



Alan Hsu

Equity Portfolio Manager and Global Industry Analyst — Energy, Renewables, and Utilities

As a member of the Utilities/Energy team, **Alan** conducts fundamental analysis and research on utilities and energy, including sustainable energy and clean technology. He is also a portfolio manager of our Global Environmental Opportunities approach, a dedicated, climate-focused impact strategy. Alan works in our Boston office.

KEY POINTS

- Climate change is an asymmetric, systemic, and largely unaddressed risk for investors.
- Climate-related asset repricing may be inevitable, potentially leading to widespread dispersion of security values.
- In our view, investors do not need to believe in climate change to recognize that addressing the risks and opportunities in their portfolios is good capital stewardship.
- Companies focused on climate change mitigation and adaptation are an evolving investment opportunity set.

Brewing storm: Are investors discounting climate risks and opportunities?

Investors are often drawn to social, technological, or economic trends that they think may offer lasting opportunities and the potential for investment returns. From e-commerce to big data to Chinese consumption, many durable themes have the potential to cause substantial asset repricing. In our opinion, prudent capital allocation compels asset owners to remain vigilant of such trends, given the potential for new risks and opportunities to arise over time.

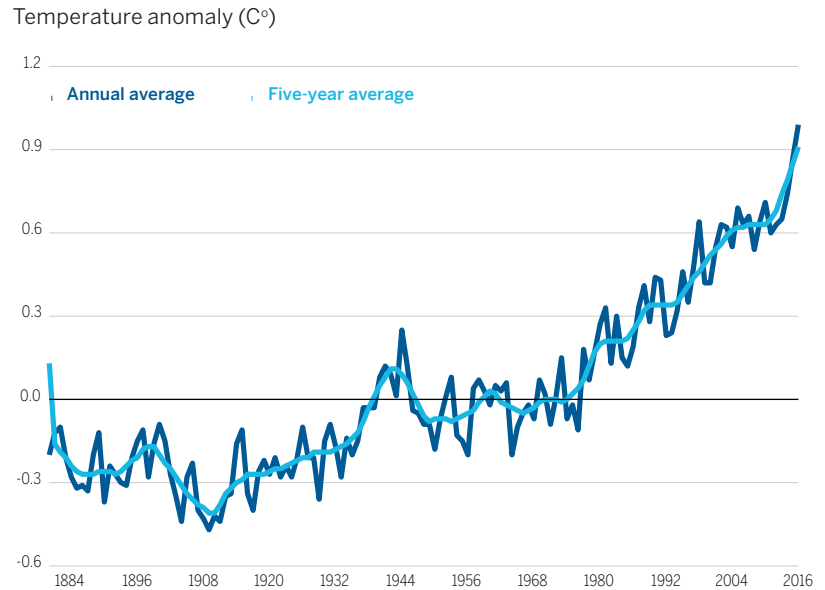
Today, one powerful, non-mean-reverting trend that we think many investors are ignoring is climate change. The scientific community is largely in agreement that climate risks — and attendant financial risks — are real, meaningful, and likely to become more acute over time. From our perspective, it is clear that the combination of increasing climate risks, greater corporate liability, and investor indifference has resulted in significant asset mispricing. Asset owners may want to consider a proactive, climate-dedicated approach that seeks to identify companies focused on climate change mitigation and adaptation.

Rising temperatures have dire consequences

Global temperatures have been rising for decades and now appear to be accelerating — with no sign of mean reversion (**FIGURE 1**). A hotter world has innumerable potential consequences for humankind and the economy. Climate researchers have warned of catastrophic scenarios, including rising sea levels that inundate coastal cities, large-scale crop failures that can cause famine, waves of climate refugees migrating to temperate regions, unsustainable pressure on aging infrastructure and power grids, and the mass extinction of many plants and animals, which would further alter our ecosystem. In our opinion, investors who continue to underestimate or ignore climate risks may do so at their own financial peril — and that of their clients.

