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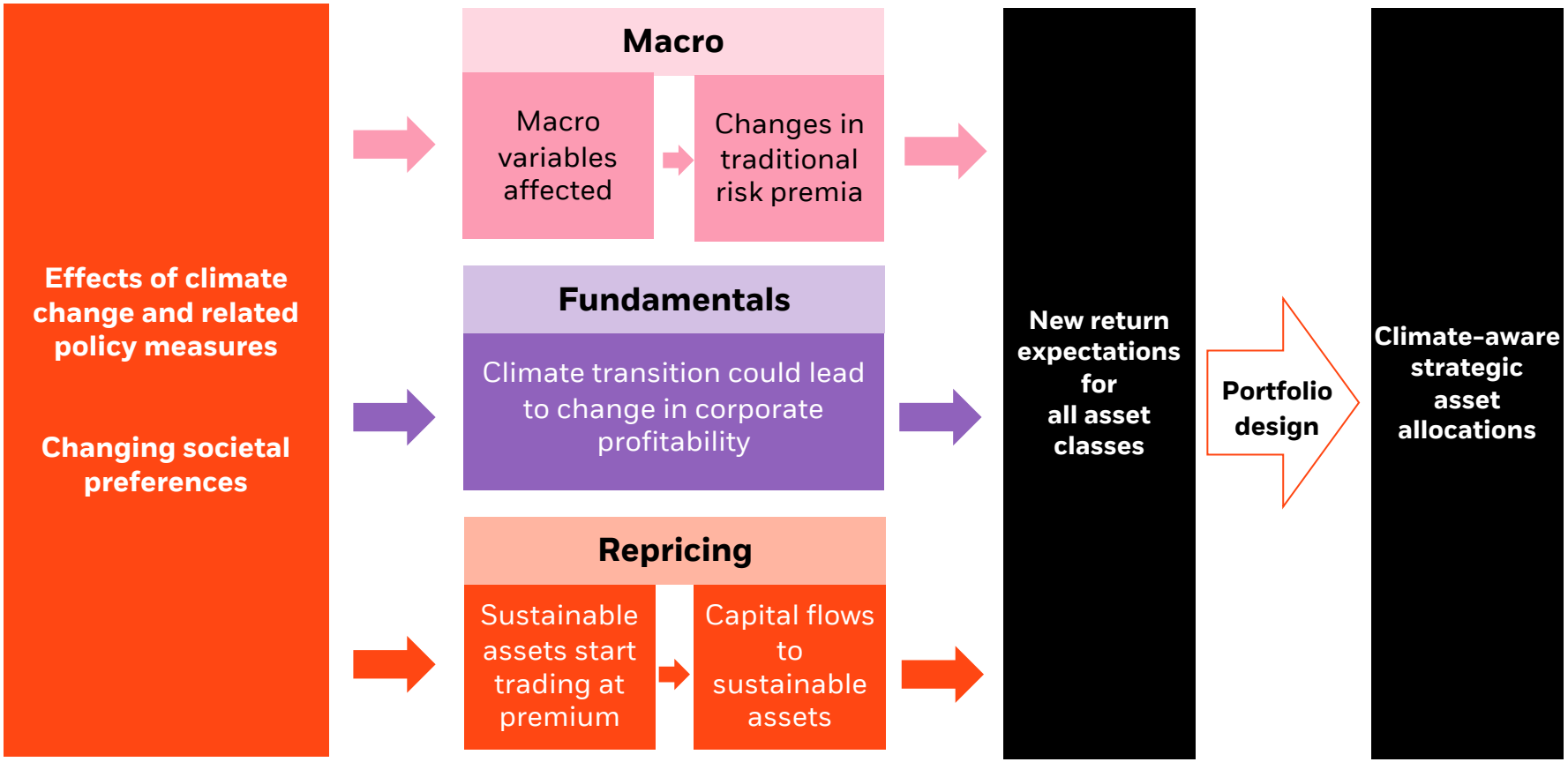
BlackRock

