectors have a disproportionate impact on European emissions and, ultimately, Europe's chances of achieving net-zero emissions by 2050. In this chapter, we take a closer look at patterns of low-carbon investment among this critical subset of companies.[28]

- Materials
- Energy
- Transport
- Agriculture
- Other

Exhibit 10: Reported emissions by sector and sub-sector

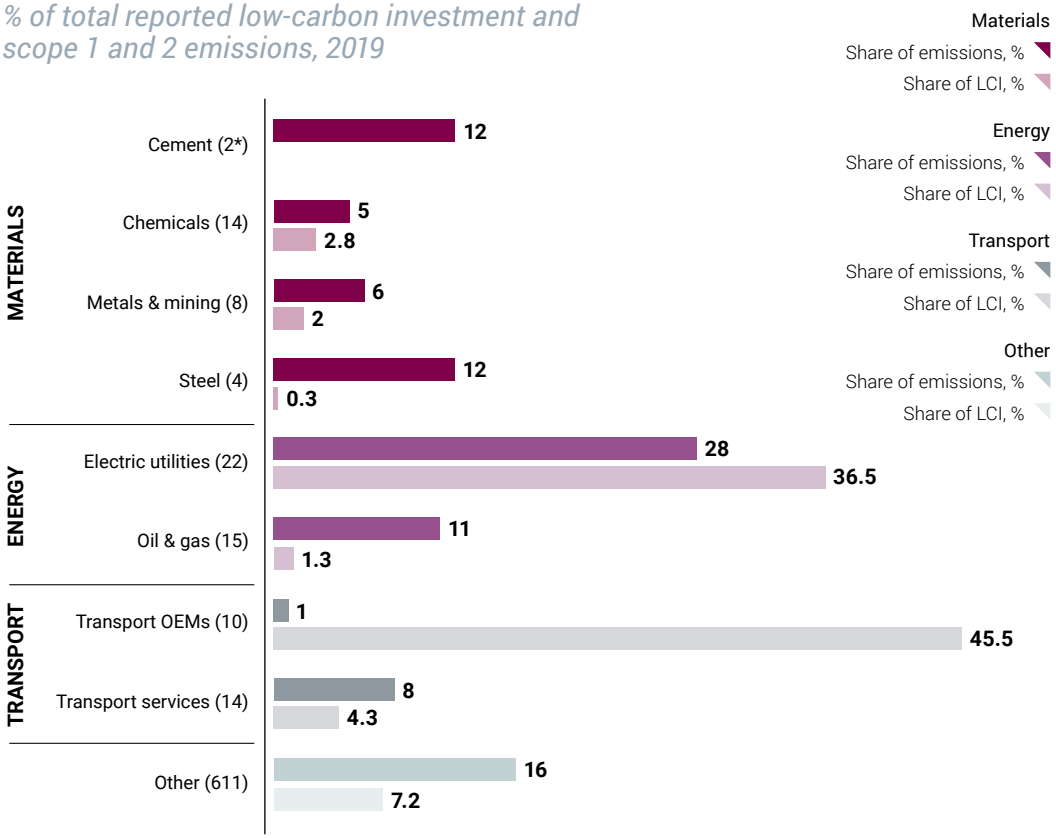
% of total reported scope 1 and 2 greenhouse gas emissions, 2019



Reported low-carbon investment is distributed unevenly across these sectors, with companies in the transport OEM and electric utilities sub-sectors making more low-carbon investments relative to their scope 1 and 2 greenhouse gas emissions (although leaving out scope 3 emissions arguably understates transport OEM emissions share) **(see Exhibit 11)**. Starker is the discrepancy between emissions and low-carbon investment for cement and steel. These two sub-sectors are responsible for 24 percent of scope 1 and 2 emissions in the CDP reporting sample, but account for a fraction of one percent of low-carbon investment. In 2019, two cement companies reported low-carbon investment of around €4 million, and four steel companies reported low-carbon investment of €408 million.

Exhibit 11: Shares of emissions and low-carbon investment by sub-sector

% of total reported low-carbon investment and scope 1 and 2 emissions, 2019



*Number next to each sub-sector refers to the number of companies reporting low-carbon investment

Based on Oliver Wyman's data handling methodology, analysis in this report only includes reported low-carbon investments where the investment start date falls within the respective company's reporting year.

Source: Oliver Wyman analysis, CDP reporting data

INVESTMENT PATTERNS IN HIGH-EMITTING SECTORS

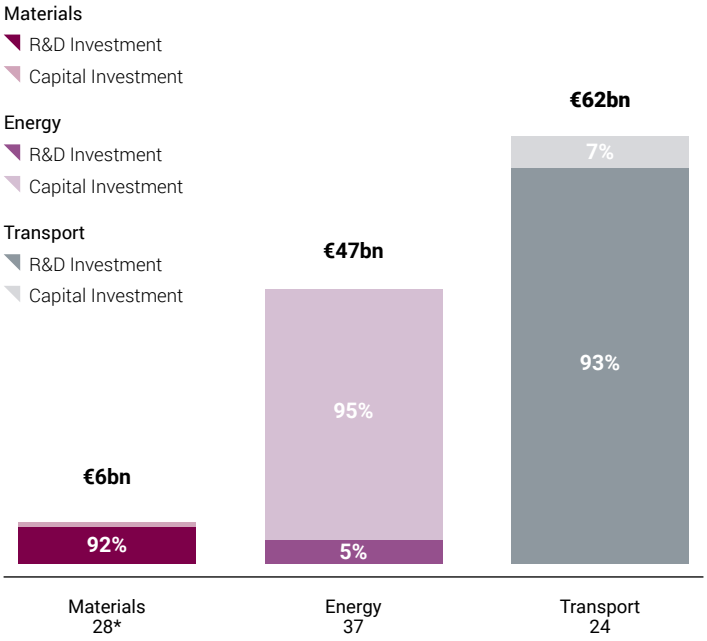
The transport sector reported the most low-carbon investment in 2019, comprising mainly R&D **(see Exhibit 12)**. This is highly significant: transport sector R&D amounted to €57 billion, accounting for 46 percent of total reported low-carbon investment in 2019. Most of this was reported by transport OEMs, reflecting both the size of Europe's automotive sector (it is the second largest in the world, behind China) and its R&D spend, which accounts for 28 percent of total EU R&D.[29]

While R&D dominated investment in the transport and materials sectors, capital investment dominated the energy sector. Overall, the picture of low-carbon investment is primarily one of power sector and road transport transformation, characterized by deployment of technologies to decarbonize the power sector and development of technologies to decarbonize road transport **(see Exhibit 13)**.

R&D from transport OEMs – reported primarily for electric vehicles – amounted to more than €43 billion and capital investments in renewables, grid infrastructure, demand side response programmes and digitalization by electric utilities amounted to over €45 billion.

Low-carbon R&D reported by transport OEMs is equivalent to three quarters of the entire R&D spend of the EU automotive sector,[30] indicating that low-carbon R&D is likely being over-reported: while it is certainly the case that low-carbon technology is a large and growing share of transport OEM R&D budgets, it is not yet all consuming. In practice, transport OEM companies often report composite R&D initiatives comprising multiple investments in different technologies as entirely 'low-carbon', however without a breakdown it is not possible to isolate the low-carbon share.

Exhibit 12: 2019 low-carbon investment in the materials, energy and transport sectors



*Number under each sector refers to the number of companies reporting low-carbon investment
Source: Oliver Wyman analysis, CDP reporting data

Low-carbon R&D reported by transport OEMs is equivalent to **75%** of the entire R&D spend of the EU automotive sector.

Exhibit 13: Top ten low-carbon investment categories by investment received

Materials Energy Transport

Rank	Technology Area	Low-carbon investment, € billions, 2019	Main contributing sub-sector
1	Electrification	43.1	Transport OEMs
2	Renewable energy	15.5	Electric utilities
3	Infrastructure	15.0	Electric utilities
4	Demand-side response programs	8.4	Electric utilities
5	Digital technology	6.6	Electric utilities
6	Green metals	2.3	Metals & mining
7	Energy/resource efficiency	2.1	Chemicals
8	Advanced technologies	0.9	Transport services
9	Product redesign	0.6	Chemicals
10	Alternative fuels	0.3	Transport services

Source: Oliver Wyman analysis, CDP reporting data

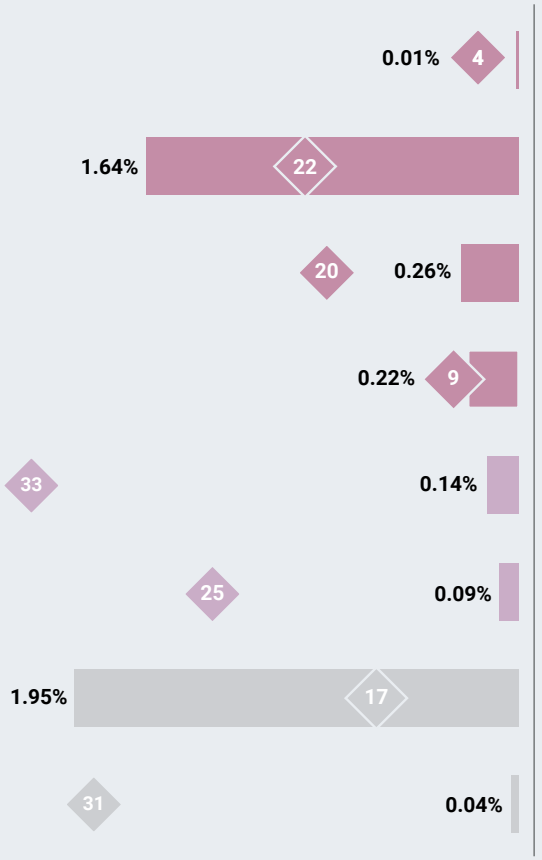
INVESTMENT PATTERNS IN HIGH-EMITTING SECTORS

Exhibit 14 shows average annual company low-carbon R&D intensities by sub-sector (low-carbon R&D as a share of revenue).[31] Unsurprisingly, transport OEM companies have the highest low-carbon R&D intensity, followed by companies in the chemicals sub-sector. These sub-sectors are innovation dependent and tend to exhibit high R&D intensities in general. The average low-carbon R&D intensities for companies in the other sectors are far behind.

R&D intensities in the energy sector tend to be low, at well under 1 percent, so it is no surprise that energy sector low-carbon R&D is small. However, although the energy sector tends to spend little on R&D in general, low spending on low-carbon R&D is still problematic given the need for continued improvement in battery technologies and breakthroughs in new energy carriers such as hydrogen for example. The small low-carbon R&D spend of steel, and particularly cement, is perhaps most problematic however, given the dependence of these sub-sectors on as yet unavailable technologies to achieve deep decarbonization.

Turning to low-carbon tangible assets, low-carbon capital investment as a share of overall capex is much higher among electric utilities than it is for other sub-sectors, reflecting the large investments utilities are making in renewable and grid infrastructure (see Exhibit 15).[32]

Exhibit 14: Average annual company low-carbon R&D intensity, by sub-sector



Materials
Average R&D intensity across 2018 and 2019
Number of reporting companies*

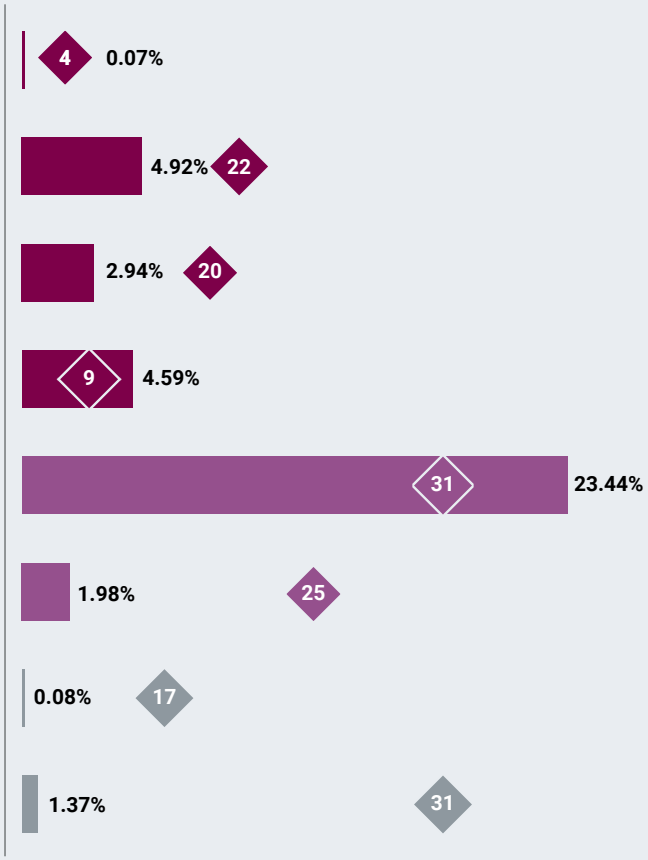
Energy
Average R&D intensity across 2018 and 2019
Number of reporting companies*

Transport
Average R&D intensity across 2018 and 2019
Number of reporting companies*

*Number refers to companies reporting low-carbon R&D investments and company announcements of 2018 revenue figures

Source: Oliver Wyman analysis, CDP reporting data

Exhibit 15: Average company low-carbon capital investment as a percentage of capex, by sub-sector



Materials
Average capex share across 2018 and 2019
Number of reporting companies*

Energy
Average capex share across 2018 and 2019
Number of reporting companies*

Transport
Average capex share across 2018 and 2019
Number of reporting companies*

*Number refers to companies reporting low-carbon capital investments and company announcements of 2018 capex figures

Source: Oliver Wyman analysis, CDP reporting data

INVESTMENT PATTERNS IN HIGH-EMITTING SECTORS

Investing for transformation

Reaching net-zero emissions requires the development and deployment of many low-carbon technologies. Some of these will offer 'continuous improvement' of existing processes – for example measures to improve efficiency – whilst others might offer step changes in emissions intensity through radical process redesign – such as the circular economy – or the introduction of novel technologies such as CCUS or alternative energy carriers such as hydrogen.

