

Integrating climate transition risk into investment portfolios

Summary

Climate change is a significant risk for investors, from the financial losses incurred from extreme weather events, the asset re-pricing in the transition to a low carbon economy to the use of law courts as a new instrument to enforce and accelerate climate change action. In this article we illustrate how we are integrating climate transition risk into our investment process and the implications from an asset allocation perspective.

According to MSCI's own measure, 20% of the MSCI All Country World Index faces asset stranding or significant challenges when it comes to the transition to a low carbon economy¹. At the same time, technologies to address climate change present substantial investment opportunities across all sectors and asset classes.

The traditional approach to assessing climate risk within an investment portfolio has been through carbon foot-printing. This involves identifying the concentrations of carbon across the investment portfolio. However, this approach has suffered from a number of short-comings. For example, it fails to capture information on changes in a company's carbon exposure or strategy. In addition, the dataset suffers from inconsistent company disclosure and in particular low reporting of Scope 3 emissions, namely the indirect emissions that occur in the value chain of the reporting company.

The past few years has therefore witnessed increasing efforts to improve ESG and specifically climate-related disclosures through, among others, the EU Action Plan and the Task Force for Climate-related Financial Disclosures. As the market awaits a long overdue improvement in ESG and specifically climate-related disclosures, attention has turned

to alternative and more sophisticated approaches to measure and manage both physical and transition climate risk within an investment portfolio. Not surprisingly, there is a rapidly developing ecosystem of data providers, asset owner initiatives and online platforms available to financial institutions that provide varying techniques that aim to integrate these risks into the investment process.

In this article, we examine some of the transition risk methodologies available in the marketplace. We provide details as to the approach we are adopting at DWS, namely the DWS climate transition risk rating. This seeks to identify the climate risks and opportunities at a security, sub-sector and sector level basis. This then allows us, among other things, to optimize a portfolio that not only reduces climate transition risk, but, also tilts investments towards entities that promote the low carbon transition.



Michael Lewis
Head of ESG Thematic Research
Michael.Lewis@dws.com



Carsten Keil
Head of ESG Engine & Solutions
Carsten.Keil@dws.com

Forecasts are based on assumptions, estimates, views and hypothetical models or analyses, which might prove inaccurate or incorrect

November 2019 — For Qualified Investors (Art. 10 Para. 3 of the Swiss Federal Collective Investment Schemes Act (CISA).For Professional Clients (MiFID Directive 2014/65/EU Annex II) only. For Institutional investors only. Further distribution of this material is strictly prohibited.

Australia: For Professional Investors only

The three channels of climate risk

Physical, liability and transition risk are the three channels of climate risk from an investment perspective². Physical climate impacts can range from water stress and cropland decline to river flooding and heat-waves with potential disruptive effects on property and trade flows.

Liability risks relate to those individuals or entities who have, or will suffer losses or damages due to climate change and who seek compensation from those they hold responsible. Typically these are the world's largest carbon emitters and potentially financial sector actors who have facilitated "polluters" in their business activities.

Clyde & Co., the international law firm, found that as of this year around 1,200 climate change cases had been filed across 30 jurisdictions including Australia, Brazil, Canada, Germany, India, Spain, the UK and the US³. However, most climate change litigation has taken place in the United States with over 950 cases filed there so far. This includes nine cities and counties from New York to San Francisco suing major fossil fuel companies and seeking compensation for climate change damage such as pollution and rising sea levels.

Finally, transition risks relate to the increasing scope of climate change regulation, technological change and shifts in consumer preferences. These have the power to alter significantly the operating model of businesses with the potential of driving revaluation events both to the upside and downside. For example, companies not managing climate risks with sufficient strength (downside revaluation risk) or companies seizing the opportunities presented by the transition to a low carbon economy (upside revaluation potential).

In this article, we examine the processes required by asset managers and asset owners to integrate transition risk into the investment process, which are becoming part of the fiduciary duty requirements for institutional investors. In future articles, we will outline how we are integrating physical climate risk into the investment process.

Assessing climate transition risk methodologies

Poor disclosure and backward looking data have presented investors with significant challenges as to whether climate transition risk within an investment portfolio context were being achieved with the available ESG datasets. For example, carbon foot-printing, which identified the concentrations of carbon within a portfolio, was useful in identifying systemically important carbon emitters, but is a poor proxy for climate risk in general.

To address the shortcomings of carbon foot-printing, more sophisticated approaches to address climate risk have emerged. For example, when it comes to integrating climate transition risk, multiple data providers and numerous transition risk assessment methodologies have come to the marketplace.