Climate Aware Capital Market Assumptions

A framework for climate-aware portfolio construction

We redesign our macroeconomic assumptions and incorporate the impacts of climate change on long-term asset returns through 3 channels: macro, repricing and fundamentals. The result: climate-aware strategic portfolios

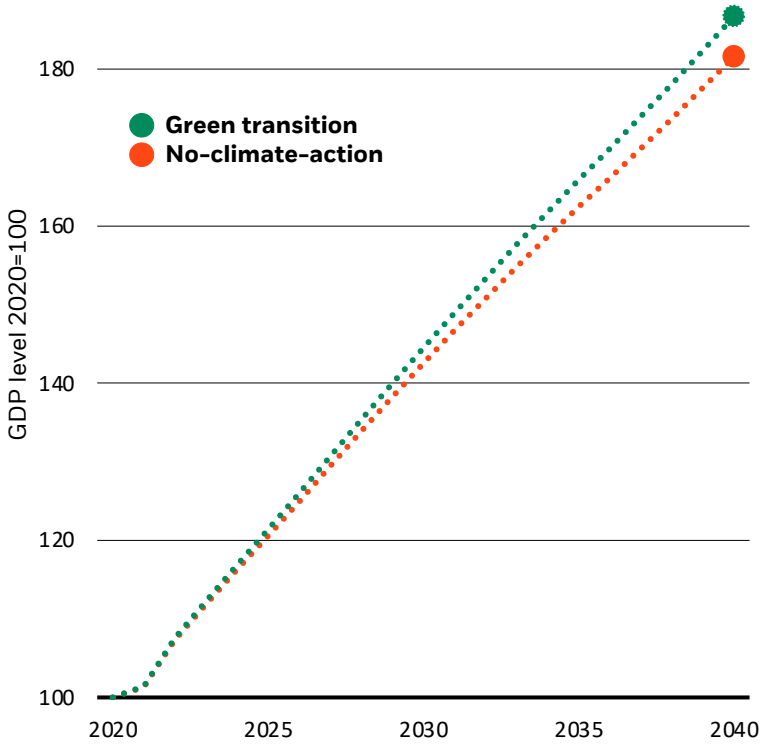
Framework for climate-aware portfolios

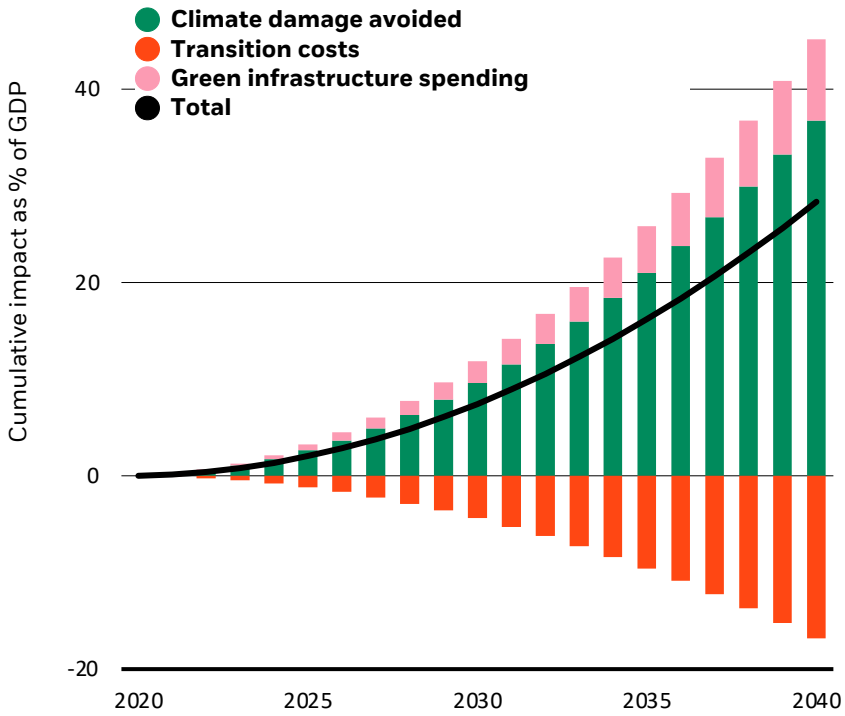


BlackRock Investment Institute, Feb 2021. Climate-aware capital market assumptions incorporate the impacts of climate change on macroeconomic variables and asset class returns, in addition to traditional return drivers.