Research indicates that by the end of the century, financial asset losses from rising global temperatures could reach US\$43 trillion in present-value terms — or 30% of the world’s entire stock of manageable assets.¹

FIGURE 1
Climate change is a trend without mean reversion



As of 31 December 2016 | Source: National Aeronautics and Space Administration

Exacerbating the economic and physical risk of climate change is the continual shift of urban population centers to low-lying coastal regions. According to the National Oceanic and Atmospheric Administration (NOAA), US coastal areas have become much more crowded than the rest of the country. In 2010, the US Census Bureau reported that from 1960 to 2008, the US coastal population grew by 40 million people, an 83% increase. Housing units along the US coast rose by 100% during that same period, from 16 million to over 33 million.² The global picture is the same. One study found that population density for low-elevation coastal zones is five times higher than the global density average — and is expected to quadruple by 2030.³

More population density means more economically valuable, physical-capital stock is at risk of flooding from weather events or sea-level rise. Urbanization has exacerbated flooding concerns by hampering coastal cities’ ability to withstand natural disasters. Heavy rainfall and storm surges from hurricanes create drainage challenges in heavily developed areas, as asphalt and concrete aren’t porous enough to absorb water. And it’s not just infrastructure or personal property that is at risk. For example, according to NOAA, each year US coastal communities “produce more than US\$7.9 trillion in goods and services, employ 54.6 million people, and pay US\$3.2 trillion in wages.”⁴ Again, the threat of disruption to economic activity is enormous and is by no means unique to the US. The OECD estimates coastal flooding in large port cities including Shanghai and Mumbai could put up to US\$35 trillion in property and infrastructure at risk by 2070.⁵

¹“The cost of inaction: Recognising the value at risk from climate change,” The Economist Intelligence Unit, 2015.

²<https://www.census.gov/topics/preparedness/about/coastal-areas.html>

³Neumann, B, et al. “Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding: A Global Assessment,” PLOS, March 2015.

⁴Total Economy of Coastal Areas, NOAA, 2017.

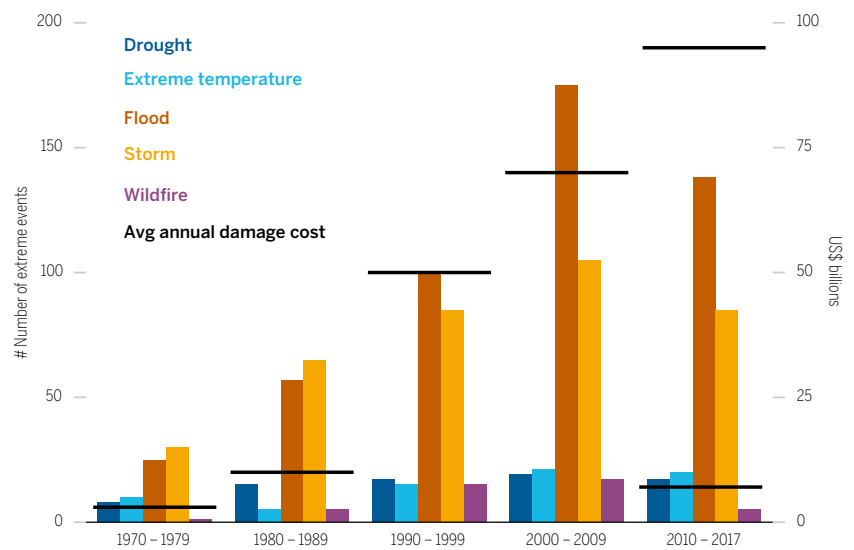
⁵“Climate change could triple population at risk from coastal flooding by 2070,” OECD, April 2007. This data has not been updated by OECD in recent years; however, we believe the estimate presented is still accurate.

Recovery costs from the 2017 US wildfires and hurricanes could top US\$50 billion.⁸

Hurricane Harvey was the third “500-year” flood to hit Houston, Texas, since 1979.⁹

These trends — rising climate-related risks and greater vulnerability of physical and economic capital in the most climate-susceptible regions — have elevated the cost of natural disasters. FIGURE 2 shows the growing frequency and annual costs in the US of extreme weather events, with storms and floods accounting for the vast majority of weather-related disasters. Annually, since the start of the decade, the world has experienced between 25 and 40 weather events costing at least a billion dollars, with several of those costing many times that amount.⁶ The UN reports that between 1995 and 2015, 90% of disasters were linked to climate change at an annual cost of between US\$250 billion and US\$500 billion.⁷