We expect these will continue to evolve. Indeed a significant data resolution is already underway and global efforts to improve disclosure such as through the EU Action Plan and the Task Force on Climate-related Financial Disclosures, will mean further enhancements will occur in terms of incorporating climate risk into the investment process in the months and years ahead. Indeed we have seen significant strides in the area of mapping physical climate risk to listed equity market performance. In future DWS research, we will explain how we are also integrating physical climate risk into our investment process.

For the time being, and when it comes to integrating climate transition risk, there exists a multitude of scoring methodologies available. These include the methodologies from MSCI, ISS-Oekom, Sustainalytics, S&P Trucost, the Paris Agreement Capital Transition Assessment, the Transition Pathway Initiative and Moody's. Each have their own distinct characteristics and a brief overview of these methodologies are outlined below.

MSCI Low Carbon Transition Score

MSCI's low carbon transition methodology is based on a carbon intensity footprint measure¹. The key addition from previous methodologies is that avoided emissions are now considered. This means that MSCI approximates the emissions not generated when a company's products are used instead of products from industry peers such as electric cars versus cars with internal combustion engines. MSCI finds that 20% of the constituents of the MSCI All Country World Index (ACWI) face asset stranding or significant

Forecasts are based on assumptions, estimates, views and hypothetical models or analyses, which might prove inaccurate or incorrect

November 2019 — For Qualified Investors (Art. 10 Para. 3 of the Swiss Federal Collective Investment Schemes Act (CISA). For Professional Clients (MiFID Directive 2014/65/EU Annex II) only. For Institutional investors only. Further distribution of this material is strictly prohibited.

Australia: For Professional Investors only

transition challenges, most notably in the energy, utilities and materials' sectors¹.

ISS-Oekom's Carbon Risk Rating

ISS-Oekom rating system captures not just the current carbon-related performance of the company and its ability to seize climate-related opportunities, but, it also incorporates the company's industry specific characteristics favouring companies involved in clean tech solutions and penalising those with high GHG emissions along their value chain⁴.

Sustainalytics's Carbon Pillar Risk rating

Sustainalytics rating methodology covers carbon related risks in the companies' own operations as well as concerning the company's products and services. When it comes to emissions from the company's own operations this refers to its energy use and GHG emissions covering not just scope 1 and 2 but also parts of scope 3, such as transport and logistics. In terms of the company's products and services it refers to the energy efficiency and/or GHG emissions of its services and products during the usage phase.

S&P Trucost's Carbon Earnings at Risk

The carbon earnings at risk methodology identifies current and future carbon price scenarios in 130 regions to identify sectors, companies or business segments at risk in the event companies have to pay a future price for their greenhouse gas emissions⁵. According to the World Bank, at the moment only 20% of global GHG emissions are covered by a carbon price and less than 5% of those are priced at levels consistent with reaching the temperature goals of the Paris agreement⁶.

However, an increasing number of jurisdictions are implementing carbon pricing schemes, 57 compared to 51 last year. As a result, a growing number of companies are also assessing carbon pricing from a risk management perspective. According to CDP, over 1,300 companies, including 100 Fortune Global 500 companies who have disclosed and are using an internal carbon pricing mechanism, or plan to implement internal carbon pricing within two years (2017 data)⁷. These are being used by these companies to assess investment decisions and manage their long-term climate risks.

Paris Agreement Capital Transition Assessment (PACTA)

The 2 Degrees Investment Initiative developed this methodology to address the limitations of relying on corporate disclosure of ESG/climate data. Despite the growing focus by regulators, investors and companies on climate change, the proportion of companies disclosing their carbon emissions is still surprisingly low. PACTA provides an alternative approach by assessing companies' current installed assets and capex plans for key carbon intensive sectors. This methodology has been used with financial regulators such as the California Insurance Commission, which has therefore prompted many more financial institutions to consider climate risk exposure and management.

Transition Pathway Initiative (TPI)

The TPI is an asset owner backed research initiative with the London School of Economics and FTSE Russell. This methodology evaluates and tracks the quality of companies' carbon management and how future carbon performance compares to national targets/pledges and the Paris climate agreement ambition. In its latest findings published in September 2019, TPI finds that of the top 109 energy companies, only two oil and gas companies are aligned with the emission reduction pledges made by national governments in the Paris Agreement⁸.

Moody's carbon transition assessment (CTAs)

This approach assess the carbon transition risk to non-financial companies from evolving policy, legal, technological and market changes. It then considers of how these trends are evolving in specific geographies and sectors and hence the implications for individual companies. The CTAs are forward looking as they not only examine the current positioning of the company, but, also their plans to mitigate climate risks⁹.