Avoiding climate change damages means an improved growth outlook – once compared to the true alternative

Estimated GDP paths and cumulative impact as a percentage of GDP under two scenarios for China, 2020-40



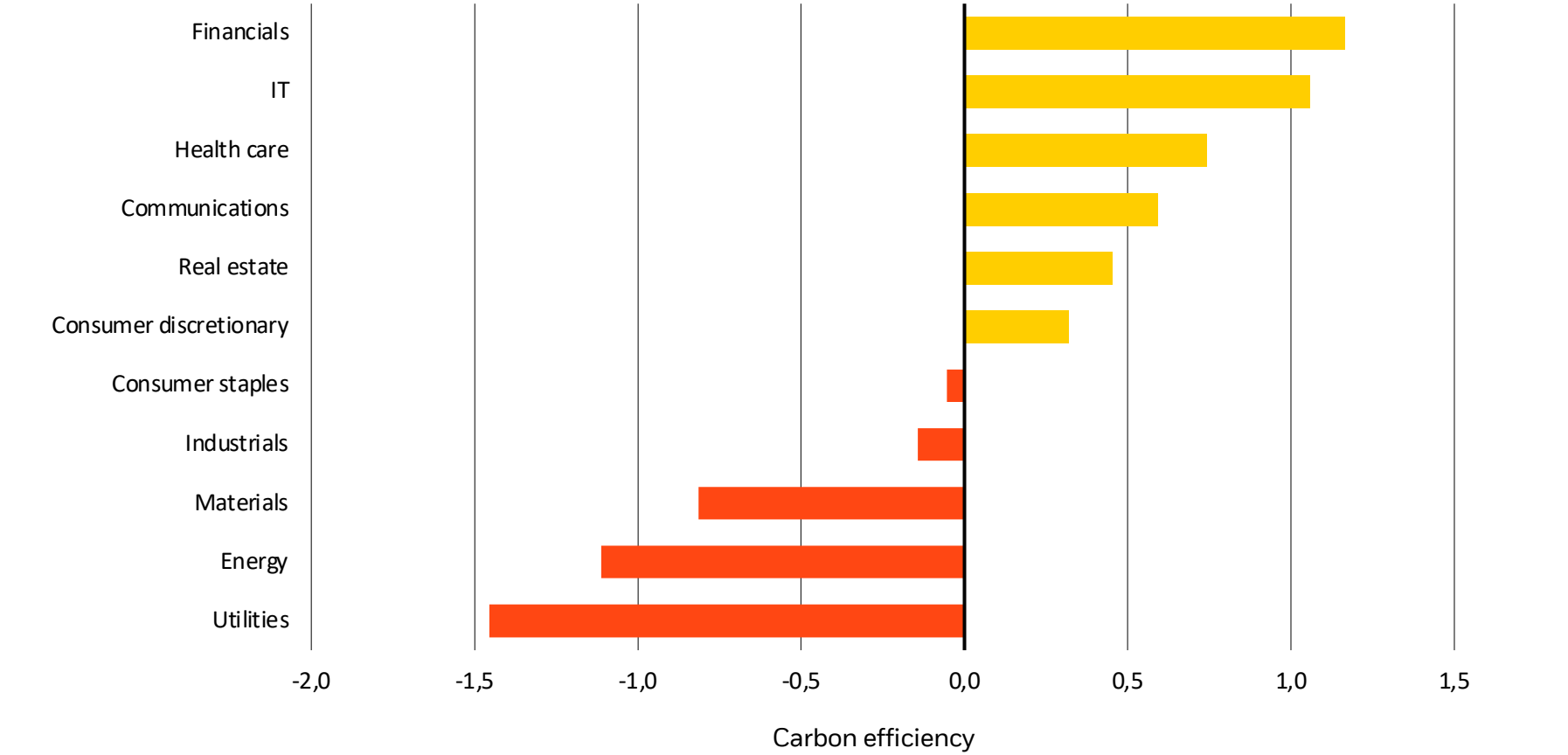


Forward looking estimates may not come to pass. Sources: BlackRock Investment Institute, Banque de France, International Energy Agency, OECD, January 2021. Notes: The chart on the left shows our estimated path for China's GDP over the next 20 years under the two mentioned scenarios. GDP levels are rebased to 100 as of 2020. The chart on the right shows the cumulative impact on long-term GDP under a green transition relative to a no-climate-action scenario. The bars show the overall estimated impact of three factors – avoidance of climate damages (positive), green infrastructure spending (positive) and costs associated with the transition (negative). The black line shows the estimated net impact. Our estimates of the impact under a climate-aware scenario are based on expected changes in energy consumption including composition, relative carbon and renewables pricing and on potential losses due to global warming. Energy consumption is estimated as a function of GDP and the relative price of energy per the Banque de France's working paper no. 759 titled the Long-term growth impact of climate change and policies. GDP losses from global warming are calibrated on analysis of Impact Assessment Models per W. Nordhaus and A..Moffat (2017). We assume green infrastructure spending programs of 1% of GDP gradually phased out over the next 10 years.

It is not yet fully in the price

As climate risk is recognised as investment risk, we believe asset cost of capital will adjust to reflect climate risks and will drive relative returns. Carbon emission intensity is widely used by investors as an indicator of sustainability of companies.