FIGURE 2
Damaging climate events are becoming more frequent and costly



Data through 4 May 2017 | Source: EM-DAT Database

Climate risk focus implies inevitable asset repricing

Markets seem to woefully underappreciate the systemic risk of climate change, and in our view, asset prices do not appropriately reflect this long-term global threat. There is now growing urgency to act, with many national governments implementing policy changes intended to mitigate and prepare for climate risk. As of this writing, more than 170 countries have ratified the 2015 Paris Agreement, for example. Many US cities and nonstate actors — including corporates — have begun to pay closer attention to climate risk. Some institutional investors in Europe and the US are already making asset allocation decisions based on carbon/climate risk exposure. Carbon trading, which exists in many regional markets today, will expand in coming years: China has declared plans to implement carbon-trading markets before the end of the decade, as has the Dutch government.

Recognizing that inadequate information on climate risks can lead to misallocation of resources and mispricing of assets, the G20 asked the Financial Stability Board (FSB) in 2015 to research ways in which the financial sector can account for climate-related issues. The FSB called on the Task Force for Climate-Related Financial Disclosures to develop climate disclosures that promote “informed investment, credit, or lending and insurance underwriting decisions.”¹⁰

⁶“Annual Global Climate and Catastrophe Report,” Aon Benfield, 2016. (Costs are adjusted for inflation.)

⁷United Nations Office for Disaster Risk Reduction.

⁸“House approves \$36.5 billion hurricane and wildfire package,” *The New York Times*, 12 October 2017. (Estimates based on Congressional appropriations.)

⁹“How to cope with floods,” *The Economist*, 2 September 2017.

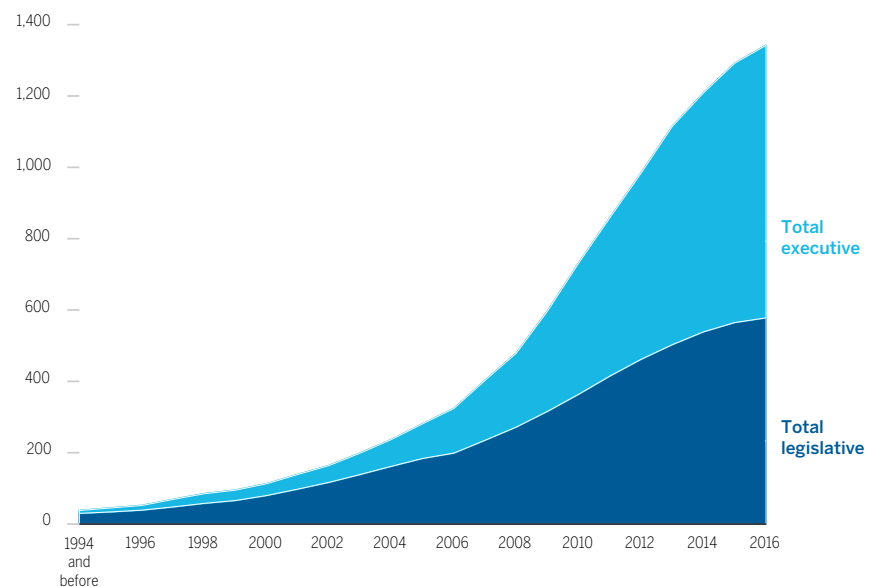
This would in turn allow stakeholders “to better understand the concentrations of carbon-related assets in the financial sector and the financial system’s exposures to climate risks.”¹¹ Two years later, in early 2017, the Task Force released a set of disclosure recommendations highlighting key climate risks and describing opportunities for investment in resource efficiency and resilience.

Over time, we believe financial markets will likely embrace such financial disclosures and recalibrate their views of asset values as a result. The Asset Owners Disclosure Project reported that fewer than 10% of investors calculate their portfolios’ carbon footprints.¹² As disclosure and reporting make climate risk more apparent, large portions of investors’ portfolios could be in more jeopardy, particularly if climate awareness results in a secular rerating of assets. Specifically, equities of companies bearing greater-than-appreciated climate risk may trade at discount rates that are too low today, so holding all else equal, those companies could be perceived as less valuable as climate-risk premiums rise. The opposite would hold true for carbon-advantaged companies. Pervasive asset repricing should also result in broad dispersion of security values across sectors, widening the gap between potential climate “winners” and “losers.”