The DWS approach to ESG integration and climate transition risk

The cornerstone of our ESG integration efforts in public markets is the DWS ESG Engine. This uses data from three generalist providers – MSCI, ISS and Sustainalytics – and supplements these inputs with further information from three specialised providers, S&P Trucost, ISS Ethix and RepRisk. This means the ESG Engine has access to more than 35 million data points for over 10,000 companies. This enable us, as a first step, to rank the ESG quality, from A to F, of

Forecasts are based on assumptions, estimates, views and hypothetical models or analyses, which might prove inaccurate or incorrect

November 2019 — For Qualified Investors (Art. 10 Para. 3 of the Swiss Federal Collective Investment Schemes Act (CISA)). For Professional Clients (MiFID Directive 2014/65/EU Annex II) only. For Institutional investors only. Further distribution of this material is strictly prohibited.

Australia: For Professional Investors only

corporate and sovereign issuers from the developed and developing world in both listed equity and fixed income markets.

When it comes to ranking issuers specifically on climate transition risk, DWS has designed and implemented its own proprietary climate transition risk rating via the ESG Engine. This seeks to identify the risks and opportunities associated with a transition to a low carbon economy. In a similar way to how we assess the ESG quality of corporates and sovereigns, the DWS A to F climate transition rating system enables us to identify, among other things, climate transition leaders and laggards.

Initially we began by amalgamating the latest generation climate risk measures of MSCI, ISS-Oekom and Sustainalytics. In the fourth quarter of 2019, we added S&P Trucost's carbon value at risk methodology to our ranking assessment, with an overview of the results outlined below. This then enabled our transition risk methodology to incorporate not just carbon intensity metrics and climate investment solutions but also to assess the potential implications of more stringent carbon price schemes across sectors and geographies.

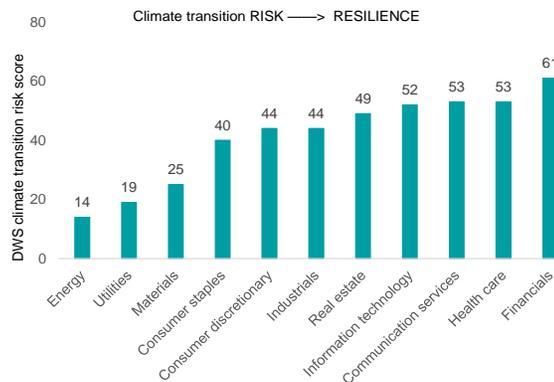
The DWS Climate Transition Risk scoring ranges from 0 (absolute climate transition risk laggard) to 100 (absolute climate transition risk leader) which is then translated into our traditional A to F letter rating system.

A-C (which identifies constituents with a score in excess of 50) we label as leaders and have either low or perfectly managed risks and those delivering climate solutions and benefiting from opportunities in the transition to a low carbon economy. D to F (which identifies constituents with a score of less than 50) are labelled laggards and those with elevated risk. E and F constitute the true laggards, which an ESG investors or climate transition risk averse investor should seek to avoid. This approach then enables us to identify at a sector, sub-sector and individual security level basis the extent of the climate transition risk and opportunity.

We find that the high and excessive transition risk companies, that is issuers with a DWS Climate Transition Risk rating of E and F are mostly operating in the energy, utilities and materials sectors. For example, in the case of the energy sector, the median climate transition risk score for the sector is 14, and consequently very close to what we define

as an absolute laggard. Meanwhile our findings reveal that those companies with limited climate transition risk exposure are those in the financials, communication services, health care and IT sectors, Figure 1.

FIGURE 1: MEDIAN CLIMATE TRANSITION RISK SCORE BY SECTOR



Source: DWS Investment GmbH (October 2019)

How climate transition risk affects financial performance is at the heart of this mapping exercise. For example, within materials, the availability of key inputs in the mining sector such as water and energy will likely physically and financially constrain the establishment of new operations or make existing operations uneconomical.

Meanwhile new business opportunities should arise as demand will likely increase for materials used in existing and future low-carbon energy and industrial technologies. Examples include copper, which is important for electrification and improving energy efficiency. Similarly substituting steel for aluminium can help reduce emissions within the transportation sector although the energy intensive nature of aluminium smelting also needs to be taken into consideration.

In certain countries, the transportation sector has overtaken the power sector as the most carbon intensive industry. Governments, and particularly those in Europe, are responding with new stringent fuel economy and emissions regulations encompassing CO₂, NO_x and Particulate Matter. This may see car manufacturers not only incur penalties due

to missed emission reduction targets, but, also force companies to invest in new product strategies.