Estimated carbon efficiency for MSCI USA sectors, February 2021

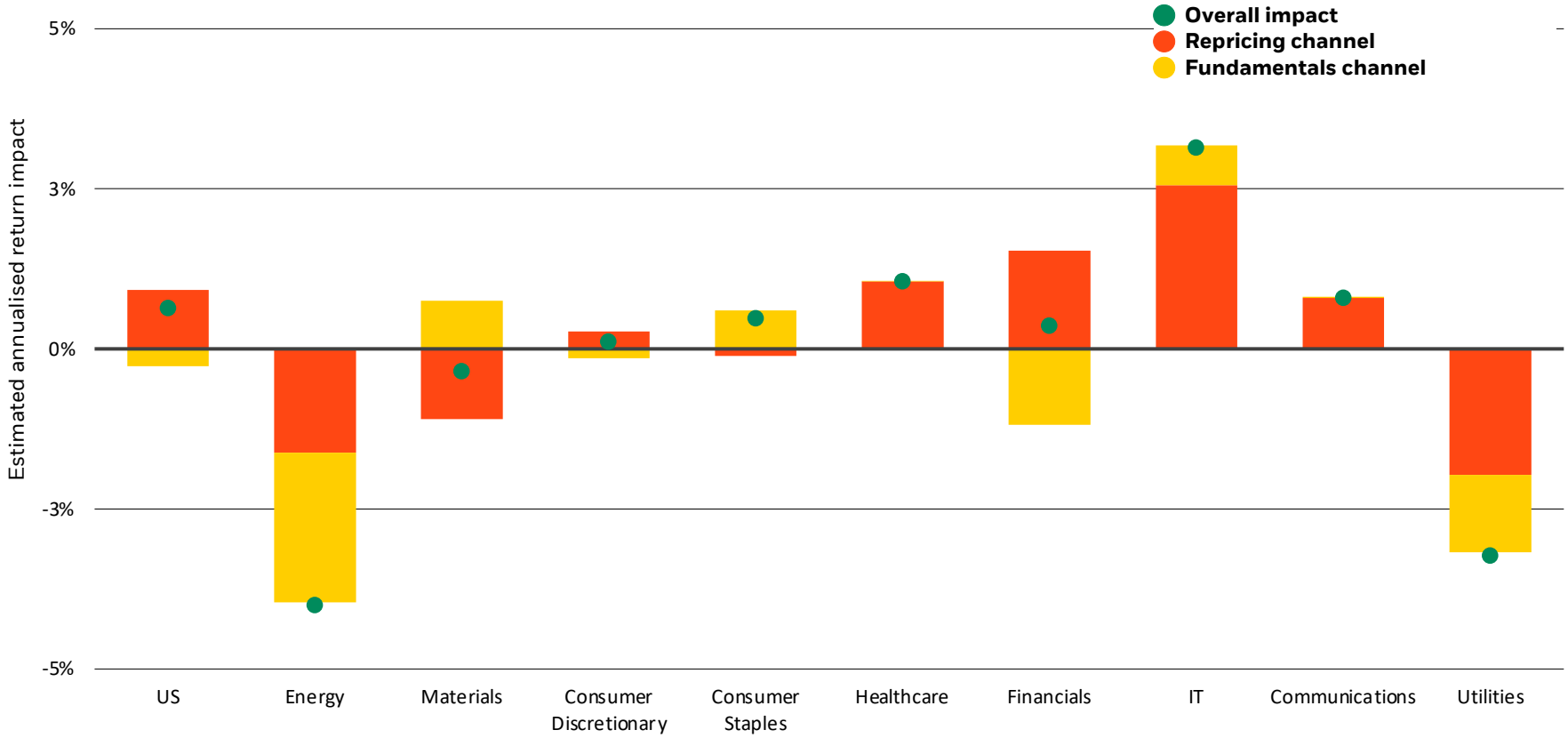


Indexes are unmanaged and do not account for fees. It is not possible to invest directly in an index. This information is not intended as a recommendation to invest in any particular asset class or strategy or as a promise - or even estimate - of future performance. Sources: BlackRock Investment Institute with data from Refinitiv Datastream and MSCI, February 2021, Notes: The chart shows the carbon efficiency measured as total carbon emissions relative to the aggregate firm value for the sectors of the MSCI USA index. The carbon efficiency measure is shown in Z-score terms – or in relation to the mean across sectors. Both Scope 1 (direct emissions from owned or controlled sources) and Scope 2 (indirect emissions from electricity purchased) are considered. These can help gauge the exposure of companies to carbon pricing initiatives as part of climate change mitigation policies.

Fundamentals channel presents risks and opportunities

We believe the transition to a low carbon economy will involve wide-reaching policy, regulatory and behavioural change and innovation. This could impact profitability and growth opportunities - creating sector winners and losers

Estimated 5-year expected return differential for MSCI U.S. sectors in green transition vs no-climate-action, Feb 2021