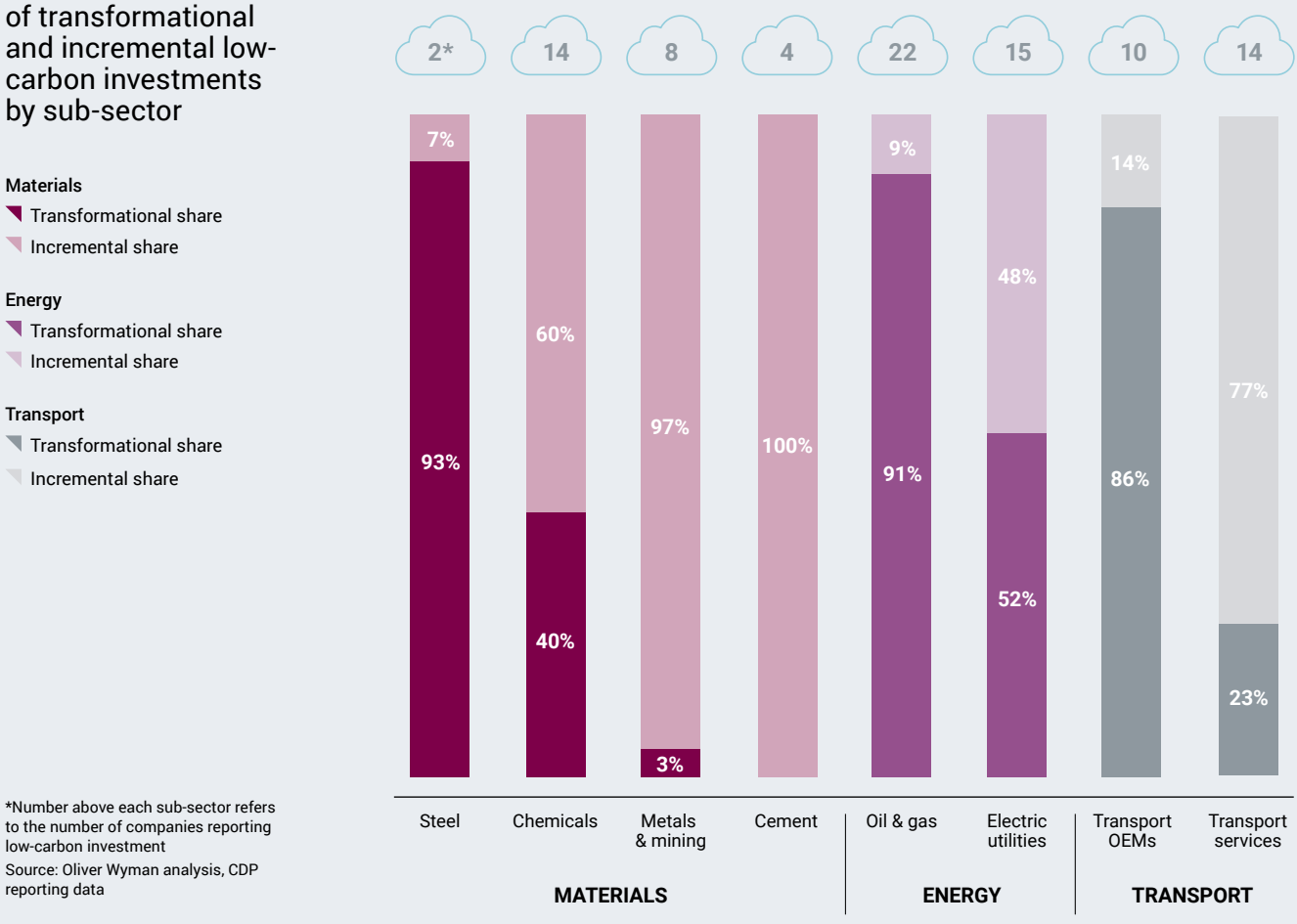
In reality of course, both kinds of innovation are needed. For example, the European Commission's modelling of pathways to reach net-zero emissions by 2050 includes steep continuous improvements in energy efficiency alongside a combination of technological transformations through CCUS, negative emissions technologies, electrification technologies, hydrogen, synthetic fuels and a shift towards more circular business models.[33]

There is a risk, however, that company low-carbon investment is biased against transformational technology because it may disrupt existing business models, have higher risk of failure and take longer to pay back.

Moreover, the viability of transformational technologies may depend on coordinated investments in other sectors and appropriate government regulations **(see Box 3)**. But companies that do not invest now in developing transformational technologies face significant transition risk in the future, as they may find themselves lacking the technologies needed to thrive in a net-zero economy. Efficiency improvements are vital, but on their own they are not a route to complete decarbonization.

To investigate the extent to which companies are investing in transformational technologies, an analysis of low-carbon investment categories was undertaken by sub-sector, with investment categories labelled as 'incremental' or 'transformational' depending on whether they were judged to offer continuous improvement of existing processes or disruptive change with the potential for a step change in emissions intensity. The results of this exercise are shown in **Exhibit 16**.[34] It suggests that transformational investments comprise a significant share of low-carbon investment across most sub-sectors, with the notable exceptions of cement (where only two companies reported) and metals & mining.

Exhibit 16: Shares of transformational and incremental low-carbon investments by sub-sector



*Number above each sub-sector refers to the number of companies reporting low-carbon investment

Source: Oliver Wyman analysis, CDP reporting data

INVESTMENT PATTERNS IN HIGH-EMITTING SECTORS

Renewables projects were the most frequently reported low-carbon investment among both oil & gas companies and electric utilities, attracting

€15 billion

and driving transformational investment in both cases.

Materials

Over the past year, Europe has seen a strong signal of change from first-movers in the materials sectors with HeidelbergCement AG, LafargeHolcim Ltd., and thyssenkrupp AG setting Paris-aligned emissions reduction targets approved by the Science Based Targets initiative (SBTi). These companies are demonstrating to stakeholders that ambitious climate action goes hand-in-hand with successful business, despite the challenge that the transition to a net-zero-carbon economy presents to their sectors.

Materials includes some of the most challenging sub-sectors to decarbonize, because certain carbon intensive industrial processes cannot be easily electrified and lack alternative low-carbon substitutes. This means that complete decarbonization is dependent on the development of transformational technologies that offer alternative production pathways or alternative materials. However, the materials sector spent ten times less on applied R&D for radical process redesign and product redesign than it did on applied R&D for energy and resource efficiency. More broadly, incremental investment in energy efficiency received €2.2 billion, comprising 34 percent of total materials sector low-carbon investment.

In the steel sub-sector, low-carbon investment is clearly oriented towards transformational technologies. Transformational investments accounted for over 90 percent of investment, of which around two thirds were directed towards CCUS technologies, comprising €246 million of commitments in 2019. New process plants and alternative steelmaking processes attracted €132 million between them. Apart from CCUS, there was little evidence that other potential breakthrough technologies attracted significant new investment however. One hydrogen initiative, comprising a €17 million investment from SSAB, was detailed, but other technologies with the possibility of displacing metallurgical coal and blast furnaces, such as electric arc furnaces and electrochemical reduction, were not reported.

A significant new zero-carbon electrochemical reduction initiative in the metals and mining sub-sector was reported by Rio Tinto however, with a €168 million investment in carbon-free aluminium smelting as part of a joint venture with Alcoa with support from Apple and the governments of Canada and Quebec. But more broadly, low-carbon investment in the metals and mining sub-sector was largely incremental in nature, with €2.1 billion of investment in 'green metals' relating primarily to the production of metals for clean technologies and improved supply chain practices.

In the cement sub-sector, aside from a nominal investment of €10,000 in CCS, low-carbon investment was directed exclusively towards incremental improvement, primarily through fuel switching.[35] Investments in technologies such as low-clinker and novel cements were not reported. This result should be interpreted carefully, as it is a snapshot of investment based on two companies' reporting. Nevertheless, it is certainly the case that investment in transformational technologies such as CCUS and novel cements will be necessary if the sub-sector is to avoid painful downstream disruption from alternative construction materials in a zero-carbon future.

In the chemicals sub-sector, 40 percent of low-carbon investment was transformational in nature. Chemicals companies actually reported a higher number of transformational initiatives than incremental initiatives, but the latter – mostly centred around energy and resource efficiency – received more than twice the investment per initiative, probably reflecting the comparable maturity of these technologies and their readiness for deployment. Transformational investments were directed towards the redesign of products and processes and biomaterials.

Energy

Renewables projects were the most frequently reported low-carbon investment among both oil & gas companies (12 initiatives across 9 companies) and electric utilities (19 initiatives across 14 companies), attracting €15 billion and driving transformational investment in both cases. Electric utilities reported not only a greater number of renewable initiatives, but also a much higher quantum of investment: €14 billion (or €750 million per initiative) compared to just over €1 billion (€98 million per initiative) in oil & gas, where renewable power remains a small share of business. More than half of this was attributable to Repsol's acquisition of renewable assets from Viesgo, including three hydroelectric plants in the north of Spain. Nevertheless, despite this comparably modest outlay, renewables still dominated low-carbon investment in the oil and gas sub-sector, accounting for three quarters of low-carbon investment.

While renewables comprised a significant share of low-carbon investment among electric utilities (31 percent), also evident were investments in new transformational technologies to enable grid flexibility and greater renewable penetration, such as demand side response programmes, which received €8.4 billion of investment (19 percent). Iberdrola reported the largest investments, with an €8.5 billion renewables project, €8.2 billion investment in demand side response and €6.5 billion invested in digital technology. Electric utilities' incremental investments were dominated by energy efficiency, comprising €15 billion of investment in 2019 and accounting for 44 percent of total reported investments in energy efficiency across all sectors.

INVESTMENT PATTERNS IN HIGH-EMITTING SECTORS

The energy sector has the most mature technology profile, reflected by the emphasis on capital investment rather than R&D. Companies reported over €15 billion of investment in demand side response programmes and new infrastructure at the commercial testing stage, and over €4 billion of investment in renewables, digital technology and smart systems at the major launch stage.

Transport

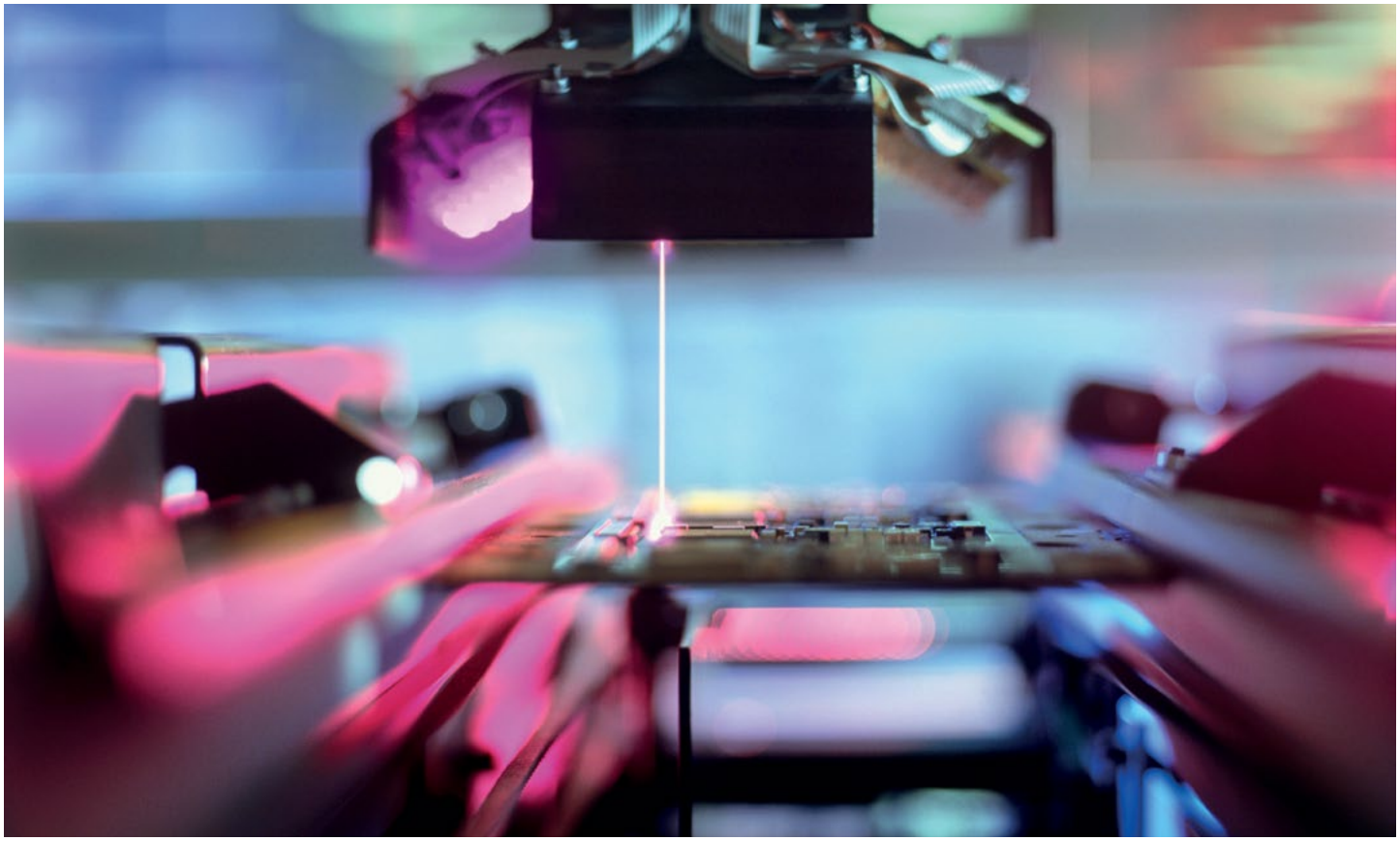
The European transport sector accounts for a large and growing share of European emissions. On land, reaching net-zero emissions by 2050 will require a rapid shift from internal combustion engines to electric drivetrains in road transport, alongside greater use of public transport and rail and waterways for freight.

In response, transport OEMs are making significant transformational investments in electric drivetrains. More than three-quarters of low-carbon investment from transport OEMs prioritized electrification. These investments were large – €11 billion per initiative on average – indicative of their maturity and the scale of transformation anticipated. For example, Volkswagen reported €30 billion of investment by 2023 on electrification, as part of a broader programme of investments in e-mobility, autonomous vehicles, new mobility services and digitalization.

Transformational investments in hydrogen – another zero-carbon transport technology – accounted for less than one percent of transport OEMs' reported investments, indicating that the sub-sector expects to achieve decarbonization primarily through battery electric vehicles, with hydrogen likely restricted to niche applications. Transport OEMs also made sizable investments in energy efficiency.[36]

Air and sea transport arguably face the greatest decarbonization challenges, as demand is increasing rapidly, and readily substitutable low-carbon technologies appear some way off. This has not gone unnoticed by policymakers, and the European Commission's Green Deal raises the prospect of greater regulatory intervention, including bringing both sectors more fully into the ETS and examining options to tax international fuels. In response, transport services companies, such as freight forwarders, airlines and logistics companies, made over €1.1 billion of transformational investment in alternative fuels and advanced technologies – though this was still dwarfed by over €4.1 billion of investments in incremental technologies mainly focused on efficiency improvements.

Investments in hydrogen – another zero-carbon transport technology – accounted for **less than 1%** of transport OEMs' reported investments.



Are companies investing enough in transformational breakthrough technologies?

For road transport and the power sector, reported investments chart a clear course for transformation based on deployment of renewables and accompanying technologies, alongside very large investments to develop battery electric vehicles. For other sectors, the shape of transformation is less clear. It will require a series of technological breakthroughs in hard to abate sub-sectors such as cement, steel, chemicals, aviation and shipping. Technologies such as CCUS and hydrogen (see Box 3), synthetic fuels and advanced biofuels are widely seen as critical, but these were rarely mentioned in companies' disclosures and not associated with significant investments (see Exhibit 17).

For example, despite its potential zero-carbon applications in transport, industry and the energy sector, CDP reporting companies revealed minimal new investment in hydrogen. Six projects were identified, accounting for a fraction of a percent of low-carbon investment in the respective materials, transport and energy sectors. Seven CCUS projects were identified, accounting for 4 percent of low-carbon investment in the materials sector (where it is arguably most critical) and a vanishingly small share in the energy sector.

There was also little reported investment in advanced biofuels and none in synthetic fuels, which are particularly important for decarbonizing aviation. One exception is the airline SAS, which made an R&D investment in alternative jet fuels as part of its support for the European Advanced Biofuels Flightpath, a European Commission initiative to enable aviation's use of 2 million tons of biofuels by 2020. However, this only amounted to €83,000.

Despite the European Commission's policy focus on the circular economy – it is a key focus of the Green Deal and featured prominently in the Commission's 1.5LIFE scenario for achieving net-zero emissions by 2050 – it was hardly mentioned in companies' disclosures. A small number of low-carbon initiatives concerned with waste reduction and material efficiency in the materials sector are however aligned with a transition to a more circular economy. For example, the metals producer Aurubis reported an investment to provide residual heat from copper smelting at its Hamburg plant for use in district heating. Overall though, circular initiatives comprised only a fraction of a percent of materials sector low-carbon investment.

Exhibit 17: Investments reported in breakthrough technologies

Breakthrough technology	Example application*	Number of investments	Low-carbon investment € millions, 2019
Advanced biofuels and synthetic fuels	◥ Advanced biofuels that do not compete with food production or require agricultural land for use in aviation and shipping ◥ Synthetic aviation fuels from captured carbon and hydrogen produced with zero-carbon electricity	3	5
Alternative materials	◥ Displace conventional cement, steel, plastics and chemicals	6	543
Carbon capture, utilization, and storage	◥ Abate industrial process emissions ◥ Produce carbon feedstock for production of carbon neutral synthetic fuels, new materials	7	256
Circular economy	◥ Minimize waste and material production ◥ Recover energy	6	35
Electrochemical reduction	◥ Avoid process emissions in metal production	1	168
Hydrogen	◥ Displace fossil fuels for industrial heat generation ◥ Use as a reduction agent in industrial processes for example, steelmaking ◥ Produce hydrogen feedstock for manufacture of carbon neutral synthetic fuels ◥ Use hydrogen fuel cells ◥ Repurpose the natural gas distribution network	6	141

*Example applications in practice, not necessarily as reported to CDP.
Source: Oliver Wyman analysis, CDP reporting data

CLOSING THE INVESTMENT GAP

The materials sector undertook only **5%** of low-carbon investment despite being responsible for **35%** of reported scope 1 and 2 emissions.