As a result, regulation and technologies are potentially combining to drive out diesel engines, and eventually all internal combustion engines, and enable the electric vehicle and e-mobility sectors to become key growth markets for carmakers.

While the oil sector widely dismissed the threat of electric vehicles, arguing as late as in 2017 that they were a drop in the ocean of cars, leading car companies are already shifting their strategy. According to Reuters, the world's leading automotive companies had committed US\$90bn to electric vehicle strategies by January 2018¹⁰. According to BNEF, incremental sales of EVs may be higher than that of internal combustion engines by 2020, and by 2023 internal combustion engine sales should already be falling¹¹.

When it comes to the fossil fuel sector, investors may be financially impacted even before companies see the peak in fossil fuel demand. This is what happened in the coal and European electricity sector transitions. For example, the share prices of major US coal producers is a case in point. Leading ones saw their share price peak around 2011 at the point when rapid coal demand growth slowed. By 2014, global coal demand stagnated and the largest one filed for bankruptcy¹².

Similarly, fossil fuels in electricity generation peaked across the OECD in 2007 at a time when solar PV and wind were just 1% of the electricity mix¹³. Shortly before then, the share price of leading German power utilities also peaked. Since then, US\$150bn+ of assets have been written down, and the European power sector's capitalisation has fallen significantly.

From a sector perspective, we identified energy, materials, real estate and utilities with the highest degree of climate transition risk. We then investigated climate risks by sub-sector and individual security such that for utilities, for example, we find that independent power companies within the MSCI ACWI are populated with the largest share of excessive transition risk entities. Within materials, it is construction and then metals and mining where climate transition risks are most prevalent. For industrials, securities in the marine and airline sectors are most exposed.

In terms of coverage, the DWS climate transition risk rating can be evaluated for approximately 13,000 issuing entities. Of the entire population, we find that issuers with high transition risk (E rating) and excessive transition risk (F rating) exist for between 10-20% of the population.

The Inevitable Policy Response

Revaluation events in response to technological change, climate-focused regulations or changing consumer preferences are already happening and may become more widespread and significant in the years ahead. Indeed with an increasing number of actors demanding action to address the climate crisis, it seems inevitable that even more robust climate policies and regulations will emerge over the next few years. This will therefore expose investors to additional financial risk. In response, the Principles for Responsible Investment alongside Vivid Economics and Energy Transition Advisors (ETA) have launched the Inevitable Policy Response (IPR).

The IPR assesses when policy-makers will most likely act (by 2023-2025), how they will act (carbon pricing, banning the sale of emission emitting cars, phasing out coal use, energy efficiency measures) and who will be hit (from the costs to the economy, the sectors, regions and asset classes most exposed) and who are likely to be the most valuable companies in the transition to a low carbon economy. We expect this will also become an important tool for climate risk and opportunity integration.

Climate transition risk and the DWS asset allocation process

In order to enhance our asset allocation process and given ongoing asset re-pricing risk, we not only look to incorporate less climate risk, but also to capture the low carbon investment opportunities. Indeed by identifying the climate risk leaders and laggards not just at a sector level, but also on a sub-sector and security level basis we are able to invest in sectors that may not look appealing on a headline climate transition risk basis, but thanks to gaining exposure to specific sub-sectors and individual securities we can capture lower climate risk or even a measurable investment opportunity.

We find that investment opportunities are particularly concentrated in the information technology, utilities and

Forecasts are based on assumptions, estimates, views and hypothetical models or analyses, which might prove inaccurate or incorrect

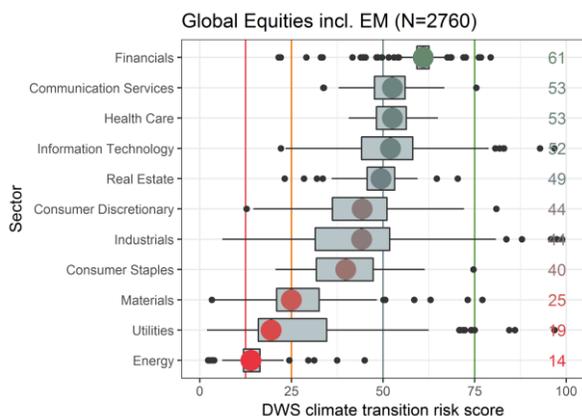
November 2019 — For Qualified Investors (Art. 10 Para. 3 of the Swiss Federal Collective Investment Schemes Act (CISA). For Professional Clients (MiFID Directive 2014/65/EU Annex II) only. For Institutional investors only. Further distribution of this material is strictly prohibited.