Finally, an even more worrisome aspect of climate change that asset owners may need to incorporate into their risk-management framework is climate liability. The proliferation of carbon-reduction laws and many other regulations increases companies’ legal liabilities associated with climate stewardship. By early 2017, more than 1,200 climate laws and policies were in place across 164 countries, up from around 60 in 1997 (FIGURE 3).¹³

FIGURE 3
Climate laws and regulations have been on the rise

Total legislative and executive acts or policies



As of 31 December 2016. | Sources: Climate Change Laws of the World database, Grantham Research Institute on Climate Change and the Environment, Sabin Center for Climate Change Law.

¹⁰Recommendations of the Task Force on Climate-Related Financial Disclosures, June 2017.

¹¹“Proposal for a Disclosure Task Force on Climate-Related Risks,” Financial Stability Board, November 2015.

¹²“Global Climate 500 Index 2015,” Asset Owners Disclosure Project.

¹³Nachmany, et al. “Global trends in climate change legislation and litigation,” Grantham Center for Climate Law, 2017.

Annual infrastructure spending requirements for climate resiliency are estimated to increase from US\$2.6 trillion to US\$4.3 trillion by 2030.¹⁵

We strongly believe that over the next decade, more regulation, ambitious climate targets, and stricter enforcement of climate-mitigation laws will be the norm around the world, regardless of the level of climate-related weather adversity, compelling governments and companies to change their behavior and mitigate any potential climate liability. We think that for many entities, maintaining the status quo or doing too little will not only be financially imprudent, but legally risky as well. Asset owners, particularly those with long investment horizons, should recognize this creeping portfolio risk and the associated asymmetric return distribution associated with it.

Investment opportunities center on mitigation and adaptation

There are a number of steps investors can take to prepare their portfolios for the potential effects of climate change and potentially take advantage of opportunities stemming from asset mispricing. Adding a dedicated, climate-focused strategy that is informed by the latest climate science, tracks an evolving opportunity set, and invests in companies that focus on climate change mitigation and adaptation is one possible approach. This type of strategy leverages thought leadership from the scientific community, which is actively pursuing such solutions. Leading organizations such as the World Economic Forum and the Center for Clean Air Policy both see combining mitigation and adaptation as effective ways to solve for climate risks and adversity.¹⁴

Climate change mitigation involves efforts to decarbonize our energy mix through the adoption of renewable power sources, electrified transportation, resource efficiency, and pollution control. Climate change adaptation, which accepts that some damage may be irreversible, entails mitigating risk to, upgrading, or replacing at-risk physical capital with sustainable infrastructure. Massive investments to finance the engineering and construction of climate-resilient roads, bridges, ports, railways, and buildings are needed to ensure both the long-term integrity of a country’s infrastructure and the continuity of basic goods and services such as water, electricity, and communications to affected areas during a natural disaster.

Climate change mitigation	Climate change adaptation
Renewables	Sustainable energy infrastructure
Electrification	Urban redesign
Resource efficiency	Transport infrastructure
Pollution control	Water and natural resource efficiency
	New property development

A dedicated climate strategy informed by science and the changing regulatory landscape can potentially offer institutional investors with multidecade horizons the following benefits:

- A fundamental asset-liability match vis-à-vis climate risk
- A way to manage risks beyond near-term, localized, or purely weather-related
- Liquid, scalable climate resilience
- Higher inflation sensitivity and lower reinvestment risk relative to many private climate solutions
- An effective hedge if policy, legislation, or consumer choice accelerate carbon-free or other climate-focused initiatives (including divestment)

¹⁴World Economic Forum, 2016 Global Risks Report; Shannon Uvardy and Steve Winkelman, “Green Resilience: Climate Adaptation and Mitigation Synergies,” Center for Clean Air Policy, 2014.