Low-carbon capital investment needs to increase significantly – on the order of 100 percent – to place companies on track for net-zero emissions by 2050. While this is a very large increase, it is not insurmountable in the context of overall capital expenditures: it would mean increasing the share of low-carbon investment in capex from 12 to 25 percent.

Low-carbon R&D also needs to increase. With the notable exception of transport OEMs and chemicals companies, low-carbon R&D intensities are low, notably in 'hard to abate' sub-sectors such as cement and steel where the need for breakthrough technologies is most pressing.

The need for greater low-carbon investment is arguably most pressing in the materials sector, which undertook only 5 percent of low-carbon investment despite being responsible for 35 percent of reported scope 1 and 2 emissions. Priorities include breakthrough technologies such as CCUS and hydrogen, with the potential to drive deep decarbonization not only in the materials sector, but also in other 'hard to abate' sectors such as international transport. More investment is also required in alternative materials and circular economy technologies and processes.

However, even where low-carbon investment is high and transformation is underway, increases are still needed. This report has highlighted the dominance of renewables and electrification of road transport in low-carbon investment, but recent data, including that presented in this report, indicates European renewables investment has slowed when it needs to accelerate.[37] And despite significant R&D on electric vehicles, more investment is needed to accelerate deployment, particularly for commercial vehicles.

In the following sections we examine the evidence from CDP reporting data on what business practices enable low-carbon investment, before examining the external context in terms of barriers to investment and access to finance.

For European companies currently reporting to CDP, the estimated annual low-carbon capital investment requirement consistent with a net-zero by 2050 pathway is **around €122 billion a year**.

Business practices to enable low-carbon investment

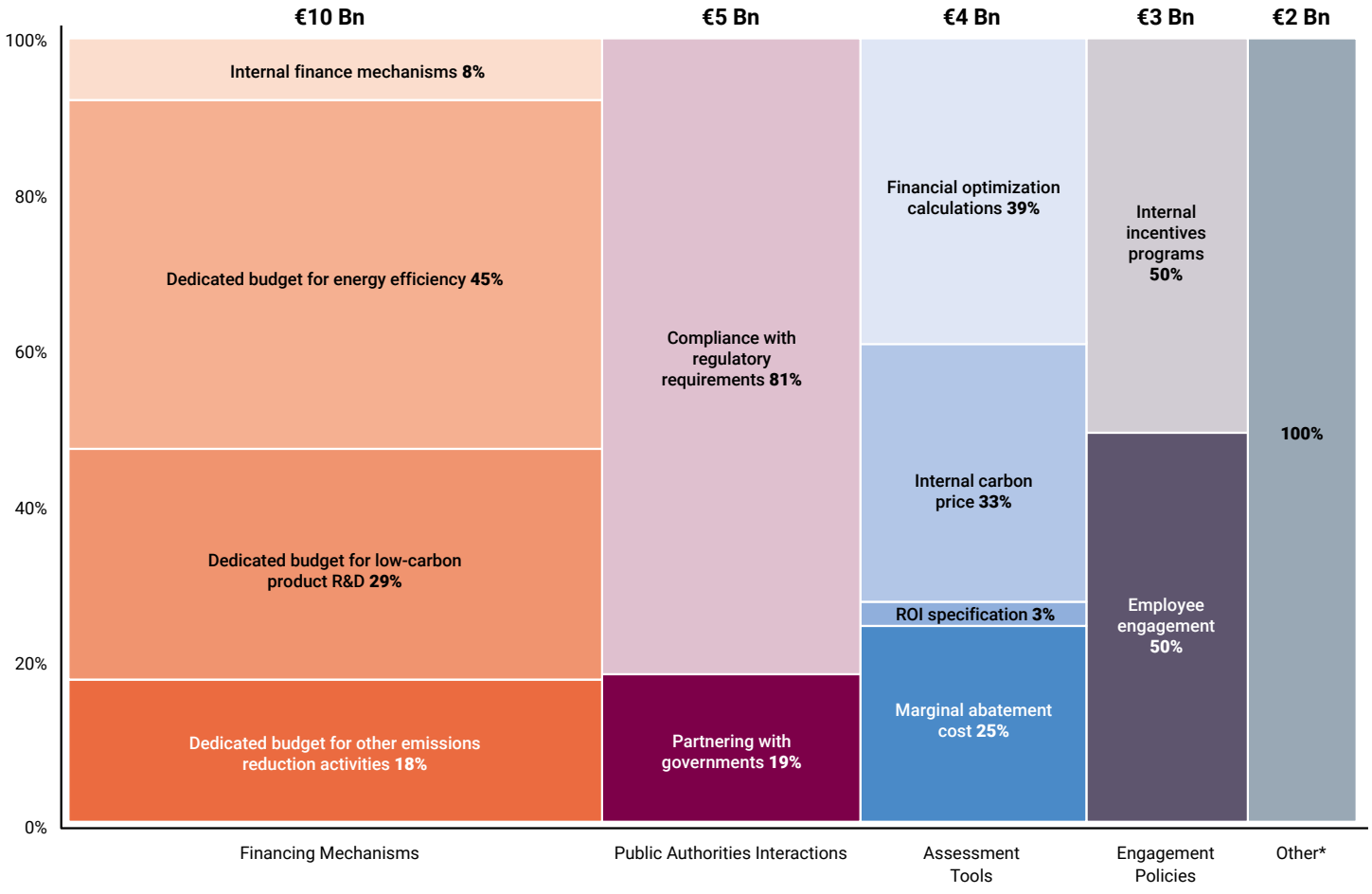
CDP's data indicate that low-carbon investment is associated with certain internal investment practices, ambitious corporate emissions reduction targets and the integration of climate change into corporate governance and strategic planning processes.

1. Internal investment practices

Of the €124 billion of total low-carbon investment reported in 2019, companies from both high-impact MET and from other sectors reported €24 billion of investments in specific emissions reduction initiatives, and provided details on the tools and approaches used to support these investment decisions. These include different internal financing mechanisms, tools with which to assess investment opportunities and programmes for staff engagement. **Exhibit 18** shows the scale of low-carbon investments enabled by these different approaches. It is noteworthy that the single most significant internal driver was the existence of ringfenced budgets for energy efficiency, underlining the importance of company-specific financing mechanisms. The importance of regulation is also clear, as regulatory compliance drove the second-largest amount of low-carbon investment. Employee engagement practices appear comparably less important, although this might change in the future, as societal concern about climate change grows and staff expectations of employers increase.

Exhibit 18: Breakdown of low-carbon investment amounts by internal driver

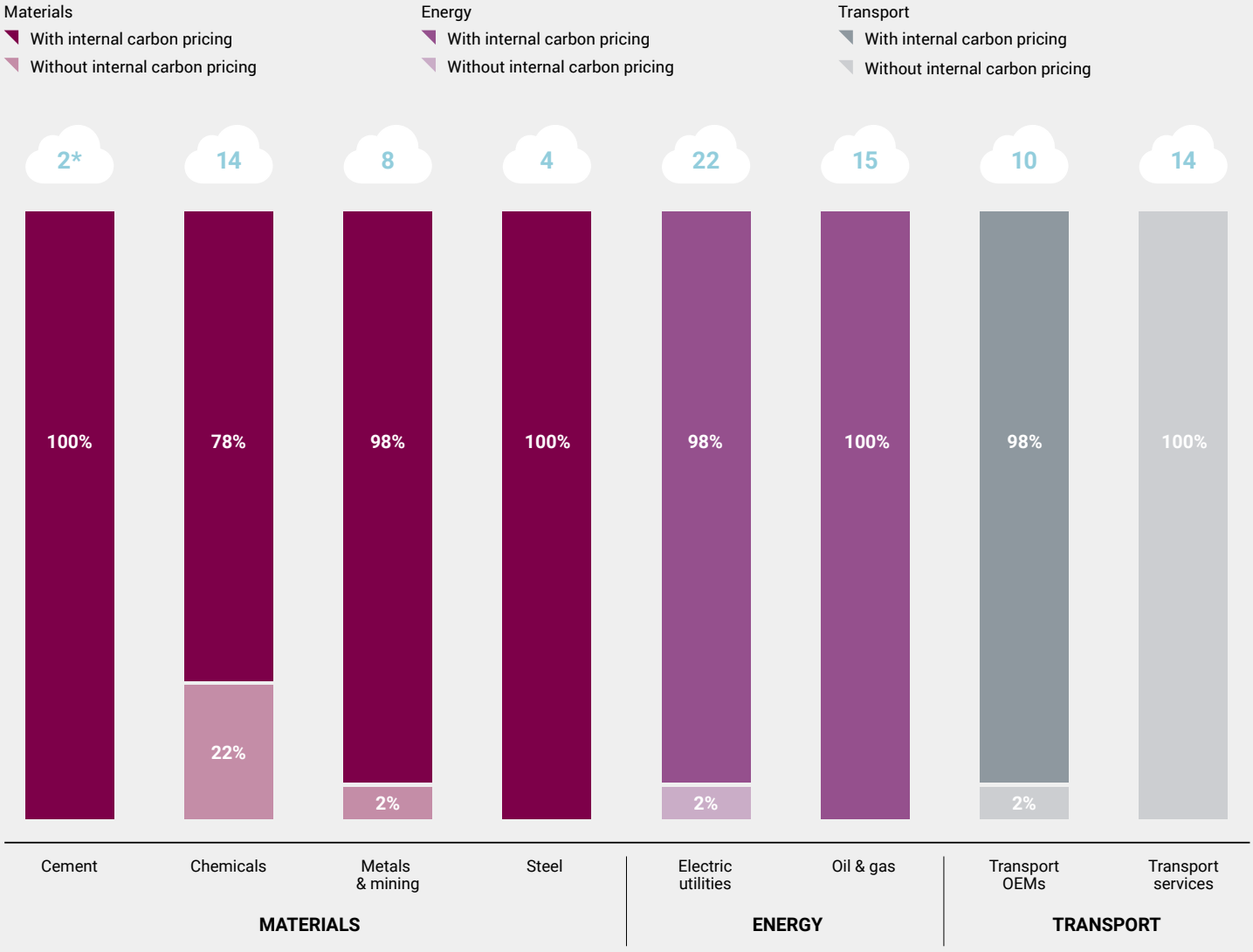
€ billions, across all sectors, 2019



*This amount refers to investments in specific emissions reduction initiatives with the lack of disclosed investment methods, which cannot be categorized as any one of the internal drivers

Source: Oliver Wyman analysis, CDP reporting data

Exhibit 19: Low-carbon investment by companies with and without internal carbon pricing
% of reported sub-sector low-carbon investment, by MET high-impact sector, 2019



*Number above each sub-sector refers to the number of companies reporting low-carbon investment.
Source: Oliver Wyman analysis, CDP reporting data

Within high-impact sectors specifically, internal carbon pricing is widely used as an investment appraisal tool and strongly associated with low-carbon investment. With the exception of transport services, and to a lesser extent, chemicals, almost all low-carbon investment among MET companies is subject to an internal carbon price (**see Exhibit 19**).

Within the transport services sub-sector, just over half of companies do not use internal carbon pricing, and the majority, responsible for over 80 percent of the sub-sector's low-carbon investment, have no plan to do so within the next two years. The relative lack of exposure of transport services companies to the ETS or other emissions regulations likely explains this marked difference.

2. Corporate emission reduction targets

Higher low-carbon investment is also associated with ambitious voluntary emissions reduction targets in high-impact MET sectors. For example, companies with targets approved by the SBTi, and companies with targets they report as science-based (but not verified by SBTi) are responsible for the majority of low-carbon investments across high-impact sectors **(see Exhibit 20)**. In total, 160 European companies, some represented in CDP's dataset, have set science-based targets, accounting for slightly less than half of all global science-based targets approved by the SBTi.[38]

The transport sector has the largest amount of investment made by companies without any emissions targets. Among the transport OEMs that reported, 5 out of 12 have no officially approved targets but plan to set some in the next two years, while 2 do not expect to set any in this period.

Of course, the association of ambitious voluntary emissions reduction targets and low-carbon investment does not mean that the former causes the latter. However, verifiable corporate emissions reduction targets in combination with effective internal investment processes **(see Exhibit 18)** and transition plans **(see Exhibit 22)** might reasonably be expected to drive low-carbon investment. With the rapid growth in sustainability-linked lending **(see *Mobilizing financial capital* section)** ambitious and verifiable emissions reduction targets could also provide a basis for accessing sustainable finance at preferential rates, through loans where meeting commitments results in a lower interest rate.

3. Corporate governance and strategic planning

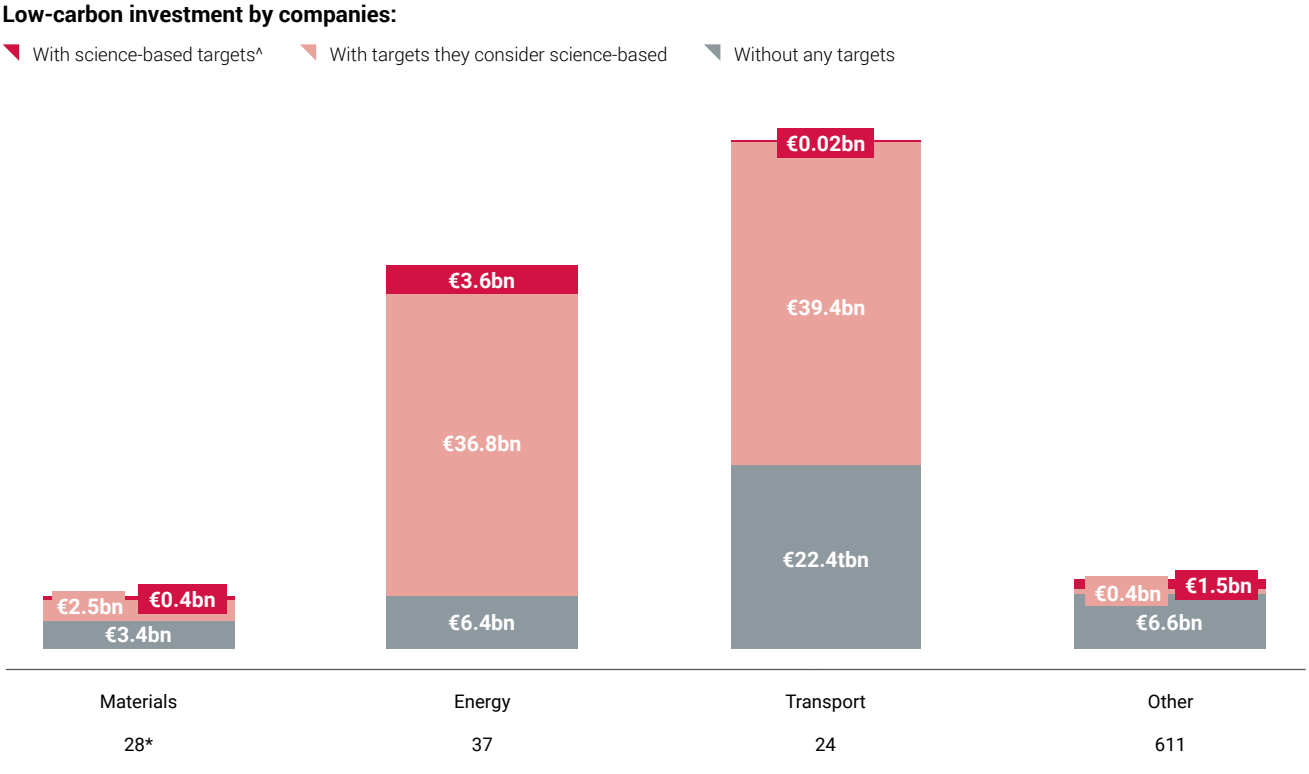
Companies that integrate climate change into their corporate governance and strategic planning processes similarly contribute most of the investments in emissions reduction initiatives. For example, in 2019, 100 percent of investment in emissions reduction initiatives was made by companies which reported board oversight of climate-related issues; 96 percent of investment was made by companies which have integrated climate change into strategic planning; and 95 percent of investment was made by companies which have put in place incentives for management of climate-related issues **(see Exhibit 21)**.