Australia: For Professional Investors only

industrials' sectors even though at a headline sector level some of them represent high transition risk plays.

Figure 2 provides a more in-depth examination of where climate risk and opportunities reside by sector. For example, the boxplots identify the 25th and 75th percentile of the sector distribution according to its climate transition risk score. The whiskers examine the extremities or tail of the distribution. It also includes the outliers that exist across many sectors including where risk scores are in excess of 50 and 75 and which classify inside our A-C rating. This is the segment of the universe we identify as offering climate investment solutions. We find that these are most prevalent in the information technology, industrials and utilities' sectors.

FIGURE 2: IDENTIFYING CLIMATE TRANSITION INVESTMENT OPPORTUNITIES BY SECTOR



Source: DWS Investment GmbH (October 2019)

Within IT, investment opportunities are specifically concentrated in the hardware and communications sectors. In industrials, it is in the electrical equipment and building producing sub-sectors while in utilities it is among the water utility entities and within a subset of the independent power companies focused on renewable parks.

From a sector allocation perspective, a model portfolio not only needs to be optimised to avoid carbon transition risk, but, it also needs to be tilted towards sectors that promote the low carbon transition. In a typical model portfolio, this is likely to mean reduced allocations to energy, materials, utilities and real estate and increased allocations to IT, communication services and health care.

Climate transition risk, stress testing and regulatory requirements

Climate change has moved to the top of the political agenda across multiple jurisdictions. This is clearly illustrated by the ambitions of the EU Sustainable Finance Action Plan and the work of the Network for Greening the Financial System (NGFS) which is examining, among other things, how to mitigate the financial stability risks when it comes to climate change. Recent comments from the newly elected heads of the IMF, the European Commission and the European Central Bank indicate that the momentum in this area is only likely to accelerate¹⁴.

For investors, and particularly those operating in Europe, it is becoming a regulatory requirement to integrate ESG and specifically climate risk into the investment process. In addition, from next year, PRI signatories will be required to report under the framework of the Task Force on Climate-related Financial Disclosures (TCFD).¹⁵

This will have significant reach given the growing PRI signatory base. As of October 2019, the number of asset owner and asset manager PRI signatories had hit roughly 2,350 with the US, UK, France, Australia, Canada and the Netherlands constituting almost 60% of total signatories¹⁶.

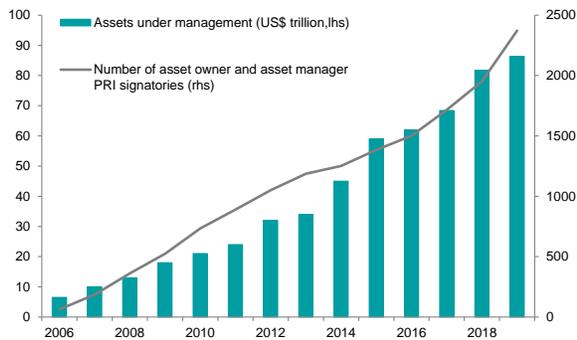
Local regulators and supervisors around the world are also responding, from the large insurance regulators in the US including climate risk assessment in their regulatory reviews¹⁷ to the announcement in September 2019 by the Malaysian central bank that it will require local financial institutions to report on their exposure to climate risks¹⁸.

We expect that efforts in Europe may become a template for other regions in the world. Indeed the launch of the International Platform on Sustainable Finance by the EU in October 2019 will allow organisations and networks from around the world to share, exchange and potentially align initiatives on sustainable finance.

Forecasts are based on assumptions, estimates, views and hypothetical models or analyses, which might prove inaccurate or incorrect

November 2019 — For Qualified Investors (Art. 10 Para. 3 of the Swiss Federal Collective Investment Schemes Act (CISA). For Professional Clients (MiFID Directive 2014/65/EU Annex II) only. For Institutional investors only. Further distribution of this material is strictly prohibited.

Australia: For Professional Investors only

FIGURE 3: PRI SIGNATORIES BY NUMBER AND ASSETS UNDER MANAGEMENT

Source: PRI signatory database (Data as of April each year)

DWS climate risk screening and mandates

Combining multiple data sources is the key capability of DWS's ESG Engine, our proprietary software which integrates six data sources into our investment systems and processes. Our Climate Transition Risk rating methodology is now part of our ESG screening with this methodology is also available for mandates. This therefore extends and complements the existing capabilities within the ESG Engine that includes norms-based screens, sector exclusions, best-in-class and screening according to the United Nations' Sustainable Development Goals among others.