¹⁵“The cost of inaction: Recognising the value at risk from climate change,” The Economist Intelligence Unit, 2015. Actual data may vary, perhaps significantly, from estimates.

The World Economic Forum lists the failure of climate change mitigation and adaptation as “the greatest global risk of the next 10 years.”¹⁶

Conclusion

The investment case is clear to us. The potential cost of climate-related disasters is extremely high, physical and financial assets appear mispriced, changes are likely to be inevitable, and asset repricing has already begun. From a capital stewardship standpoint, this is a practical financial issue — not a purely philosophical one. Investors don’t have to believe in climate change to recognize the need for a proactive approach to managing and hedging this long-term risk. Factoring in carbon-reduction policies and legislation, evolving standards for renewables adoption, and climate-change innovation from companies around the world, it’s clear to us that asset prices will adjust in time. With green shoots of repricing already underway, we find companies and regions that focus currently on climate change mitigation and adaptation to be attractive investments.

In our assessment, climate-aware investing bears little opportunity cost relative to global equity-market investing and may be an effective hedge for the many looming risks. Institutional investors may either help lead asset repricing or be pressured by depreciating stranded assets and rising values for climate-advantaged companies. Our conviction in the efficacy of a climate-focused investment approach stems from the myriad economic, technological, and regulatory changes that we believe will likely lead to asset repricing and generate new investment opportunities. ■

More climate insights from Wellington Management

To learn more about Wellington’s views on the investment implications of climate change, please see:

- [“What should we do about climate change?”](#) by Spencer Glendon

¹⁶World Economic Forum, 2016 Global Risks Report.

Why climate leadership will likely come from the insurance industry

With liabilities that are often measured in decades, property and casualty (P&C) insurers are effectively long climate risk. P&C insurance companies generally accept climate science, while having a vested economic interest in managing and hedging climate risk. As a result, we believe P&C companies will likely be critical change agents in climate-risk repricing through the facilitation of climate mitigation and adaptation.

Insurance in general and the P&C industry in particular have historically served valuable societal benefits. By pooling and managing risk, insurance enables companies and individuals to innovate and test new business models. By supporting entrepreneurship and promoting trade, the insurance industry is a key economic driver. Insurance also effectively prices — and reprices — risks over time, helping to ensure the efficient allocation of capital.

Shortcomings of current risk-management tools

Today the industry attempts to manage climate risks by focusing on one of four major approaches: risk transfer, risk avoidance, raising premiums, or investing in private infrastructure (FIGURE 4). We think each of these approaches is limited in its ability to address the systemic, long-term threat of climate change.

- **Risk transfer** through the use of weather derivatives or catastrophe bonds is a short-term solution that tends to ignore longer-term risks. Pricing assumes historical data, which will likely prove unreliable in the face of accelerating climate change.
- **Risk avoidance** may mitigate risks for the insurer, but sends insufficient pricing signals to the marketplace, perpetuating the mispricing of climate risk. Additionally, avoidance nearly always implies eventual dependence on a state or government agency that may be ill equipped to underwrite risk.
- **Raising premiums** has two potential drawbacks. First, it may limit underwriting opportunities. Second, premiums are still mostly based on backward-looking models that do not reflect future weather and climate risks. Both of these issues imply that current premiums may be too low.
- **Private-infrastructure** investing can help underwrite the creation of necessary climate-resilient assets, but this approach can be difficult to scale and can present liquidity, reinvestment, and inflation-hedging risks.

The problems of correlation

In addition to these challenges, a correlation risk between insurance assets and liabilities poses a tricky dilemma. Insurance companies must ensure that their assets (in this case, their investments) do not lose value concurrent with increases in their liabilities (claims they have underwritten). Unless an insurer's liabilities on physical property perfectly price in climate change, those obligations can become more onerous over time. At the same time, if an insurer's investment portfolio is heavily exposed to assets bearing climate risk, they may face classic asset-liability mismatch.