Less investment is undertaken by companies using climate scenario analysis, although at 74 percent, it is still a significant amount. This likely reflects the nascent stage of climate scenario analysis in many sectors, as companies develop approaches to implement the recommendations of the Taskforce on Climate-Related Financial Disclosures (TCFD).

By exploring the implications of a range of possible futures and how a business might respond, scenario exercises can provide extremely valuable input into strategic planning and risk management processes. So, while companies investing in emissions reduction initiatives have clearly already

Exhibit 20: Low-carbon investment by companies with and without targets approved by the Science Based Targets initiative

€ billions, across all sectors, 2019



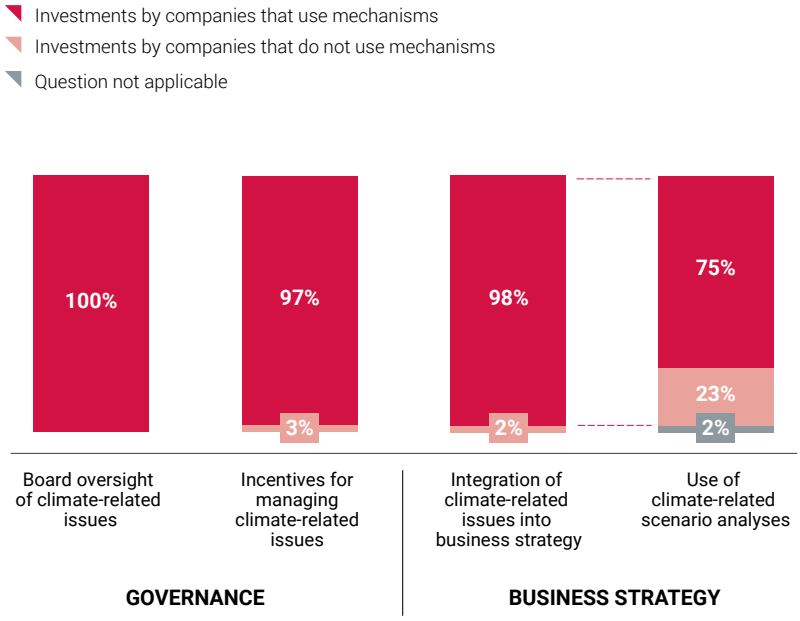
*Number under each sector refers to the number of companies reporting low-carbon investment
^These targets have been approved as science-based by the Science Based Targets initiative (SBTi)
Source: Oliver Wyman analysis, CDP reporting data

incorporated climate issues into board oversight and strategic planning processes, continued development of climate scenario exercises will allow them to strengthen these processes with more robust analysis on climate risks and opportunities.

Lastly, with the notable exception of the steel sub-sector, nearly all low-carbon investment among high-impact companies is informed by low-carbon transition planning, reflecting the growing demands of investors for low-carbon transition plans to be in place **(see Exhibit 22)**. Given the transition risks faced by the steel sub-sector, this discrepancy is surprising, although those companies without transition plans did report that they expect to have developed one within the next two years.

Exhibit 21: Low-carbon investment by companies with and without climate-related governance and business strategies

% of total reported low-carbon investment, across all sectors, 2019

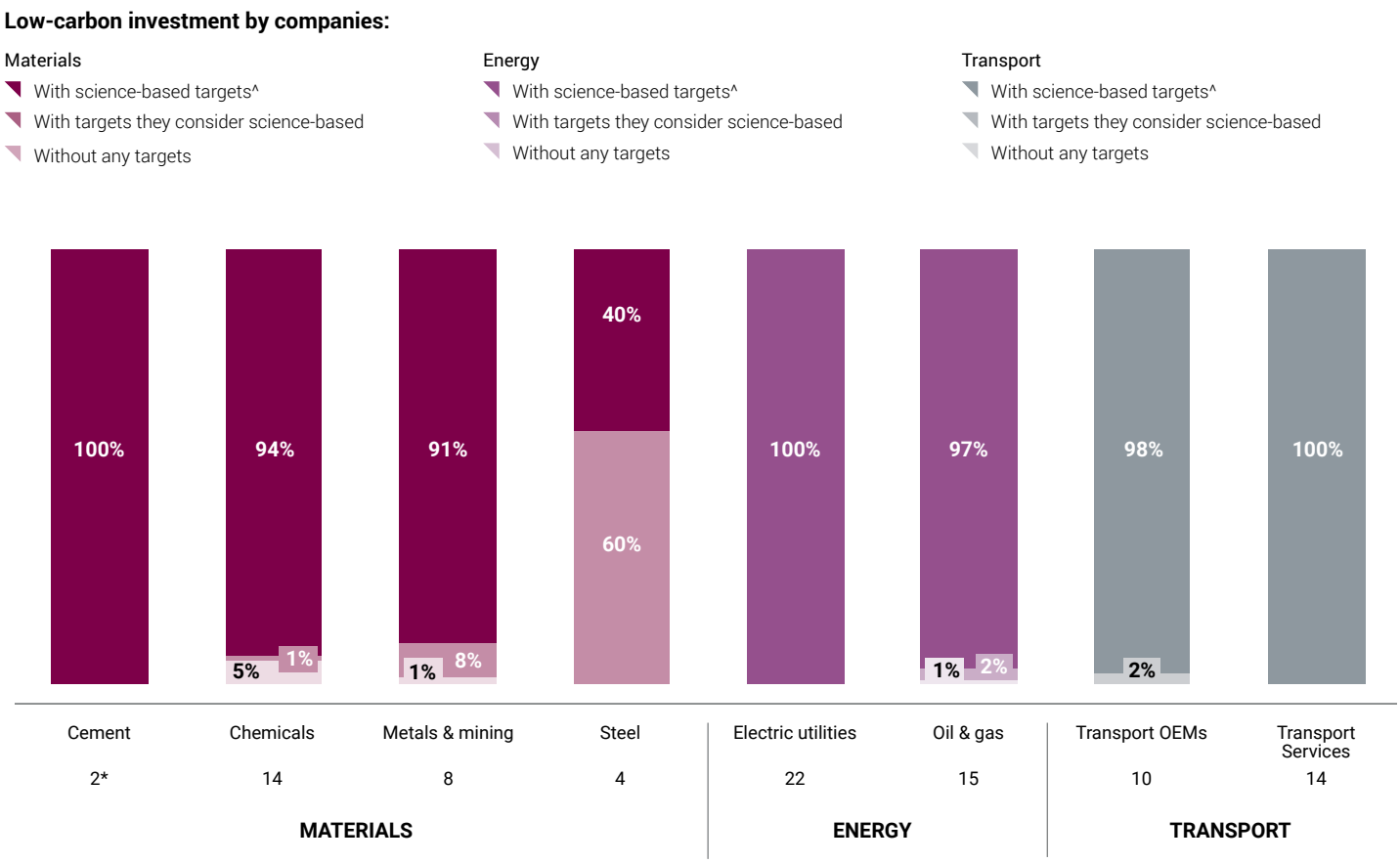


Note: Companies that responded with "Question not applicable" did not integrate climate-related issues into their business strategies

Source: Oliver Wyman analysis, CDP reporting data

Exhibit 22: Low-carbon investment by companies with and without low-carbon transition plans

% of reported sub-sector low-carbon investment, by MET high-impact sector, 2019



*Number under each sub-sector refers to the number of companies reporting low-carbon investment

Source: Oliver Wyman analysis, CDP reporting data

Estimates for fossil fuel subsidies in the EU range from

€55 billion to €112 billion

a year – on the scale of corporate low-carbon capital investment reported to CDP.

Barriers to low-carbon investment

In practice, companies face various barriers to scaling up low-carbon investment, a number of which were touched on in *The net-zero investment gap* section. These can be considered as falling into three broad categories – unfavorable economics, disruptive business models and uncertainty.

1. Unfavorable economics

Many low-carbon investment opportunities may be technologically proven but not (yet) economically viable. Immature low-carbon solutions may be expensive compared to the existing technology because they lack economies of scale and technological learning processes have yet to drive down production costs.

A sufficiently high and stable carbon price is critical to addressing the cost disadvantage of new low-carbon technologies, as highlighted in the discussion on CCUS and hydrogen in The net-zero investment gap section. However, although recent ETS reforms have helped increase carbon prices, further reforms will likely be needed for prices to reach levels consistent with net-zero emissions by 2050.[39]

Fiscal policies can also help new low-carbon technologies become competitive. For example, taxation of international aviation fuels could help synthetic jet fuel overcome its cost disadvantage relative to kerosene. More generally, removing fossil fuel subsidies is a *sine qua non* for deep decarbonization, as these amplify any cost disadvantage faced by low-carbon solutions competing against hydrocarbon-based technologies. Data on fossil fuel subsidies are scarce but estimates for the EU range from €55 billion to €112 billion a year [40] – on the scale of corporate low-carbon capital investment reported to CDP.

More mature low-carbon technologies may still face investment barriers due to their higher capital costs. For example, the higher upfront capital costs of renewable energy and electric vehicles mean they need low-cost financing to be profitable against incumbent technologies. Their economics can therefore be improved with policies to reduce upfront costs, such as capital subsidies, and lower finance costs or de-risk investment, such as guarantees or blended finance.

2. Business model disruption

Transformational technologies may threaten existing revenue streams, as is the case for electric drivetrains in heavy duty vehicles **(see Box 5)**, deterring investment among incumbents. Another possible example is the disincentive for vertically integrated cement companies to pioneer low-carbon clinker substitutes and novel cements which could threaten the viability of upstream clinker production installations.[41] More broadly, the transition to a circular economy would entail many such disruptions, particularly for materials companies.

Low-carbon standards that tighten over time can help companies transition their business models and manage disruptive risks. They have been employed by the EU in numerous areas, notably as a means to move automotive manufacturers towards zero-emission drivetrains. Given the pressing need to accelerate the decarbonization of the industrial sector, low-carbon standards for materials may hold considerable potential. Indeed, one reporting company from the materials sector cited the *absence* of regulatory obligations to produce low-carbon materials as an impediment to investment.

3. Uncertainty

Many low-carbon technologies have long time horizons, so face considerable uncertainty about the future. Common examples include:

Price uncertainty

For example, uncertainty about the likely evolution and stability of carbon prices hampers investment in industrial CCUS **(see Box 3)**. Price signals are also inhibited by poorly designed taxation policies. For example, the EU Energy Taxation Directive undermines low-carbon investment by creating uncertainty in the tax treatment of low-carbon fuels and by penalizing energy storage.[42]

Demand uncertainty

New low-carbon technologies have unknown demand. For example, cement companies may be reluctant to invest in novel cements not only because they threaten upstream investments, but also because they lack a strong demand signal from the construction industry.

Tightening low-carbon standards, as discussed above, can provide a signal of future demand against which to invest. Mandates offer another means to create confidence about future demand and could be considered for synthetic jet fuels and low-carbon materials. Phase-out dates for incumbent high-carbon technologies, such as those set by EU governments for coal power plants and internal combustion engines, can work in a similar way to mandates, by implying a level of future demand for low-carbon alternatives. Finally, governments can also use public procurement policies to guarantee a quantum of future demand at a viable price point. Potential is likely greatest in construction and transport, where the public sector is typically an important source of demand. Specific opportunities might include procurement commitments for low-carbon construction materials for public works and for zero-emission heavy duty vehicles, such as buses, refuse trucks and military trucks.

Contingencies

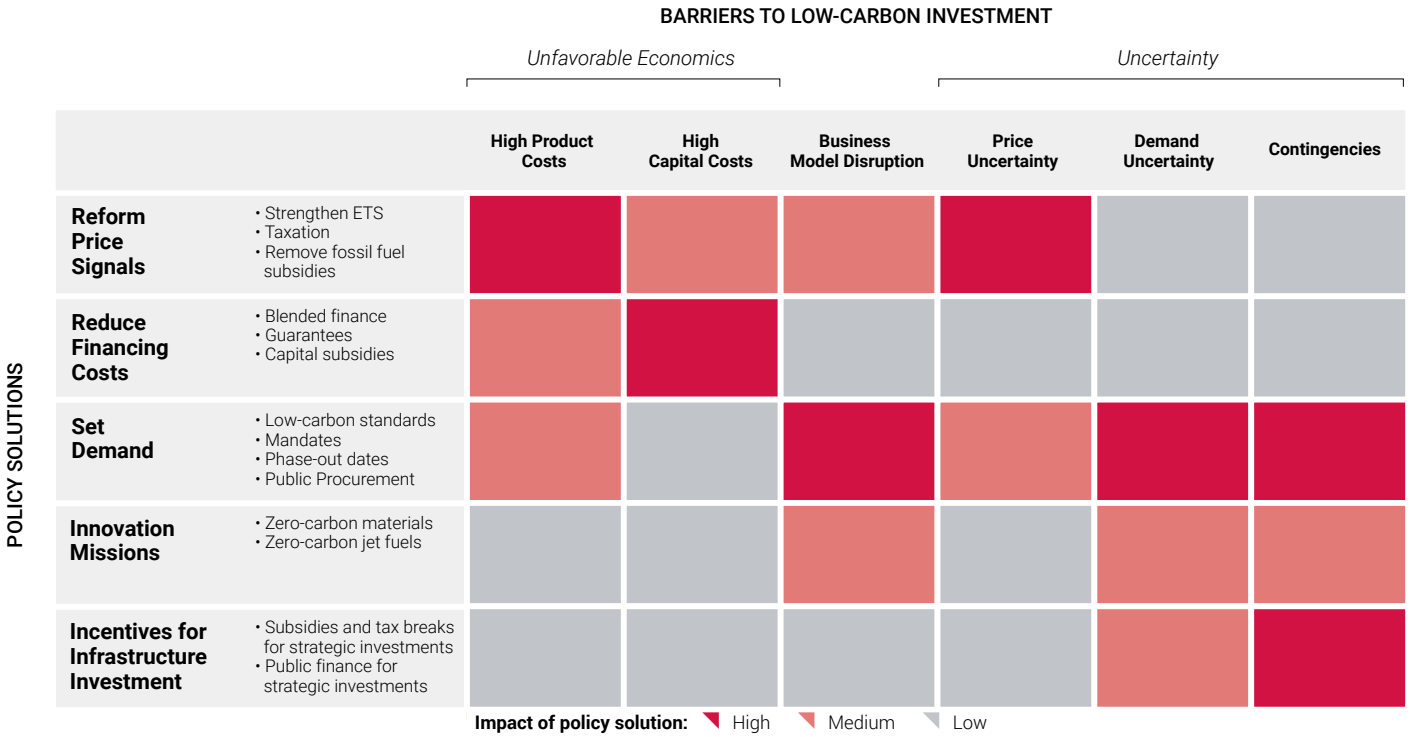
The viability of new technologies such as CCUS and hydrogen may depend upon parallel investments in adjacent sectors and the development of enabling infrastructure (see Box 3).

Mandates can help address uncertainties over contingent investments. For example, mandates could be set for volumes of carbon to be captured or hydrogen to be manufactured; or for products using captured carbon and hydrogen feedstocks such as synthetic jet fuels and new materials. Coordinated, cross-sector policies and targeted public investments can help incentivize investment in enabling infrastructure for hydrogen and CCUS.

Finally, mission-driven innovation policies can help catalyze public-private R&D partnerships and provide companies with clarity on innovation priorities that can expect policy support and public funding. Candidates for innovation missions might include zero-emission aviation and shipping, and zero-carbon materials for example.

Exhibit 23 shows these barriers (along the horizontal axis) against the types of policy intervention to address them (along the vertical axis). Policies to provide long-term confidence in price and demand are critical.