As such this means that the DWS climate risk screening will be applied to all our ESG funds, whereby excessive climate transition risk is avoided (F) and higher levels of risk (E) and unknown risk is limited (to 5% each)

This will have important implications. Our work shows – for a wide capital weighted global universe including emerging markets - that excluding the highest risk band (F) reduces the carbon footprint to 90% yet keeps 99% of the assets since high climate transition risk is correlated with high carbon intensity. Limiting high transition risk ((E) to 5% of the portfolio reduces the footprint to 63% and keeps 94% of the assets and eliminating it all together reduces the footprinting to 32% and keeps 89% of the assets.

When it comes to setting standards for our own ESG labelled funds, this process will set an even higher bar since we will continue to screen to ensure a minimum ESG quality, but we will now include climate transition risk and vice versa. This means that while an issuer might qualify as a climate transition leader, if it violates another ESG aspect, such as it is in breach of UN Global Compact, then this would disqualify it from all DWS ESG labelled funds.

Conclusion

There have been significant advancements in addressing climate transition risk from an investment portfolio perspective in recent years. This has been warranted given the shortcomings of carbon foot-printing as a proxy for climate risk.

The challenge for investors has been to understand the increasing variety of climate transition risk methodologies available in the marketplace followed by the subsequent incorporation of climate risk into the investment process.

By combining the various techniques offered by multiple data providers we aim to capture risk across multiple dimensions that capture carbon intensity metrics, carbon pricing scenarios and climate-related opportunities. This ability to identify climate risks and opportunities at a security, sub-sector and sector level basis allows us to optimize a portfolio that not only reduces climate transition risk, but, also tilts investments towards entities that promote the low carbon transition.

Forecasts are based on assumptions, estimates, views and hypothetical models or analyses, which might prove inaccurate or incorrect

November 2019 — For Qualified Investors (Art. 10 Para. 3 of the Swiss Federal Collective Investment Schemes Act (CISA).For Professional Clients (MiFID Directive 2014/65/EU Annex II) only. For Institutional investors only. Further distribution of this material is strictly prohibited.

Australia: For Professional Investors only

References

- ¹ MSCI (March 2019). Low carbon transition categories and scores
- ² Bank of England-Prudential Regulatory Authority (September 2015). The impact of climate change on the UK insurance sector
- ³ Clyde and Co (March 2019). Climate Change – the evolving landscape of litigation
- ⁴ ISS-Oekom (2019). Climate Risk Rating - Methodology
- ⁵ S&P Trucost (2018). Integrating future carbon price risk into portfolio analysis
- ⁶ World Bank Group (June 2019). State and Trends of Carbon Pricing 2019
- ⁷ CDP (October 2017). Putting a price on carbon
- ⁸ Transition Pathway Initiative (September 2019). Management quality and carbon performance of energy companies
- ⁹ Moody's (September 2019). Framework to assess carbon transition risk for corporate sectors
- ¹⁰ Reuters (15 January 2018).
- ¹¹ Bloomberg NEF (May 2019). Electric Vehicle Outlook 2019
- ¹² For details on this and the European electricity companies discussed, see Carbon Tracker (September 2018). According to their estimates, fossil fuels will peak in the 2020s as renewables look set to supply all growth in energy demand
- ¹³ BP Statistical Review of World Energy (1965-2018)
- ¹⁴ IMF (September 2019). Working Paper 19/185; EU Commission, 2019. Political guidelines for the Next European Commission 2019-2024
- ¹⁵ PRI (February 2019)
- ¹⁶ PRI signatory database (October 2019)
- ¹⁷ NAIC Climate Risk Disclosure Survey, California Department of Insurance
- ¹⁸ Bank Negara Malaysia (September 2019). Governor's keynote speech at the regional conference on climate change

Important information – UK - FOR PROFESSIONAL CLIENTS ONLY

Issued in the UK by DWS Investments UK Limited. DWS Investments UK Limited is authorised and regulated by the Financial Conduct Authority.

Any reference to “DWS”, “Deutsche Asset Management” or “Deutsche AM” shall, unless otherwise required by the context, be understood as a reference to DWS Investments UK Limited including any of its parent companies, any of its or its parents affiliates or subsidiaries and, as the case may be, any investment companies promoted or managed by any of those entities.

This document is a “non-retail communication” within the meaning of the FCA's Rules and is directed only at persons satisfying the FCA's client categorisation criteria for an eligible counterparty or a professional client. This document is not intended for and should not be relied upon by a retail client.