FIGURE 4
Existing climate risk-management tools have some limitations

Current tool	Limitations
Risk transfer	<ul style="list-style-type: none"> • Does not solve long-term, systemic risk • Inefficient pricing and liquidity dynamics • Catastrophe models and forecasts reflect near-term risks only
Risk avoidance	<ul style="list-style-type: none"> • Implies governance dependence on cost sharing and risk pricing • Creates insufficient price signals
Premium adjustments	<ul style="list-style-type: none"> • Impacts near-term underwriting opportunity • Real costs untenable; backward-looking climate models • Default to state reliance ensures inadequate price signal
Private infrastructure	<ul style="list-style-type: none"> • Inflation risk • Reinvestment risk • Difficult to scale • Illiquid • Fundamental asset-liability match unclear

Source: Wellington Management

From 1980 to 2015, 91% of insurance-loss events globally were weather-related extremes. Those events caused 1.7 million deaths.¹⁸

An equity investment approach can help insurers manage climate risk

In our view, it seems clear that the insurance industry should provide leadership on climate-risk repricing. No amount of insurance makes a bad risk a good risk, so in the face of accelerating climate change, we think insurers must consider more expansive, multidecadal approaches to climate-risk management. We believe that a public equity investment strategy that offers exposure to companies engaged in climate mitigation and adaptation can complement existing hedging strategies.

Decoupling investment risk from the rising climate-related liability risks that insurers are facing may be a more sustainable long-term approach. Should carbon trading or carbon taxation be more widely used, inflationary pressures on claims and other liabilities may intensify, making a liquid equity-based approach potentially additive to a broader investment portfolio. Those costs are not currently captured in most insurers' asset bases, which are still dominated by fixed income investments. In the US, for example, insurers still allocate over 60% of their portfolios to bonds.¹⁷ Some portfolio allocators are beginning to recommend equity-investment-based approaches to their insurance clients as well, advocating a combination of asset reallocation (including divestment and environmental, social, and corporate governance [ESG] awareness), hedges using low-carbon indexes or derivative overlays, and engagement on policy and physical-risk disclosures.

.....
Additional disclosures

This piece contains estimates and forecasts. Actual results may differ, perhaps significantly, from the estimated and forecasted data shown.

¹⁷"A firm foundation: How insurance supports the economy," Insurance Information Institute, 2017 (data supplied by NAIC and sourced from S&P Global Market Intelligence).

¹⁸Munich Re NatCatSERVICE.



WELLINGTON MANAGEMENT COMPANY LLP Boston | Chicago | Radnor, PA | San Francisco

WELLINGTON MANAGEMENT AUSTRALIA PTY LTD Sydney

WELLINGTON MANAGEMENT CANADA LLC Serviced from Boston and Chicago

WELLINGTON MANAGEMENT HONG KONG LTD Hong Kong | Beijing Representative Office

WELLINGTON MANAGEMENT INTERNATIONAL LTD London | Frankfurt

WELLINGTON MANAGEMENT JAPAN PTE LTD Tokyo

WELLINGTON MANAGEMENT SINGAPORE PTE LTD Singapore

WELLINGTON MANAGEMENT SWITZERLAND GmbH Zurich

WELLINGTON LUXEMBOURG S.à r.l. Luxembourg

www.wellington.com

Wellington Management Company LLP (WMC) is an independently owned investment adviser registered with the US Securities and Exchange Commission (SEC). WMC is also a commodity trading advisor (CTA) registered with the US Commodity Futures Trading Commission. In certain circumstances, WMC provides commodity trading advice to clients in reliance on exemptions from CTA registration. In the US for ERISA clients, WMC is providing this material solely for sales and marketing purposes and **not** as an investment advice fiduciary under ERISA or the Internal Revenue Code. WMC has a financial interest in offering its products and services and is not committing to provide impartial investment advice or give advice in a fiduciary capacity in connection with those sales and marketing activities. WMC, along with its affiliates (collectively, Wellington Management), provides investment management and investment advisory services to institutions around the world. Located in Boston, Massachusetts, Wellington Management also has offices in Chicago, Illinois; Radnor, Pennsylvania; San Francisco, California; Beijing; Frankfurt; Hong Kong; London; Luxembourg; Singapore; Sydney; Tokyo; and Zurich. ■ This material is prepared for, and authorised for internal use by, designated institutional and professional investors and their consultants or for such other use as may be authorised by Wellington Management. This material and/or its contents are current at the time of writing and may not be reproduced or distributed in whole or in part, for any purpose, without the express written consent of Wellington Management. This material is not intended to constitute investment advice or an offer to sell, or the solicitation of an offer to purchase shares or other securities. Investors should always obtain and read an up-to-date investment services description or prospectus before deciding whether to appoint an investment manager or to invest in a fund. Any views expressed herein are those of the author(s), are based on available information, and are subject to change without notice. Individual portfolio management teams may hold different views and may make different investment decisions for different clients.