Exhibit 23: Addressing barriers to low-carbon investment



Source: Oliver Wyman analysis

Mobilizing financial capital

The energy transition is capital intensive. It can be broadly characterized as a shift away from a fossil fuel-based system with high operating costs (for fuel) to a system with high capital costs (for renewables and low-carbon technologies). For this reason, the accessibility and cost of finance is a critical determinant of transition economics: because low-carbon technologies have high capital costs, a small reduction in financing costs can have a large impact on project profitability and investment.

Data on low-carbon financing is piecemeal and incomplete, but we estimate that the low-carbon financing available to European companies was of the order of €112 billion in 2018,[43] compared to low-carbon investment reported to CDP of €124 billion[44] **(see Exhibit 24)**.

Reorienting capital flows towards low-carbon opportunities at a pace and scale consistent with the EU's decarbonization goals will require actions to improve the bankability of low-carbon projects, for example through policy reforms to address the barriers discussed above. It will also require greater use of public funding to de-risk investments and leverage private capital, as identified in the European Commission's *European Green Deal Investment Plan*.

Financial sector reforms will also be needed to enable financial institutions and markets to better assess transition risks and allocate capital accordingly. This is a key objective of the reforms the EU is pursuing as part of its ***Action Plan on Sustainable Finance***.

Important developments in this regard include efforts to enhance transparency and consistency of climate-related data, and steps to improve the allocation of capital in light of climate-related risks.

Transparency and consistency of climate-related financial data

The development of high quality, climate-related data which investors and lenders can use to make fully informed decisions on project and company sustainability is still in its early stages. Particular challenges include differing reporting approaches of companies, poor concordance of different ESG ratings data, a lack of standards for different 'green' financial products raising concerns about 'greenwashing' and a limited market infrastructure for trading and marketing green investments, such as labelling for green exchanges.

Various efforts are underway to improve the standardization of climate-related disclosures and data in Europe. One advantage of CDP's reporting system is that it can harmonize frameworks and standards within one comparable dataset. For example, CDP has also launched *Climetrics*, the climate rating for funds, which provides a holistic and independent assessment of a fund's climate-related risks and opportunities. *Climetrics* rates over 17,000 funds every month, representing €15.9 trillion, or around 31 percent of the mutual fund market. At the system level, as part of its *Action Plan on Sustainable Finance*, the European Commission has proposed a taxonomy for sustainable activities and is working to develop labels for green financial products and to strengthen transparency of ESG disclosures.

Another key dynamic is the shift towards enhanced disclosure of climate risks and opportunities by companies and financial institutions as a result of the TCFD. Improved climate-related information can allow providers of financial capital to better assess transition risks and allocate capital, thus managing exposure to assets that could be impaired during a low-carbon transition. More and more European companies are now taking steps to enhance disclosure of climate risks. At the start of 2020, 361 European companies with a combined market capitalization of €4.87 trillion supported the TCFD.[45] Furthermore, since 2018 all companies responding to CDP globally (8,400 companies in 2019) can disclose in line with the TCFD recommendations as CDP's platform is fully aligned.

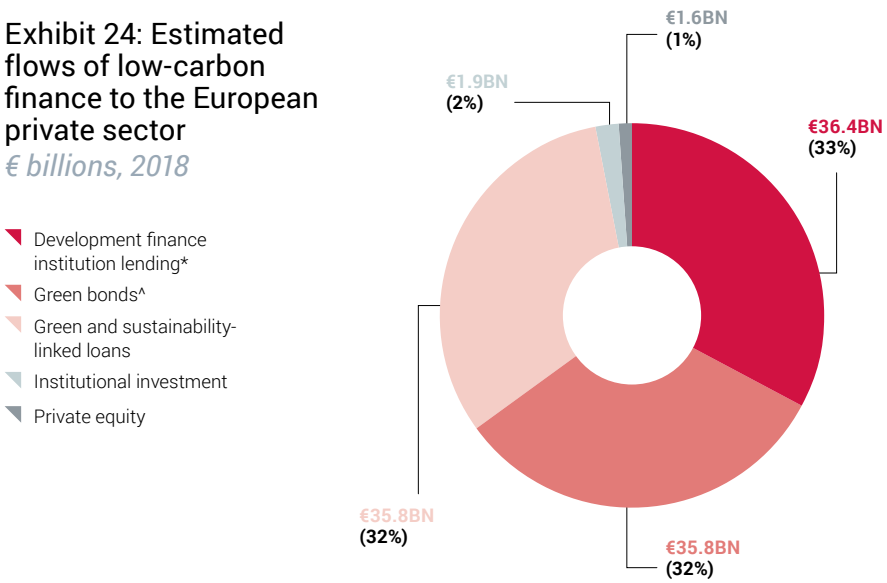
However, most are early in the process of implementing the TCFD's recommendations and policymakers in a number of jurisdictions are seeking to accelerate this process. For example, Article 173 of France's Energy Transition Law requires companies to disclose their emissions more precisely, the United Kingdom's green finance strategy includes proposals for mandatory disclosure of climate risks for listed companies from 2022, and the EU plans to align current corporate reporting regulation with the TCFD through a review of the Non-Financial Reporting Directive starting in 2020.

Improved capital allocation

Improved financial data on climate and sustainability can underpin broader financial sector action to better quantify and assess climate-related risks and allocate capital more appropriately. Three dynamics are of note in

Exhibit 24: Estimated flows of low-carbon finance to the European private sector

€ billions, 2018



*Development finance institution lending includes both confirmed lending to the private sector and lending where information on the recipient was unavailable
^Green bonds refer to green bond issuance by the European private sector
Source: Climate Policy Initiative, Dealogic, Oliver Wyman analysis

Box 6: Transition impacts on commercial credit risk in the banking sector

One of the key challenges faced by banks and investors in managing transition risk is understanding how the low-carbon transition may unfold, and the implications for their loans and investments in different transition scenarios. Oliver Wyman has worked with various banks to help them quantify the potential impacts of different transition scenarios on their credit portfolios.

Oliver Wyman has illustrated this approach by modelling the sudden imposition of a carbon tax on commercial lending to oil & gas companies and electric utilities, resulting in increases in the probability of default – a key credit metric for banks – of two to three times on average, corresponding to potential losses of $50 billion to €300 billion in these two sectors.

The exercise also revealed how changes in credit risk varied significantly within sectors, as companies with greater exposure to high carbon assets (such as oil sands or coal generation) exhibited higher increases in probability of default, while companies with more diversified portfolios and exposure to low-carbon products and services were less affected. Effective management of transition risks within credit portfolios will therefore require a borrower-level understanding of risk.

Although banks have begun to adopt transition risk models, they are in the early stages of doing so. Research by Oliver Wyman indicates that only a small number of institutions have started to incorporate transition risk into lending decisions and in general, banks have yet to embed transition risk into their risk appetite or limit frameworks. This picture is likely to change as modelling capabilities develop and regulatory scrutiny of climate risks increases. In the future, climate risks may be factored into pricing and risk capital weights, resulting in 'good' climate risks having greater access to capital and lower lending rates.

Source: Oliver Wyman

this regard: increasing regulatory scrutiny of climate risks, the development of transition risk modelling among financial institutions and green financial innovation.

Increasing regulatory scrutiny of climate risks

A growing number of financial regulators recognise climate risk as a threat to financial stability and are taking steps that increase the onus on financial institutions to consider climate risks in their capital allocation decisions. By the start of 2020, 54 regulatory authorities were members of the Network of Central Banks and Supervisors for Greening the Financial System (NGFS)[46], which has made a number of recommendations including the integration of climate risks into macro and micro prudential supervisory frameworks, achieving robust and internationally consistent climate-related disclosures and developing a taxonomy of economic activities that will help financial institutions to identify green financing and investment opportunities.[47] Some regulators are also examining the case for adjusting asset risk weightings for climate risks, which could potentially see green loans attracting lower regulatory capital requirements.

A number of European regulators are now taking steps to assess the resilience of individual banks and insurers and the financial system as a whole to climate risks. For example, De Nederlandsche Bank has undertaken a stress test of the financial sector against transition risk, and Banque de France and the Bank of England will subject banks and insurers to climate stress tests in 2020.

Development of transition risk modelling

A growing number of banks and investors have begun to use models to quantify the impact on transition risks on their lending books and investments.[48] The results of these analyses indicate that transition risks can have a material impact on asset values. For example, portfolio modelling undertaken by Mercer found that investments in high impact sectors such as coal, oil & gas and electric utilities could see annual return falls of 4 to 7 percent by 2030 in a 2°C scenario.[49] Modelling of illustrative commercial credit portfolios by Oliver Wyman found that, on average, default probabilities for loans to electric utilities and oil & gas companies could increase 2 to 3 times in a scenario in which a carbon tax of $50 per tonne is suddenly imposed **(see Box 6)**.[50] As models such as these become more established within financial institutions, they can be expected to increasingly inform investment, lending and capital allocation decisions.

Financial innovation

Low-carbon activities and business models may be risky, untested and disruptive and have distinct financing needs. New financial products designed for the exigencies of low-carbon investment are therefore needed. European financial services companies reporting to CDP identified €985 billion of low-carbon opportunities, but the prize could be even greater should capital be mobilized on the scale needed to achieve global climate goals. Examples of financial innovations showing strong growth in 2019 at a global level include green bonds, green loans and sustainability-linked loans **(see Exhibit 25)**.[51]

This wave of green innovation has yet to spread to financial derivatives, although this may now be changing with the first structuring of a sustainability-linked interest rate swap by ING in 2019. Green securitizations are also emerging as a means to channel green finance to small-scale assets and small- and medium-sized enterprises.

There is significant capital chasing these products, as evidenced by the heavy oversubscription of green bond issues. However, arguably this capital is not always accessible to sectors where low-carbon investment is most urgent. Companies in high-impact or 'brown' sectors such as materials and transport have struggled to tap green bond markets because although green bond principles do not preclude them from using green bonds, perceptions of the companies as 'brown' deters investors. Yet paradoxically, it is these companies that must make some of the most significant, and ultimately transformational, low-carbon investments, precisely because they are not green.

The mismatch between the need for low-carbon investment and the availability of green finance has led to growing interest in the concept of so-called 'transition bonds' which would allow companies in brown sectors to raise debt for low-carbon activities.[52] Transition bonds currently lack a set of accepted principles or standards (although efforts are underway to address this), nevertheless a number of recent issues have been pointed to as potential examples.[53]

Sustainability-linked instruments, where the proceeds are not ringfenced for low-carbon projects but rather the interest rate is linked to overall environmental performance, may also offer opportunities, and incentives, for companies in high-carbon sectors that are serious about improving their environmental performance. For example, chemical company Kemira recently agreed a syndicated loan from Danske Bank, BNP Paribas and Swedbank with an interest rate linked to targets for emissions reductions, revenues from products that improve customer resource efficiency and its ESG rating.

The sustainability-linked financing model has also been extended to securities, with the issuance of a bond by the electric utility Enel in which the coupon is linked to achieving a target for at least 55 percent renewable installed capacity by the end of 2021. Global sustainability-linked lending has grown rapidly from $10.6 billion in 2017 to an estimated $122 billion in 2019, with Europe accounting for most of this volume.[54]

Of the €985 billion of low-carbon opportunities reported by European financial services companies in 2019, nearly 60 percent was anticipated by banks. Notable examples of green financial innovation reported to CDP included Intesa Sanpaolo's extension of up to €5 billion at preferential rates for companies verified to have adopted circular economy business models, and €982 million of sustainability-linked facilities by HSBC Holdings.

Exhibit 25: Global Green Financial Product Innovation

Product	Description	Example
Green bonds	A bond where the proceeds are earmarked for climate or environmental projects. The global green bond market has grown to $271 billion of issuance in 2019, comprising more than half of the entire sustainable debt market.	In June 2019, Engie issued a €1.5 billion green bond to finance global renewable energy projects, bringing Engie's total outstanding green bond issuance to €8.75 billion, making it one of the largest corporate issuers.
Green loans	A loan in which proceeds are dedicated for climate or environmental projects. Global green loan volumes were estimated at $6.8 billion in 2019.	In November 2019, a syndicated green loan of €1.1 billion was arranged by Intesa Sanpaolo, Natixis, UniCredit and ING for Italian train operator Italo. The proceeds will be used for refinancing existing green investments and investing in rolling stock.
Sustainability-linked loans	A loan where the proceeds are for general use, but the interest rate is linked to the sustainability performance of the company. Global sustainability-linked loan volumes, now the second-most popular thematic debt type, amounted to $122 billion in 2019, up 168 percent from 2018.	In December 2019, Royal Dutch Shell agreed a revolving credit facility with the interest rate linked to performance against its carbon intensity target, arranged by Bank of America and Barclays. This was Shell's first sustainability-themed instrument, but it meant Shell instantly became one of the world's largest issuers of sustainable debt.
Climate-aligned funds	The number of sustainable investing funds has proliferated in recent years. Products include ESG funds that use specific environmental, social and governance criteria to select securities, funds with particular sustainability themes and funds that use value-based exclusions.	In December 2018, CPR AM, a subsidiary of Amundi, launched *CPR Invest – Climate Action* in collaboration with CDP. The fund invests in global equities with a core strategy based largely on climate action while integrating ESG criteria. Nearly 1/3 of the fund's investee companies have approved science-based targets, and 98 percent of the investee companies have a CDP A or B score. As of December 2019, the carbon footprint per euro million invested in the fund is 22 percent lower than the MSCI AC World reference, which means that the fund contributes to the transition to a low-carbon economy. The fund has assets under management of €400 million after 14 months.
Green structured products	Green structured products offer investors customized exposure to securities with stronger ESG performance through an underlying index and partial capital protection. Returns are generally based on the performance of the index and are generally higher than a vanilla product with the same duration.	Euronext has created a series of Euronext CDP Environment indices in collaboration with CDP (France, Eurozone, and World versions) which are licensed exclusively to Goldman Sachs for use as the underlying for structured products for sale on the retail market. The indices are the first to take the average company performance across CDP climate, water security and forest scores to select stocks and allow investors an opportunity to invest in sustainable instruments through structured products.

Source: Bloomberg New Energy Finance, Climate Bonds Initiative, company announcements, Oliver Wyman analysis

CLOSING THE INVESTMENT GAP

The future of corporate low-carbon investment

In sum, increasing corporate low-carbon investment will require action on multiple fronts.

In the public sphere, policies must address the unfavorable economics of immature low-carbon technologies, enable companies to overcome threats to existing revenue models, and provide sufficient, long-term certainty for large transformational investments in capital intensive breakthrough technologies. Increased public financing is required to de-risk private investment and support the development of new infrastructure.

Reforms to improve transparency of climate-related data will help underpin efforts to incorporate climate risks into financial regulatory frameworks and develop transition risk modelling among financial institutions, ultimately helping to align capital allocation decisions and loan pricing with prevailing climate policies and regulations.

This is a bold and far-reaching agenda, but all of it falls within the scope of existing initiatives: *The European Green Deal*, *The European Green Deal Investment Plan* and *The Action Plan on Sustainable Finance*. Much will rest on the ambition, reach and effectiveness of the policies implemented under each.

Action on policies and regulation must be matched by action in the private sector, where the decisions to lend and invest will be taken. Among corporates, low-carbon investment decisions will be supported by emissions reduction commitments aligned with the EU's target of net-zero emissions by 2050, and the integration of climate into financial planning, strategic planning and corporate governance frameworks. Among financial institutions, continued innovation in green financial products is needed, in particular to ensure the transition financing needs of 'brown' sectors can be met.

This is a bold and far-reaching agenda, but all of it falls within the scope of existing initiatives: ***The European Green Deal***, ***The European Green Deal Investment Plan*** and ***The Action Plan on Sustainable Finance***. Much will rest on the ambition, reach and effectiveness of the policies implemented under each.