This document is intended for discussion purposes only and does not create any legally binding obligations on the part of DWS Group GmbH & Co. KGaA and/or its affiliates (DWS). Without limitation, this document does not constitute an offer, an invitation to offer or a recommendation to enter into any transaction. When making an investment decision, you should rely solely on the final documentation relating to the transaction and not the summary contained herein. DWS is not acting as your financial adviser or in any other fiduciary capacity in relation to this transaction. The transaction(s) or products(s) mentioned herein may not be appropriate for all investors and before entering into any transaction you should take steps to ensure that you fully understand the transaction and have made an independent assessment of the appropriateness of the transaction in the light of your own objectives and circumstances, including the possible risks and benefits of entering into such transaction. For general information regarding the nature and risks of the proposed transaction and types of financial instruments please go to <https://www.db.com/company/en/risk-disclosures.htm>. You should also consider seeking advice from your own advisers in making this assessment. If you decide to enter into a transaction with DWS, you do so in reliance on your own judgment.

Although information in this document has been obtained from sources believed to be reliable, we do not guarantee its accuracy, completeness or fairness, and it should not be relied upon as such. All opinions and estimates herein, including forecast returns, reflect our judgment on the date of this document and are subject to change without notice and involve a number of assumptions which may not prove valid.

Any opinions expressed herein may differ from the opinions expressed by Deutsche Bank AG and/or any other of its affiliates (DB). DB may engage in transactions in a manner inconsistent with the views discussed herein. DB trades or may trade as principal in the instruments (or related derivatives), and may have proprietary positions in the instruments (or related derivatives) discussed herein. DB may make a market in the instruments (or related derivatives) discussed herein.

DWS SPECIFICALLY DISCLAIMS ALL LIABILITY FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL OR OTHER LOSSES OR DAMAGES INCLUDING LOSS OF PROFITS INCURRED BY YOU OR ANY THIRD PARTY THAT MAY ARISE FROM ANY RELIANCE ON THIS DOCUMENT OR FOR THE RELIABILITY, ACCURACY, COMPLETENESS OR TIMELINESS THEREOF.

This document has been prepared without consideration of the investment needs, objectives or financial circumstances of any investor. Before making an investment decision, investors need to consider, with or without the assistance of an investment adviser, whether the investments and strategies described or provided by DWS, are appropriate, in light of their particular investment needs, objectives and financial circumstances. Furthermore, this document is for information/discussion purposes only and does not constitute an offer, recommendation or solicitation to conclude a transaction and should not be treated as giving investment advice.

DWS does not give tax or legal advice. Investors should seek advice from their own tax experts and lawyers, in considering investments and strategies suggested by DWS. Investments with DWS are not guaranteed, unless specified. Investments are subject to various risks, including market fluctuations, regulatory change, counterparty risk, possible delays in repayment and loss of income and principal invested. The value of investments can fall as well as rise and you may not recover the amount originally invested at any point in time. Furthermore, substantial fluctuations of the value of the investment are possible even over short periods of time.

This document contains forward looking statements. Forward looking statements include, but are not limited to assumptions, estimates, projections, opinions, models and hypothetical performance analysis. The forward looking statements expressed constitute the author's judgment as of the date of this material. Forward looking statements involve significant elements of subjective judgments and analyses and changes thereto and/or consideration of different or additional factors could have a material impact on the results indicated. Therefore, actual results may vary, perhaps materially, from the results contained herein. No representation or warranty is made by DWS as to the reasonableness or completeness of such forward looking statements or to any other financial information contained herein. The terms of any investment will be exclusively subject to the detailed provisions, including risk considerations, contained in the offering documents.

This document may not be reproduced or circulated without our written authority. The manner of circulation and distribution of this document may be restricted by law or regulation in certain countries, including the United States. This document is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any locality, state, country or other jurisdiction, including the United States, where such distribution, publication, availability or use would be contrary to law or regulation or which would subject DWS to any registration or licensing requirement within such jurisdiction not currently met within such jurisdiction. Persons into whose possession this document may come are required to inform themselves of, and to observe, such restrictions.

PAST PERFORMANCE IS NO GUARANTEE OF FUTURE RESULTS.

© DWS Investments UK Limited 2019.

Important information – EMEA

This marketing communication is intended for professional clients only.

DWS is the brand name under which DWS Group GmbH & Co. KGaA and its subsidiaries operate their business activities. Clients will be provided DWS products or services by one or more legal entities that will be identified to clients pursuant to the contracts, agreements, offering materials or other documentation relevant to such products or services.

The information contained in this document does not constitute investment advice.

All statements of opinion reflect the current assessment of DWS International GmbH and are subject to change without notice.

Forecasts are not a reliable indicator of future performance. Forecasts are based on assumptions, estimates, opinions and hypothetical performance analysis, therefore actual results may vary, perhaps materially, from the results contained here.