In Canada, this material is provided by Wellington Management Canada LLC, a US SEC-registered investment adviser also registered in the provinces of Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Nova Scotia, Ontario, Prince Edward Island, Quebec and Saskatchewan in the categories of Portfolio Manager and Exempt Market Dealer. ■ In the UK, this material is provided by Wellington Management International Limited (WMIL), a firm authorised and regulated by the Financial Conduct Authority (FCA). This material is directed only at persons (Relevant Persons) who are classified as eligible counterparties or professional clients under the rules of the FCA. This material must not be acted on or relied on by persons who are not Relevant Persons. Any investment or investment service to which this material relates is available only to Relevant Persons and will be engaged in only with Relevant Persons. ■ In Germany, this material is provided by Wellington Management International Limited, Niederlassung Deutschland, the German branch of WMIL, which is authorised and regulated by the FCA and in respect of certain aspects of its activities by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin). This material is directed only at persons (Relevant Persons) who are classified as eligible counterparties or professional clients under the German Securities Trading Act. This material does not constitute investment advice, a solicitation to invest in financial instruments or financial analysis within the meaning of Section 34b of the German Securities Trading Act. It does not meet all legal requirements designed to guarantee the independence of financial analyses and is not subject to any prohibition on dealing ahead of the publication of financial analyses. This material does not constitute a prospectus for the purposes of the German Capital Investment Code, the German Securities Sales Prospectus Act or the German Securities Prospectus Act. ■ In Hong Kong, this material is provided to you by Wellington Management Hong Kong Limited (WM Hong Kong), a corporation licensed by the Securities and Futures Commission to conduct Type 1 (dealing in securities), Type 2 (dealing in futures contracts), Type 4 (advising on securities) and Type 9 (asset management) regulated activities, on the basis that you are a Professional Investor as defined in the Securities and Futures Ordinance. By accepting this material you acknowledge and agree that this material is provided for your use only and that you will not distribute or otherwise make this material available to any person. ■ In Singapore, this material is provided for your use only by Wellington Management Singapore Pte Ltd (WM Singapore) (Registration Number 201415544E). WM Singapore is regulated by the Monetary Authority of Singapore under a Capital Markets Services Licence to conduct fund management activities and is an exempt financial adviser. By accepting this material you represent that you are a non-retail investor and that you will not copy, distribute or otherwise make this material available to any person. ■ In Australia, Wellington Management Australia Pty Ltd (WM Australia) (ABN19 167 091 090) has authorised the issue of this material for use solely by wholesale clients (as defined in the Corporations Act 2001). By accepting this material, you acknowledge and agree that this material is provided for your use only and that you will not distribute or otherwise make this material available to any person. Wellington Management Company LLP is exempt from the requirement to hold an Australian financial services licence (AFSL) under the Corporations Act 2001 in respect of financial. A registered investment adviser regulated by the SEC, among others, is exempt from the need to hold an AFSL for financial services provided to Australian wholesale clients on certain conditions. Financial services provided by Wellington Management Company LLP are regulated by the SEC under the laws and regulatory requirements of the United States, which are different from the laws applying in Australia. ■ In Japan, Wellington Management Japan Pte Ltd (WM Japan) (Registration Number 199504987R) has been registered as a Financial Instruments Firm with registered number: Director General of Kanto Local Finance Bureau (Kin-Sho) Number 428. WM Japan is a member of the Japan Investment Advisers Association (JIAA) and the Investment Trusts Association, Japan (ITA). ■ WMIL, WM Hong Kong, WM Japan and WM Singapore are also registered as investment advisers with the SEC; however, they will comply with the substantive provisions of the US Investment Advisers Act only with respect to their US clients.