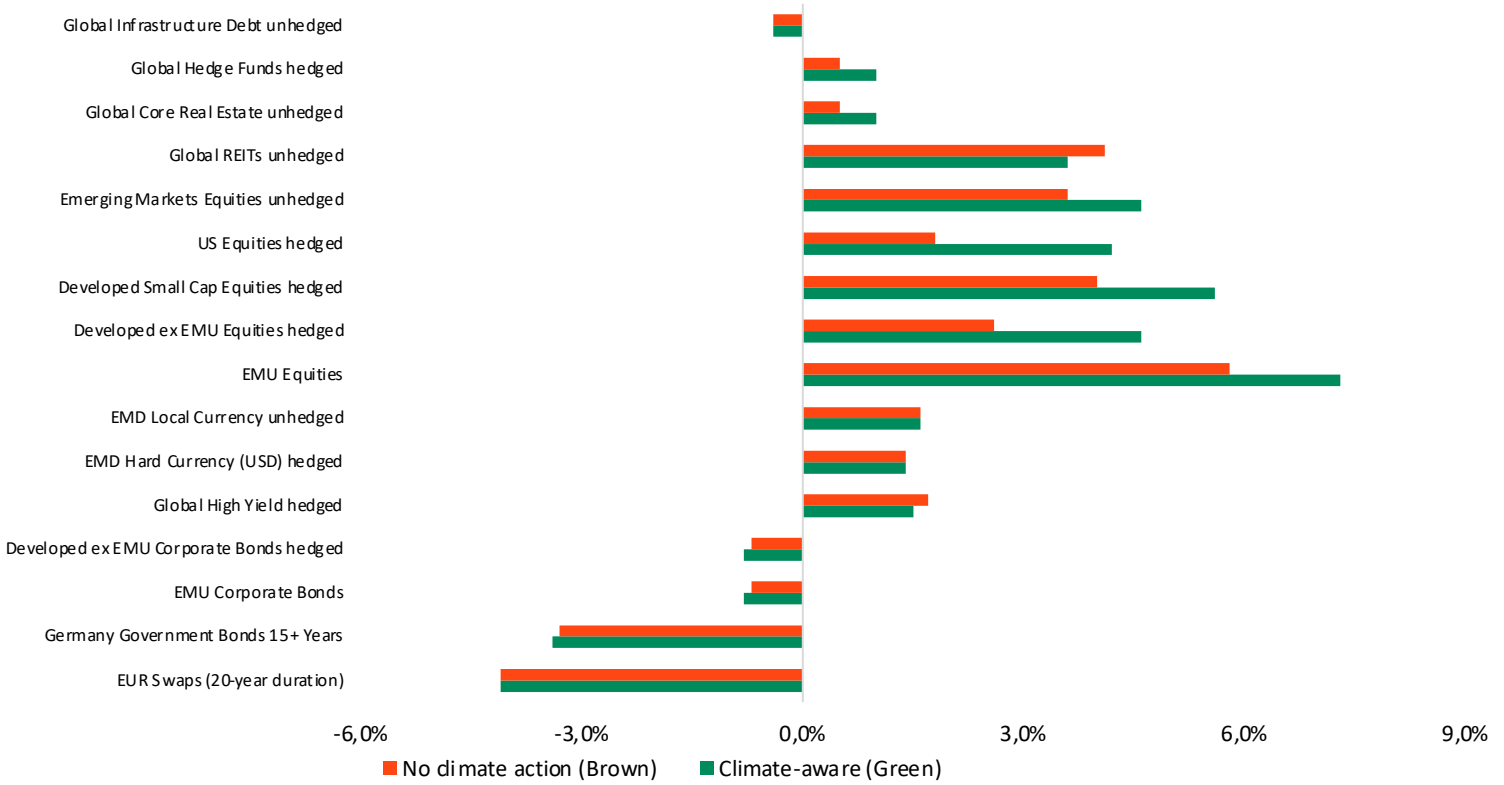


This information is not intended as a recommendation to invest in any particular asset class or strategy or as a promise - or even estimate - of future performance. Sources: BlackRock Investment Institute, with data from Refinitiv Datastream and Bloomberg, February 2021. Notes: The chart shows the difference in five-year U.S. dollar expected returns for the highest sub-category of MSCI USA sectors under two economic scenarios - a green transition and a no-climate-action scenario. The difference in expected return is attributable to repricing – the return impact of changing cost of capital - and fundamentals – or the return impact of changing earnings per share growth.

Climate change impacts all asset returns

A green transition is favourable for risk assets to a no-climate-action scenario. Explicitly accounting for uncertainty is crucial in gauging the impact of climate change on expected returns.

Brown versus Green CMA's, MT (5yr) Return



Source: BlackRock as of November 2021. Risk is based on 248 monthly constantly weighted observations, and expected returns based on Q2 2021 5-years and 20-years Capital Market Assumptions in geometric terms, public assets gross of estimated fees, private assets net of estimated fees, excluding alpha from active management. Figures subject to rounding. For illustrative purposes only.