Past performance, [actual or simulated], is not a reliable indication of future performance.

The information contained in this document does not constitute a financial analysis but qualifies as marketing communication. This marketing communication is neither subject to all legal provisions ensuring the impartiality of financial analysis nor to any prohibition on trading prior to the publication of financial analyses.

This document and the information contained herein may only be distributed and published in jurisdictions in which such distribution and publication is permissible in accordance with applicable law in those jurisdictions. Direct or indirect distribution of this document is prohibited in the USA as well as to or for the account of US persons and persons residing in the USA.

DWS International GmbH. As of: November 2019.

Important Information – APAC

DWS is the brand name of DWS Group GmbH & Co. KGaA. The respective legal entities offering products or services under the DWS brand are specified in the respective contracts, sales materials and other product information documents. DWS Group GmbH & Co. KGaA, its affiliated companies and its officers and employees (collectively “DWS Group”) are communicating this document in good faith and on the following basis.

This document has been prepared without consideration of the investment needs, objectives or financial circumstances of any investor. Before making an investment decision, investors need to consider, with or without the assistance of an investment adviser, whether the investments and strategies described or provided by DWS Group, are appropriate, in light of their particular investment needs, objectives and financial circumstances. Furthermore, this document is for information/discussion purposes only and does not constitute an offer, recommendation or solicitation to conclude a transaction and should not be treated as giving investment advice.

DWS Group does not give tax or legal advice. Investors should seek advice from their own tax experts and lawyers, in considering investments and strategies suggested by DWS Group. Investments with DWS Group are not guaranteed, unless specified.

Investments are subject to various risks, including market fluctuations, regulatory change, possible delays in repayment and loss of income and principal invested. The value of investments can fall as well as rise and you might not get back the amount originally invested at any point in time. Furthermore, substantial fluctuations of the value of the investment are possible even over short periods of time. The terms of any investment will be exclusively subject to the detailed provisions, including risk considerations, contained in the offering documents. When making an investment decision, you should rely on the final documentation relating to the transaction and not the summary contained herein. Past performance is no guarantee of current or future performance. Nothing contained herein shall constitute any representation or warranty as to future performance.

Although the information herein has been obtained from sources believed to be reliable, DWS Group does not guarantee its accuracy, completeness or fairness. No liability for any error or omission is accepted by DWS Group. Opinions and estimates may be changed without notice and involve a number of assumptions which may not prove valid. All third party data (such as MSCI, S&P, Dow Jones, FTSE, Bank of America Merrill Lynch, Factset & Bloomberg) are copyrighted by and proprietary to the

provider. DWS Group or persons associated with it may (i) maintain a long or short position in securities referred to herein, or in related futures or options, and (ii) purchase or sell, make a market in, or engage in any other transaction involving such securities, and earn brokerage or other compensation.

The document was not produced, reviewed or edited by any research department within DWS Group and is not investment research. Therefore, laws and regulations relating to investment research do not apply to it. Any opinions expressed herein may differ from the opinions expressed by other DWS Group departments including research departments. This document may contain forward looking statements. Forward looking statements include, but are not limited to assumptions, estimates, projections, opinions, models and hypothetical performance analysis. The forward looking statements expressed constitute the author's judgment as of the date of this material. Forward looking statements involve significant elements of subjective judgments and analyses and changes thereto and/or consideration of different or additional factors could have a material impact on the results indicated. Therefore, actual results may vary, perhaps materially, from the results contained herein. No representation or warranty is made by DWS Group as to the reasonableness or completeness of such forward looking statements or to any other financial information contained herein.

This document may not be reproduced or circulated without DWS Group's written authority. The manner of circulation and distribution of this document may be restricted by law or regulation in certain countries.

This document is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any locality, state, country or other jurisdiction, where such distribution, publication, availability or use would be contrary to law or regulation or which would subject DWS Group to any registration or licensing requirement within such jurisdiction not currently met within such jurisdiction. Persons into whose possession this document may come are required to inform themselves of, and to observe, such restrictions.

Unless notified to the contrary in a particular case, investment instruments are not insured by the Federal Deposit Insurance Corporation ("FDIC") or any other governmental entity, and are not guaranteed by or obligations of DWS Group.

In Hong Kong, this document is issued by DWS Investments Hong Kong Limited and the content of this document has not been reviewed by the Securities and Futures Commission.

© 2019 DWS Investments Hong Kong Limited

In Singapore, this document is issued by DWS Investments Singapore Limited and the content of this document has not been reviewed by the Monetary Authority of Singapore.

© 2019 DWS Investments Singapore Limited

Compliance Code CRC: 071792

8 November 2019