DISCLOSURE ACROSS EUROPE

DENMARK
22 4 1

ICELAND
2 0 0

NORWAY
41 4 3

UNITED KINGDOM
248 46 35

IRELAND
26 6 2

BELGIUM
19 4 1

LUXEMBOURG
5 1 0

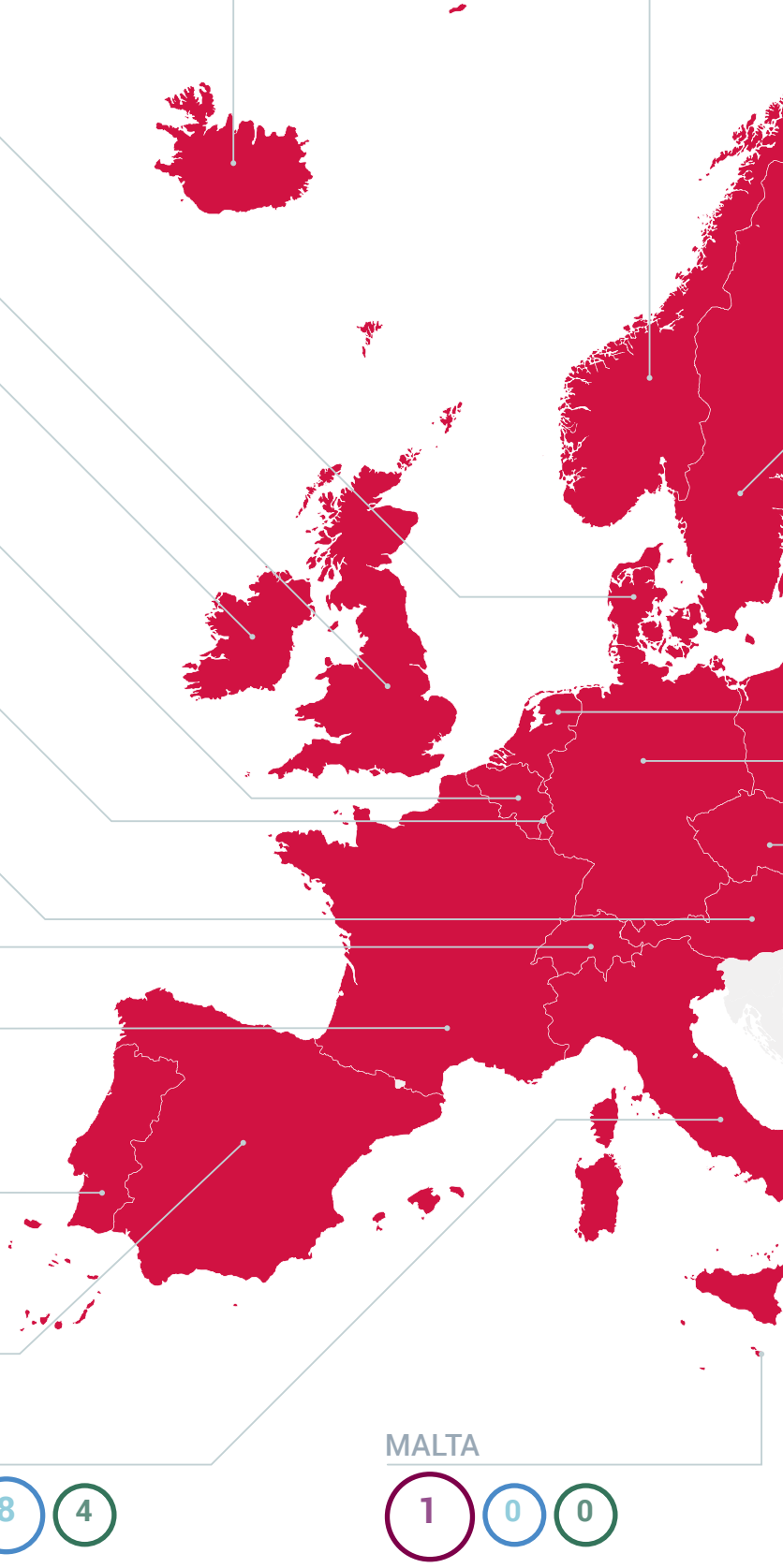
AUSTRIA
14 3 1

SWITZERLAND
59 18 6

FRANCE
109 28 14

PORTUGAL
13 3 1

SPAIN
49 13 2



ITALY
55 8 4

MALTA
1 0 0

Climate change disclosers

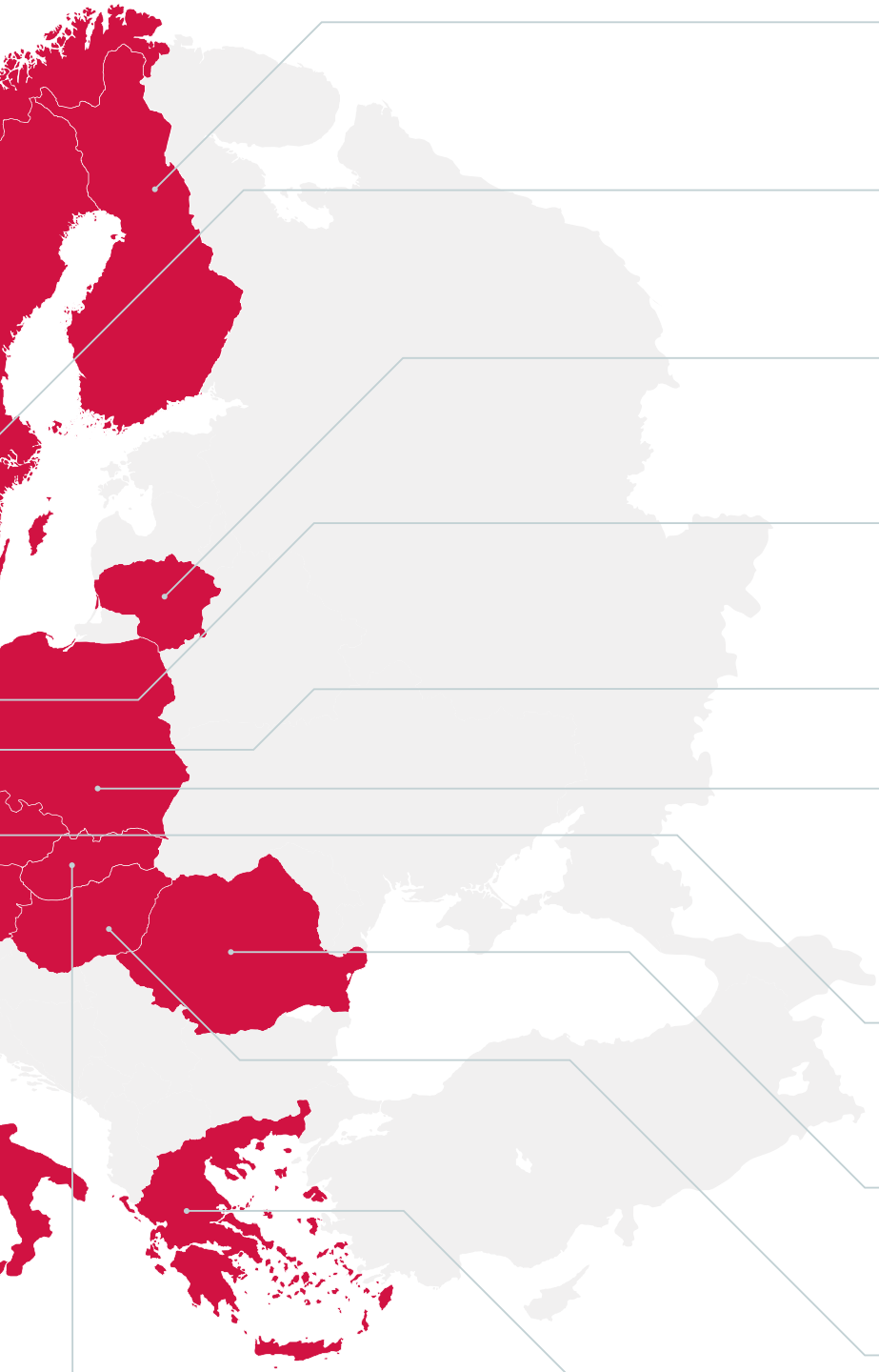
Water security disclosers

Forests disclosers

937 total climate change disclosers

199 total water security disclosers

103 total forests disclosers



FINLAND
44 6 7

SWEDEN
58 8 9

LITHUANIA
1 0 0

NETHERLANDS
44 9 9

GERMANY
101 34 8

POLAND
9 1 1

CZECHIA
4 0 0

ROMANIA
2 1 0

HUNGARY
5 1 0

SLOVAKIA
1 0 0

GREECE
5 1 0

Map displays the number of 2019 responses from all companies responding to investors in the respective country, including companies reporting through their parent companies and some private companies.

CDP'S A LIST AWARDS: RECOGNIZING EUROPEAN LEADERSHIP

5 out of the 6

companies globally to receive a triple A are based in Europe.

In 2019, there were 93 European corporates on CDP's A Lists for climate change, water security and forests. Between them, 114 A scores were awarded: 85 A List awards for climate change, 23 for water security, and 6 for forests.

Corporates in Europe achieved 44 percent of all A List scores awarded globally, and nearly half (47 percent) of the total global CDP climate change A List of 180 worldwide.

Most notably, 5 out of the 6 companies globally to receive a triple A are based in Europe, reflecting Europe's leading position for the highest levels of transparency and action across the three key interrelated environmental themes. This year, Danone, Unilever and UPM-Kymmene Corporate joined L'Oréal and FIRMENICH SA, who also achieved three A scores in 2018.

For forests, companies from Europe dominate the global forests A List, with 6 out of 8 of the best-performing companies.

On water security, the 24 European companies represent one third (32 percent) of the total awarded globally.

Within Europe, corporates from France again dominated the A List, with 22 achieving the best possible score. French companies make up over a quarter of the total European climate change A List, more than double the number of the n0ext highest performing country, the United Kingdom, which is home to 10 climate change A List companies.

Although Germany has less than half the number of A List companies than France, the DACH region more widely now has 18 companies scored A for climate change, with 7 Swiss (up from 4) and 2 Austrian companies.

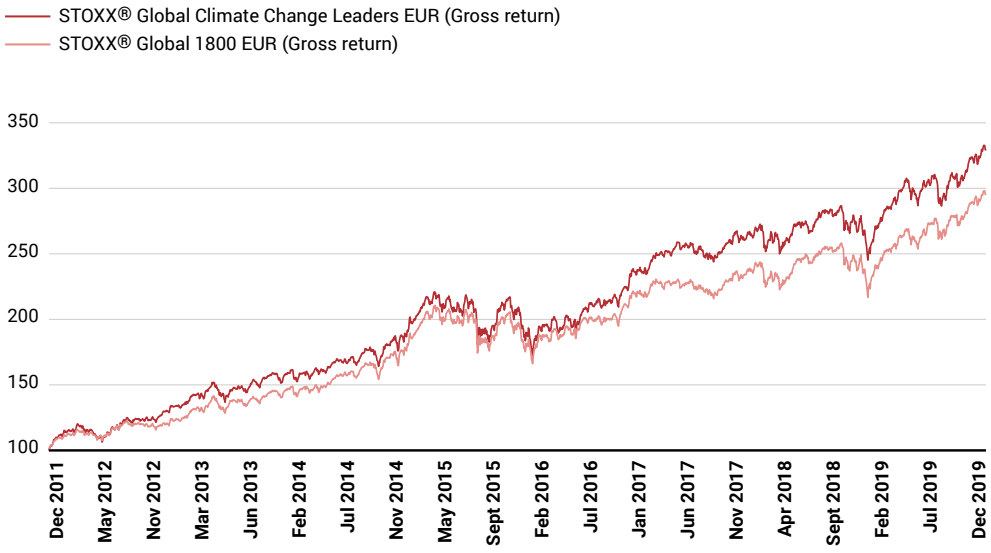
Looking beyond the comparatively small leadership group on the climate change A List (9.4 percent of scored European companies), 14.5 percent of companies in Europe achieved at least an A- score in 2019 for climate change, and 31.6 percent at least a B. This means that half of the companies in Europe were broadly performing well on climate issues when compared globally. The average score in Europe was a C.

5.3%

per annum outperformance of A List companies on the stock market over the past 7 years.

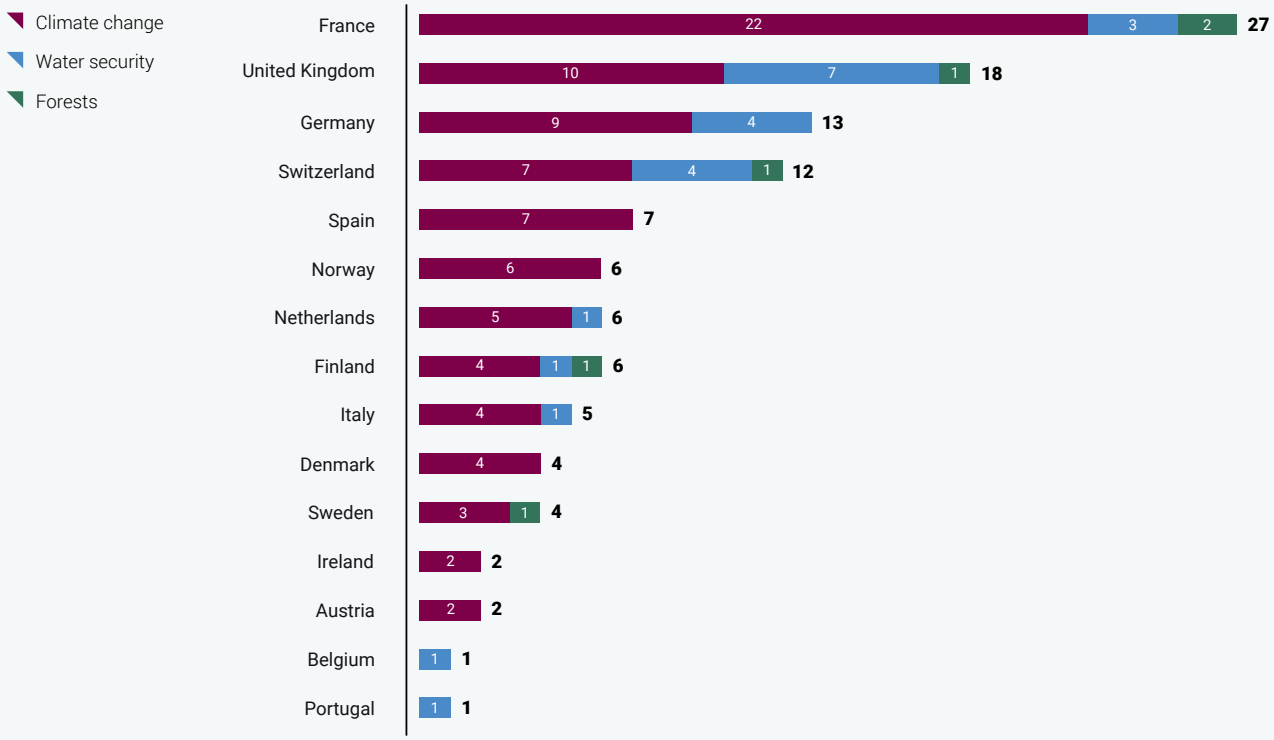
Stoxx® Global Climate Change Leaders index.