Appendix

Appendix

Indexes represented on slide 10

European equities: MSCI Europe index

EM equities: MSCI Emerging markets index

U.S. equities: MSCI USA index

China equities: MSCI China index

EM debt, local: JP Morgan GBI-EM index

EM debt, USD: JP Morgan EMBI Global Diversified Index

China government bonds: Bloomberg Barclays China Treasury + Policy Bank Total Return Index

High yield debt: BofA Merrill Lynch Global High Yield Index

Inflation-linked bonds: Bloomberg Barclays US Government Inflation-Linked Bond Index

Government bonds: Bloomberg Barclays Government Index

Credit: Bloomberg Barclays U.S. Credit Index

Ex-U.S. gov bonds: Bloomberg Barclays Global Aggregate Treasury Index ex US

Credit (10+ years): Bloomberg Barclays Long Credit index

Indexes represented on slide 11

Inflation-linked bonds: Bloomberg Barclays US Government Inflation-Linked Bond Index

Chinese government bonds: Bloomberg Barclays China Treasury + Policy Bank Total Return Index

Developed market equity: MSCI USA Index, MSCI Europe ex-UK Index, MSCI UK Index, MSCI Japan Index, MSCI Pacific ex Japan Index

Emerging market equity: MSCI Emerging markets ex China index, MSCI China index, MSCI China A-share index

DM high yield and EM debt: BofA Merrill Lynch Global High Yield Index, JP Morgan GBI-EM index, JP Morgan EMBI Global Diversified Index

Mortgage backed securities: Bloomberg Barclays US MBS Index

Global IG credit: BBG Barc Euro Aggregate Corporate Index, ICE BofA Sterling Corporate Securities Index , ICE BofA Japan Corporate Index, BBG Barc U.S. Credit Index

DM governments: BBG Barc Government Index, BBG Barc Global Aggregate Euro Treasury Index, FTSE Actuaries UK Conventional Gilts All Stocks Index, ICE BofA Japanese Governments (G0Y0) Index

Appendix

Methodology for incorporate climate change impacts in capital market assumptions

Our macroeconomic and asset return forecasts account for the impacts of climate change in the following ways:

Repricing channel

- We believe the structural shift toward sustainable investing is not yet priced in. Over coming years we expect assets perceived to be more sustainable to command a premium over less green counterparts, assuming all else is equal. We estimate the impact of this repricing in two stages: first, we arrive at a measure of a company or issuer's carbon footprint and second, use this measure to estimate a change in cost of capital.
- We use direct and indirect carbon emissions as our preferred proxy for the cost of capital. Carbon emissions are a consistently and widely reported metric. Broad carbon emissions data across companies is lagged by up to two years, so we estimate the emissions today using the most recent observation and the rate of change over time. We find that future carbon emissions can be estimated up to three years using both the level and trend of today's emissions. We further refine the metric by focusing on carbon emissions *intensity* by measuring emissions against a company's enterprise value – the sum of a firm's market capitalization and debt obligations. Focusing purely on the absolute level of emissions would unfairly penalize large firms. Considering enterprise value also brings debt into the equation, allows us to apply the analysis to both equity and credit. We use z-scores to normalize the data sets to be comparable across sectors and assets classes given the highly skewed nature of carbon metrics. We also scale a sector's carbon intensity score with -3 as the least green to +3 the most green to derive a sustainability premium.
- We assume those sectors with highest carbon intensity will experience rising cost of capital and those with lowest intensity will experience falling cost of capital. Based on an estimate of the difference in cost of capital between the most and least carbon efficient companies once climate change impacts are fully priced in, we calibrated the change in cost of capital for all regional equity sectors and regional markets.
- Our equity expected returns are estimated using an augmented dividend discount model. The change in cost of capital is introduced to the dividend discount model, to estimate the impact of the 'repricing channel'.

Fundamental channel

- Climate change and the efforts to address it will impact the profitability and growth prospects of companies. We estimate the impact on corporate earnings at the sector level of a green transition. To arrive at our estimates, we first assess the sensitivity of earnings to carbon pricing initiatives, which we expect to be a core tenet of climate mitigation policies. We assume a carbon tax of $125 in 20 years - consistent with our green transition scenario. The impact on each firm's earnings is calculated based on the expected tax on its own emissions (Direct Cost), the increase in its own energy costs (Indirect Cost), the expected passthrough of the tax and the expected abatement of emissions in response to rising carbon cost.
- In our fundamental channel, we also take account of the physical and transition risks and opportunities that could impact earnings across 34 industries.
- The return estimates are uncertain in nature – quantifying the impact of climate change (through physical and transition risk) is often challenging as there is no historical precedent. We acknowledge certain limitations of our model. We assume that no carbon tax is already priced in and so the introduction of carbon taxes would likely be a drag on prices.

Appendix

Macroeconomic model methodology

We use a long-run model of climate change that allows us to account for the physical damages, energy transition and the impact of public policies and their impact on macro variables, such as level of GDP, in a single, transparent framework. We combine our long-term growth framework with a detailed energy component with long term climate dynamics and the repercussions on economic activity.

We project the impact on GDP level in a macroeconomic climate model for 30 countries/regions using our long-term growth model based on the three factors of production: labor, capital and energy and assume a constant elasticity of substitution – in other words, there is no change in estimated impact if one factor is substituted for the other. We use the Advanced Climate Change Long-term (ACCL) assumptions set out in Banque de France's 2020 paper (Claire et al, 2020) as a starting point for estimates of the impact from climate change. These assumptions use a set of widely accepted calibrations regarding climate sensitivity, carbon emission factors, energy substitutability and efficiency, carbon storage and sequestration and regional attributions of damages in modelling different carbon pricing policies. We further augment these estimates to reflect more recent developments in energy technology based on research from Rhodium Group and Goldman Sachs. The GDP losses from global warming are calibrated on an analysis of Impact Assessment Models by Nordhaus at al (2017). Country-specific energy consumption is estimated as a function of GDP and changes in the relative price of energy (per the Banque de France estimates), while the relative price of energy is computed using the International Energy Agency's (IEA) energy prices (including taxes) and OECD GDP deflators, and projected forward using user-defined carbon and renewables pricing assumptions. Energy consumption is converted into CO2 emissions using IEA data and default emission factors collected from the Covenant of Mayors for Climate and Energy Report. The global stock of CO2 in the atmosphere is converted into a global temperature increase using the greenhouse gas trajectory adopted by the UN Intergovernmental Panel on Climate Change in 2014. The table below shows our assumptions for our two main scenarios: a green transition (our base case) and no-climate-action.

The positive effect of a green transition relative to the no climate action scenario rests on the gradual phasing in of carbon pricing consistent with the Paris Agreement, green infrastructure spending programmes (gradually phased out over ten years) and subsidies on renewable energy. We estimate the net impact of a green transition over the next 20 years to be positive at the global level but with regional divergences. The tables shows the specific assumptions we make for each scenario.

Appendix

Green transition vs no-climate-action scenario assumptions

	Green transition	No-climate-action scenario
Global temperature by 2100	Broadly within that of Paris Agreement at a global temperature increase of 1.9 degrees Celsius in 2100	Materially higher increase in global temperatures of 5.8 degrees Celsius, a more sensitive economic damage function and release of 2 Gigatons from natural carbon sinks to get to climate damages of 27% by 2100 (consistent with the upper end of the range considered by the Network for Greening the Financial System).
Climate policies assumed within the our adjusted ACCL model	Gradual increase in carbon pricing of 3% per year and in renewables subsidies of 1% per year	None
Fiscal policy assumptions beyond the ACCL model	Green infrastructure spending of 5% of GDP over 10 years, using country specific IMF multipliers, adjusting for historical implementation gaps	None
Updated carbon abatement costs since ACCL model was calibrated	Adding the 20% reduction in carbon abatement costs as estimated by Goldman Sachs	None

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