From 19/12/2011 to 31/12/2019, the Stoxx® Global Climate Change Leaders index outperformed the Stoxx® Global 1800 index by 5.3% per annum

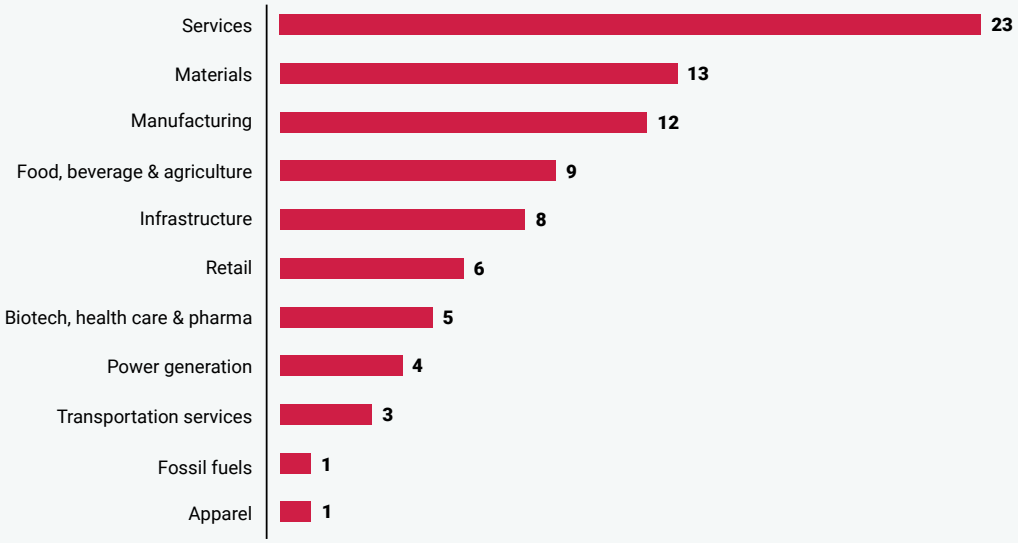


Data from December 19, 2011 to December 31, 2019

CDP A List awards in Europe



CDP climate change A List companies per sector



See all of CDP's 2019 scores here:
www.cdp.net/en/companies/companies-scores

THE A LIST:
EUROPE

Company Name	Country	Industry	Climate change	Water security	Forests
Accenture	Ireland	Services	A		
ACCIONA S.A.	Spain	Infrastructure	A		
AENA SME SA	Spain	Services	A		
Air Liquide	**France**	**Materials**	**A**	**A**	
Anheuser Busch InBev	Belgium	Materials		A	
AstraZeneca	**United Kingdom**	**Biotech, health care & pharma**	**A**	**A**	
Atos SE	France	Services	A		
BASF SE	Germany	Services		A	
Bayer AG	**Germany**	**Biotech, health care & pharma**	**A**	**A**	
Berner Kantonalbank AG BEKB	Switzerland	Financial Services	A		
Borregaard ASA	Norway	Materials	A		
Brembo SpA	**Italy**	**Manufacturing**	**A**	**A**	
British American Tobacco	United Kingdom	Food, beverage & agriculture	A		
BT Group	United Kingdom	Services	A		
Cap Gemini	France	Services	A		
Carrefour	France	Retail	A		
Cellnex Telecom SA	Spain	Retail	A		
Centrica	United Kingdom	Power generation	A		
CNH Industrial NV	United Kingdom	Power generation		A	
Coca-Cola European Partners	**United Kingdom**	**Food, beverage & agriculture**	**A**	**A**	
Coca-Cola HBC AG	**Switzerland**	**Food, beverage & agriculture**	**A**	**A**	
Constantia Flexibles	Austria	Manufacturing	A		
Danone	**France**	**Food, beverage & agriculture**	**A**	**A**	**A (soy)**
Deutsche Bahn AG	Germany	Transportation services	A		
Deutsche Telekom AG	Germany	Services	A		
Diageo Plc	United Kingdom	Services		A	
DNB ASA	Norway	Financial Services	A		
EDF	France	Power generation	A		
EDP - Energias de Portugal S.A.	Portugal	Power generation		A	
ENAGAS	Spain	Fossil fuels	A		
ENEL SpA	Italy	Infrastructure	A		
ENGIE	France	Power generation	A		
EVRY ASA	Norway	Services	A		
FERROVIAL	Spain	Infrastructure	A		
FIRMENICH SA	**Switzerland**	**Materials**	**A**	**A**	**A (palm oil)**
Gecina	France	Financial Services	A		
Givaudan SA	**Switzerland**	**Materials**	**A**	**A**	
Grieg Seafood	Norway	Food, beverage & agriculture	A		
Groupe PSA	France	Manufacturing	A		
Grupo Logista	Spain	Retail	A		
H&M Group	Sweden	Retail	A		
HeidelbergCement AG	Germany	Materials	A		
Imperial Brands	United Kingdom	Food, beverage & agriculture	A		
INDUS Holding AG	Germany	Manufacturing	A		
ING Group	Netherlands	Financial Services	A		

Company Name	Country	Industry	Climate change	Water security	Forests
Intesa Sanpaolo S.p.A	Italy	Financial Services	A		
J Sainsbury Plc	**United Kingdom**	**Retail**	**A**	**A**	
JCDecaux SA.	France	Services	A		
Kering	France	Apparel	A		
Kingspan Group PLC	Ireland	Materials	A		
Kone Oyj	Finland	Manufacturing	A		
Koninklijke KPN NV	Netherlands	Services	A		
Koninklijke Philips NV	**Netherlands**	**Biotech, health care & pharma**	**A**	**A**	
Landsec	United Kingdom	Financial Services	A		
LANXESS AG	Germany	Materials	A		
Lego Group	Denmark	Materials	A		
Lloyds Banking Group	United Kingdom	Financial Services	A		
L'Oréal	**France**	**Biotech, health care & pharma**	**A**	**A**	**A (palm oil, soy)**
Lundbeck A/S	Denmark	Biotech, health care & pharma	A		
Mercialys	France	Financial Services	A		
Metsä Board Corporation	Finland	Manufacturing	A		
Mondi PLC	United Kingdom	Manufacturing		A	
National Grid PLC	United Kingdom	Infrastructure	A		
Nestlé	Switzerland	Food, beverage & agriculture	A		
Novartis	Switzerland	Food, beverage & agriculture		A	
Novo Nordisk A/S	Denmark	Biotech, health care & pharma	A		
Orange	France	Services	A		
Ørsted	Denmark	Infrastructure	A		
Österreichische Post AG	Austria	Transportation services	A		
Panalpina Welttransport Holding AG	Switzerland	Transportation services	A		
Pernod Ricard	France	Food, beverage & agriculture	A		
Pirelli	Italy	Manufacturing	A		
REMA1000	Norway	Food, beverage & agriculture	A		
Rexel	France	Retail	A		
Royal BAM Group nv	Netherlands	Infrastructure	A		
Saint-Gobain	France	Materials	A		
Schneider Electric	France	Manufacturing	A		
SGS SA	Switzerland	Services	A		
Signify NV	Netherlands	Manufacturing	A		
Sopra Steria Group	France	Services	A		
Suez	France	Infrastructure	A		
Symrise AG	**Germany**	**Materials**	**A**	**A**	
Telefónica	Spain	Services	A		
TETRA PAK	**Sweden**	**Manufacturing**	**A**		**A (timber)**
thyssenkrupp AG	Germany	Services	A		
TUI Group	Germany	Services	A		
Unibail-Rodamco-Westfield	France	Financial Services	A		
Unilever plc	**United Kingdom**	**Materials**	**A**	**A**	**A (palm oil, soy)**
UPM-Kymmene Corporation	**Finland**	**Materials**	**A**	**A**	**A (timber)**
Vallourec	France	Materials	A		
Valmet	Finland	Manufacturing	A		
Vattenfall Group	Sweden	Power generation	A		
Veidekke ASA	Norway	Infrastructure	A		
Volkswagen AG	Germany	Infrastructure		A	

Climetrics
The Climate Rating for Funds

CLIMETRICS FUND AWARDS
2019 RESULTS

Climetrics independently rates 17,000 global funds representing **€15.9 trillion** – or 31% of the global fund market.

The Climetrics Fund Awards was introduced for the first time in 2018 and awarded the asset managers of ten funds investing in European equities with the best performance through Climetrics, CDP's climate rating for investment funds.

For the 2019 awards, fifteen funds across the global equity, European equity and emerging markets equity asset classes are recognized as the top climate performers.

The awarded funds stand out as generally investing in companies which are better at disclosing and managing material climate, water and deforestation issues.

The ranking is based on Climetrics' new underlying methodology, which now includes water security and forests data from CDP in addition to climate change. Climetrics measures the performance of a fund's holdings, its asset manager's governance of climate issues, and its investment policy, to help investors find funds well-positioned in the transition to a low carbon economy.

The rating is most affected by a fund's holdings, so is heavily influenced by the active investment decisions taken by fund managers. Using data from CDP, ISS-ESG and other sources[55], Climetrics calculates how well companies in a fund's portfolio disclose and manage material risks and opportunities related to climate change, water security and deforestation, which are key climate-related concerns for financial markets.

The methodology now uses a new materiality factor to calculate scores at a portfolio level. This gives higher scores to stocks which have highly material climate, water or forests risks but disclose and manage them well, for example by setting science-based targets to reduce emissions in line with the level needed to limit global warming to 1.5°C.

For the Climetrics Fund Awards 2019, the top five actively managed funds for the European and global equity categories were selected based on their underlying Climetrics score, chosen from hundreds issued with the best, '5-leaf', Climetrics rating in the European equity and global equity categories. The top five funds in the emerging markets equity class were also awarded.

In the European equity asset class, French asset manager La Banque Postale took three of the top five positions. And, overall, French asset managers were awarded over half of all the given awards across the categories, reflecting both the comparatively better performance on climate, water and forests issues from listed companies in France, and the leading role of French investors and asset managers in the transition to a low carbon, more resource-secure economy.

Climetrics independently rates around 17,000 global funds representing €15.9 trillion – or 31 percent of the global mutual fund market. It issues ratings on a scale of '1-leaf' to '5-leaf' using a best-in-universe approach. All ratings are free to search on **www.cdp.net/en/investor/climetrics.**

Climetrics Fund Award
Top 5 European equity funds

	Fund name	Asset manager	Category
5 leaves	Epargne Ethique Actions	Ecofi Investissements	European equity
5 leaves	LBPAM ISR Actions Euro	La Banque Postale Asset Management	European equity
5 leaves	LBPAM Responsable Actions Europe	La Banque Postale Asset Management	European equity
5 leaves	LBPAM ISR Actions Environnement	La Banque Postale Asset Management	European equity
5 leaves	Mirova Europe Sustainable Equity	Mirova	European equity
5 leaves	Ecofi Enjeux Futurs	Ecofi Investissements	Global equity
5 leaves	Jupiter Global Ecology Growth	Jupiter Asset Management	Global equity
5 leaves	MAM Transition Durable Actions	Meeschaert Asset Management	Global equity
5 leaves	Storebrand Global Solutions	Storebrand Asset Management	Global equity
5 leaves	Swedbank Robur Transition Global	Swedbank Robur	Global equity
4 leaves	Comgest Growth Emerging Markets	Comgest	Emerging markets equity
4 leaves	Stewart Investors Global Emerging Markets Sustainability Fund	First State Investments	Emerging markets equity
4 leaves	Raiffeisen-Nachhaltigkeit-EM-Aktien	Raiffeisen Kapitalanlage-Gesellschaft mbH	Emerging markets equity
4 leaves	RBC Funds (Lux) Emerging Markets Equity Focus	RBC Global Asset Management	Emerging markets equity
4 leaves	SPP Emerging Markets Plus	SPP Fonder	Emerging markets equity

> We urgently have to see real action from investors to move capital into companies with lower carbon and more sustainable business models. Greater transparency in the fund industry is key to this process. Climetrics' aim is to give investors confidence about their investments, and these awards recognize that certain funds represent a more progressive approach in lowering long-term risks to investors from climate change.
>
> Nico Fettes, Head of Climetrics at CDP

FEATURED CASE STUDY: L'ORÉAL

Climate change is a pressing global issue and its repercussions require urgent action. With a commitment to making a profound transformation towards a low-carbon business model, L'Oréal aims to play a catalyzing role and contribute actively to addressing this challenge.

As part of our global sustainability program "Sharing Beauty With All", we reduced the CO_2 emissions of our plants and distribution centres by 77 percent between 2005 and 2018 – exceeding our target of -60 percent by 2020 – while our production volume increased by 38 percent over the same period.

To achieve this, we implemented a strategy based on three pillars:

1. Reducing its energy requirements by improving energy efficiency across all its facilities (buildings, equipment, etc.).
2. Increasing the use of local renewable energy wherever possible.
3. Achieving the targets defined for the sites without carbon offsetting projects.

We elaborated this renewable energy strategy according to the local possibilities offered by the plants in the various countries where we operate. For most of our carbon reduction projects, we use locally produced renewable energy, or directly produce our own renewable energy (biomass, biomethanisation, solar panels, etc.). In 2018, renewable electricity accounted for 66 percent of power requirements at L'Oréal's plants and distribution centres and 57 percent at administrative sites and research centres.

But we want to pursue our efforts with an even greater ambition. In 2018, we began to put our new Science Based Targets-approved 2030 commitments into practice: we have committed to reduce our entire greenhouse gas emissions (scopes 1, 2 and 3) by 25 percent in absolute terms, compared to 2016. And by 2025, all L'Oréal's manufacturing, administrative and research sites will have achieved carbon neutrality.

At L'Oréal, we see sustainability as the only possible way forward and are doing everything we can to be an exemplary leader. We have undertaken and accomplished multiple initiatives, but we must collectively accelerate our efforts in the face of the climate crisis. It is the condition inherent to the company's long-term success and to safeguarding our planet. It is a moral imperative.

Jean-Paul Agon
Chairman and Chief Executive Officer
L'Oréal

FEATURED CASE STUDY: FIRMENICH

In 2019, Firmenich was one of only two companies to achieve CDP triple "A" status for climate change, water security and forests. This distinction is a testament to our commitment to conducting our business responsibly, with ambitious sustainability goals embedded in our strategy.

We believe in setting bold targets that drive progress and inspire actions in our company, our industry and our supply chain. In fiscal year 2019, we cut our Scope 1 and 2 CO_2 emissions by 30.2 percent compared to our fiscal year 2015 baseline and surpassed our 2020 goal to reduce absolute Scope 1 and 2 CO_2 emissions by 20 percent one year in advance; allowing us to already start focusing on our future goals, and our science-based 2030 targets.

90 percent of our global electricity comes from renewables or RECs, and more than 20 of our manufacturing sites now operate solely with 100 percent renewable electricity. Beyond our operations, we are committed to fighting the urgent climate crisis, and preserving and restoring earth resources, including forests. We focus on driving transparency in our supply chain, and investing in reforestation initiatives: last year, we quadrupled the number of suppliers asked to disclose their deforestation impact via CDP, and our response rate went up 15 percent. We have also invested in the Livelihoods Funds since 2011, supporting innovative investment models to address environmental degradation, climate change and rural poverty.

Regarding water, our operations mostly use water for cleaning: we consume a very small amount of water and most of our cleaning water goes back into the water system after usage and treatment. Therefore, we not only target water in our operations but also in our ingredients, our supply chain, and local communities. Asking our suppliers to disclose their water initiatives drives them to improve their supply chain sustainability and to take other relevant action. Last year, among suppliers disclosing their water performance to CDP, 71 percent had a water policy and 58 percent integrated water-related issues into long-term business objectives.

Firmenich has been leading real change since we made our first public environmental commitment to sustainable business, three decades ago, and our commitment remains unwavering.

Neil McFarlane
Senior Vice President Quality, Health, Safety & Environment
Firmenich

CDP SCORING METHODOLOGY 2019

CDP Scoring Partners

ADEC INNOVATIONS ESG SOLUTIONS

DEKRA

RepRisk Due diligence on ESG and business conduct

CDP scoring lays down milestones marking the progress of a company's sustainable journey. It provides a roadmap to companies to compare themselves to the best in class. The scoring methodology has evolved over time to influence company behaviour in order to improve their environmental performance. Scoring at CDP is mission-driven, focusing on principles and values for a sustainable economy, and highlighting the business case for change.

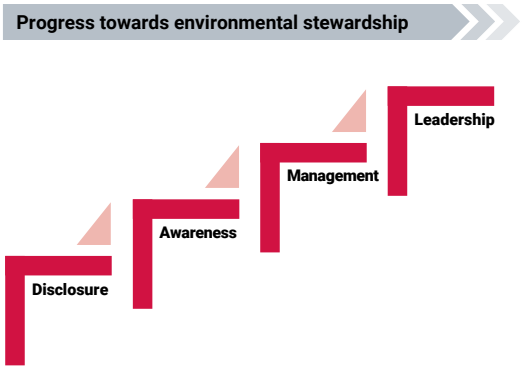
CDP's 2019 questionnaires are focused on the high-impact sample companies in each of the three themes – Climate Change, Water, and Forests.

To operationalise this approach, in 2018 CDP developed an Activity Classification System (CDP-ACS), a three-tiered system starting from the lower rung of Activity, going up to Activity Group and, finally, Industry. This framework categorizes companies by the most relevant sectors. It focuses on the diverse activities from which companies derive revenue and associates these with the impacts on their business from climate change, water security and deforestation. This helps ensure a better understanding of company actions according to their environmental risk, opportunity and impact and is essential for better comparability of data.

While the bulk of the scoring logic applies to all sectors and questionnaires alike, each of the questionnaires comes with a somewhat tailored scoring methodology. The sector-based approach allows CDP to make more meaningful assessments of companies' responses, incorporating each sector's characteristics and nuances, resulting in a score that reflects the company's progress in environmental stewardship and enabling better benchmarking against other companies.

The scoring of CDP's questionnaires is conducted by accredited scoring partners trained by CDP. CDP's internal scoring team coordinates and collates all scores and run data quality checks and quality assurance processes to ensure that scoring standards are aligned between samples and scoring partners.

Illustration of scoring levels



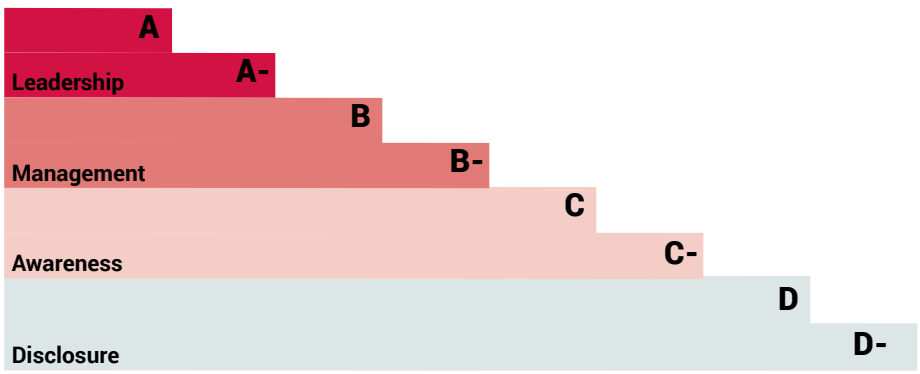
Responding companies are assessed across four consecutive levels which represent the steps a company moves through as it progresses towards environmental stewardship: Disclosure which measures the completeness of the company's response; Awareness which intends to measure the extent to which the company has assessed environmental issues, risks and impacts in relation to its business; Management which is a measure of the extent to which the company has implemented actions, policies and strategies to address environmental issues; and Leadership which looks for particular steps a company has taken which represent best practice in the field of environmental management.

Questions may include criteria for scoring across more than one level. The criteria for scoring the levels are distributed throughout the questionnaire. All of the questions are scored for the disclosure level. Some of the questions have no awareness, management or leadership level scoring associated with them.

Scoring categories and weightings

Further technical guidance for companies on the methodology can be found on: **www.cdp.net/en/guidance/guidance-for-companies**

Climate Change	Water	Forests
65-100%	65-100%	60-100%
0-64%	0-64%	0-59%
45-75%	45-75%	45-69%
0-44%	0-44%	0-44%
45-79%	45-79%	45-79%
0-44%	0-44%	0-44%
45-79%	45-79%	45-79%
0-44%	0-44%	0-44%



F = Failure to provide sufficient information to CDP to be evaluated for this purpose.

CDP breakdowns down its scoring into categories in order to better focus on key data points and provide a more detailed breakdown of a company's score. Scoring categories in 2019 are sub-groups of the 2019 questionnaire modules and are unique to each theme, but within each theme they are consistent across all sectors.

Each sector within each theme is affected by and manages environmental issues in a specific way. To capture these specificities, different weightings will be applied amongst sector scoring categories in each theme.

Weightings are applied by calculating the Management and Leadership score per scoring category in the same way as previous years: Numerator/Denominator * 100. These % scores are then translated into a category score per level by calculating the proportion of points achieved relative to the category weighting: Category weighting (%)/ 100 * Management/Leadership score (%). The category scores for each level are then summed together to calculate the overall final score.

Scoring weightings will only be applied to each of the scoring categories at Management and Leadership level. Where a scoring category consists of new questions, low weightings will reflect this. Weightings will be applied differently across sector categories for each theme to reflect this.

Public scores are available in CDP reports, through Bloomberg terminals, Google Finance and Deutsche Börse's website. CDP operates a strict conflict of interest policy with regards to scoring and this can be viewed at **bit.ly/2Sx3hLd**

Category	Management weighting	Leadership weighting
Governance	12.0%	12.5%
Risk management processes	10.0%	
Risk Disclosure	8.0%	
Opportunity Disclosure	8.0%	
Business Impact Assessment & Financial Planning Assessment	5	
Business Strategy	5	
Scenario Analysis	1	
Targets	12	
Emissions reductions initiatives and low carbon products	5	
Scope 1 & 2 emissions (incl. verification)	12	
Scope 3 emissions (incl. verification)	5	
Emissions breakdowns	0	
Energy	6.0	7.0
Additional climate-related metrics (incl. verification)	0.0	
Carbon pricing	2.0	0.0
Value chain engagement	5.0	
Public policy engagement	1.0	0.0
Communications	1.0	0.5
Sign off	2.0	
100% Disclosure points	0.0	2.0
Overall Total	**100%**	**100%**

Endnotes

1 Combining total electric utility capital investments and transport OEM R&D investments in electrification. Total transport OEM R&D is a larger, likely overstated number due to the inclusion of conventional technologies in some of the low-carbon R&D initiatives reported.

2 Models suggest non-CO_2 emissions must reach net-zero a decade or so later. See IPCC (2018) 'Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development', in 'Global Warming of 1.5°C: An IPCC Special Report'.

3 In practice, state and non-state actors use varying definitions of 'emissions' for net-zero. 'Net-zero CO_2' and 'carbon neutrality' refer only to carbon dioxide emissions; 'net-zero greenhouse gas emissions' refers to all greenhouse gases, while 'climate neutrality' – as favoured by the EU – can also include other climate forcers such as black carbon.

4 UN Global Compact (2020) 'Business Ambition for 1.5°C – Our Only Future'

5 Commission modelling of 1.5°C compatible scenarios for the EU indicate climate neutrality has been interpreted as net-zero greenhouse gas emissions. The European Council endorsed the 2050 climate neutrality at a meeting in December 2019, with the exception of Poland. However, Poland's position is not expected to hold the Commission from moving ahead.

6 See IPCC (2018) 'Global Warming of 1.5°C: Summary for Policymakers' and IEA (2019) 'World Energy Investment 2019'.

7 EIB (2019) 'Investment Report 2019/2020'.

8 This is aggregate, economy-wide investment and is calculated against a baseline assuming continuation of current policies. EC (2018) 'A Clean Planet for all: A European long-term strategic vision for a prosperous, modern, competitive and climate neutral economy', In-depth Analysis in Support of the Commission Communication COM(2018) 773. The Commission has also estimated that achieving the current 2030 targets of 40% emissions reductions compared to 1990 levels, 32 percent renewables share, and 32.5% energy efficiency will require an increase in investment of €260 billion a year from 2021-2030. See EC (2019) 'United in delivering the Energy Union and Climate Action – Setting the foundations for a successful clean energy transition', COM(2019) 285.

9 Estimated from current and planned low-carbon investments by high-impact sectors and investments in emissions reduction initiatives by other sectors. Based on Oliver Wyman's data handling methodology, analysis in this report only includes reported low-carbon investments where the investment start date falls within the respective company's reporting year.

10 The data analyzed in this report are from 882 European companies responding to investors via CDP's climate change questionnaire in 2019. The 882 European companies are stock listed in one of the 28 EU member states (the United Kingdom included) or in the EFTA countries. 45 of the 882 companies included in the dataset voluntarily reported their data. A full list of responding companies whose data is included in this report is available **here**.

11 Scope 1 emissions occur directly from company-controlled sources, scope 2 emissions occur indirectly from the generation of energy purchased by the company.

12 European Environment Agency (2019) 'Total greenhouse gas emission trends and projections in Europe'.

13 For example, Wind Europe (2018) 'Wind Energy in Europe: Trends and Statistics' reports wind capacity additions fell 33% in 2018, with continued problems reported in 2019 – see Wind Europe (2019) 'Collapse in wind energy jeopardises German and EU renewables targets'. In contrast, the solar PV market has reported strong growth in capacity additions. For example, SolarPower Europe reports a 36 percent increase in EU installed capacity in 2018, see SolarPower Europe 'EU Solar Market Grows 36 percent in 2018'.

14 For example, the EIB estimates that investment in low-carbon energy needs to double, EIB (2019). The Commission estimates increased economy-wide investment requirements of €113.5 - €172 billion a year from 2030, net of residential and transport vehicle replacements, EC (2018).

15 See EIB (2019)

16 R&D investments are only reported by companies in CDP's high-impact sectors and among these, the transport OEM sub-sector is already Europe's largest investor in R&D which it reports almost entirely as low-carbon. More data on low-carbon R&D among 'other' companies, and a more accurate breakdown of R&D from transport OEMs would be needed to perform this analysis.

17 EEA (2019) 'Progress on Energy Efficiency in Europe' shows that industrial energy efficiency has improved 38 percent since 1990, faster than all other energy consuming sectors.

18 EC (2018); IOGP (2019) 'The potential for CCS and CCU in Europe'; and Global CCS Institute Facilities Database, accessed on 16 December 2019.

19 Bloomberg New Energy Finance (2020) 'State of Clean Energy Investment'; and IEA (2019) 'World Energy Investment 2019'.

20 Wind Europe (2019) 'Collapse in wind energy growth jeopardises German and EU renewables targets', 10 May 2019.

21 Wind Europe (2019) 'Wind energy in Europe in 2018: Trends and statistics'.

22 EIB (2019)

23 Letter available at: **www.transportenvironment.org/sites/te/files/publications/2019_11_European_Green_Deal_trucks_vans_letter_final.pdf**

24 Based on total 2016 emissions from WRI ClimateWatch, available at **www.climatewatchdata.org**.

25 Note that in practice, some companies may already include avoided cost of emissions allowances in their estimates of cost savings, making a direct comparison with ETS prices difficult. For companies in heavy industries and international transport, this picture will be further complicated by the granting of free allowances.

26 European Energy Exchange.

27 Assuming upper bounds of the ranges recommended by the High-Level Commission on Carbon Prices to deliver the Paris Agreement's goals. See Carbon Pricing Leadership Coalition (2017) 'Report of the High-Level Commission on Carbon Prices'.

28 The materials, energy and transport sectors, along with agriculture, comprise CDP's High-Impact Sectors. However due to lack of reporting data, the Agriculture sector was not included in the high-impact company analysis. Click **here** for a full list.

29 European Automobile Manufacturers' Association

30 The European Automobile Manufacturers' Association reports total EU automotive R&D of €57.4 billion. This implies that transport OEMs consider almost all current R&D as low-carbon in nature.

31 Corporate R&D intensity is usually calculated as expensed R&D as a share of income. As an approximation, we annualize new R&D investment as reported to CDP using the average for 2018 and 2019 to compensate for variability in new investment. This is likely to result in an under-estimation of R&D intensity due to the omission of R&D expenditures relating to investments announced in earlier years. This is performed for each company in the sub-sector and the average taken, including for companies reporting no low-carbon R&D.

32 Based on CDP reporting guidance, low-carbon capital investment for electric utilities includes products, services and plant, property and equipment, while for other sub-sectors it is comprised of only plant, property and equipment. Average Low-carbon capital investment as a share of reported capex is calculated over 2018-19 for each company and averaged for the sub-sector. Companies reporting no low-carbon capital investment in the period are included. For example, 19 oil & gas companies reported no low-carbon capital investment over the period. Restricting the calculation to companies that did report low-carbon capital investments results in the average oil & gas company share of low-carbon investment in capex increasing from around 2 percent of capex to around 8 percent.

33 EC (2018)

34 It is important to note that this is a snapshot of low-carbon investments reported by high-impact companies in 2019; it does not represent the full stock of existing low-carbon investments that companies hold.

35 There was one additional reported investment in CCUS worth €89 million that was excluded from the analysis. This was done in line with Oliver Wyman's data handling methodology, whereby analysis in this report only includes reported low-carbon investments where the investment start date falls within the respective company's reporting year.

36 Assumed to be €7 billion driven primarily by R&D investments in energy efficiency reported by BMW, however this amount also contains undisclosed investment in electrification and mobility services, so is not purely energy efficiency.

37 The EU may struggle to meet its current target of 32 percent of final energy consumption from renewable sources by 2030, let alone what would be needed for the newly proposed 50-55% below 1990 levels by 2030 emissions reduction goal. See, for example, **www.euractiv.com/section/energy-environment/news/three-eu-countries-bump-up-renewable-energy-goal-for-2030/**

38 Of these leading companies, 40 have scope 1 and 2 targets aligned with 1.5°C aligned pathways, 48 are in line with well below 2° and a further 57 are aligned with scenarios to limit global warming to 2°C. See Science Based Target (2020) "Companies taking action', available at **sciencebasedtargets.org/companies-taking-action/**

39 A panel of leading economists has recommended carbon prices in the range of at least $40-80 per tonne in 2020, climbing to €50-100 per tonne by 2030, to achieve the Paris Agreement's temperature goals. Assuming the upper bounds to be appropriate for 1.5°C implies a carbon price of around €70 per tonne in 2020 rising to around €90 by 2030 – considerably higher than recent ETS prices in the range of €20-30 per tonne. See Carbon Pricing Leadership Coalition (2017) 'Report of the High-Level Commission on Carbon Prices'.

40 European Commission (2019) 'Energy prices and costs in Europe'; and ODI (2017) 'Phase-out 2020: monitoring Europe's fossil fuel subsidies'.

41 See, for example, Lehne and Preston (2018) 'Making Concrete Change: Innovation in Low-carbon Cement and Concrete', Chatham House.

42 EIB (2019).

43 This figure is estimated using data sources from Dealogic and CPI (2019) 'Global Landscape of Climate Finance 2019'. Climate Policy Initiative, London. Available at **climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2019/**

44 This is reported in 2019, although it is largely based on company data from 2018.

45 Companies from TCFD website, updated December 2019, and market capitalization data from CapitalIQ.

46 Data sourced from **www.ngfs.net/en/about-us/membership** as of December 2019.

47 NGFS (2019) 'A call for action: Climate change as a source of financial risk', First comprehensive report.

48 See, for example Oliver Wyman and UNEP FI (2018) 'Extending Our Horizons: Assessing Credit Risk and Opportunity in a Changing Climate' and Mercer (2019) 'Investing in a Time of Climate Change: The Sequel'.

49 Mercer (2019).

50 Oliver Wyman (forthcoming).

51 BNEF (2020) 'Sustainable Debt Sees Record Issuance At $465Bn in 2019, Up 78% From 2018', Bloomberg New Energy Finance; and CBI (2020) 'Record 2019 GB Issuance $255bn! EU largest market: US, China, France lead Top 20 national rankings: Sovereign GBs & Certified Bonds gain momentum', Climate Bonds Initiative

52 See, for example, initial proposals for transition bond guidelines from AXA Investment Managers available at **www.axa-im.com/content/-/asset_publisher/alpeXKk1gk2N/content/financing-brown-to-green-guidelines-for-transition-bonds/23818**; or

53 In Europe, Credit Agricole issued a €100 million 'transition bond' to AXA Investment Managers with the proceeds earmarked for lending for transition related activitie in high-carbon sectors, such as LNG-powered ships, energy efficiency and coal to gas switching; BNP Paribas executed a €500 million 'climate action bond' for the Italian gas utility Snam, with proceeds use for reducing methane emissions and improving the efficiency of the gas distribution network among other things.

54 BNEF (2020) 'Sustainable Debt Sees Record Issuance At $465Bn in 2019, Up 78% From 2018'; and Linklaters (2019) 'The rise of green loans and sustainability linked lending'

55 Climetrics uses market-leading company data from CDP and ISS-ESG. It also draws from additional data sources, such as from the Science-Based Targets initiative and RE100. The Climetrics methodology is strongly aligned with the TCFD recommendations. It integrates TCFD-aligned CDP scores for companies in its evaluation of portfolio holdings, and tracks asset managers' TCFD-based reporting through the PRI reporting framework.

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