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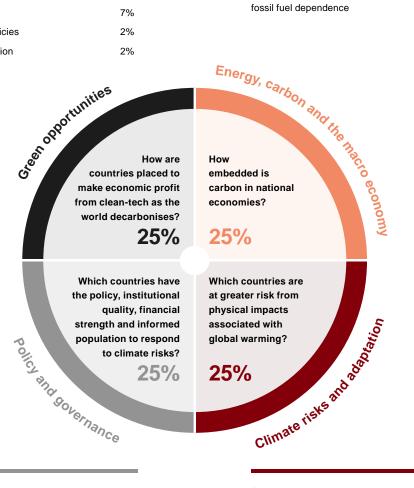
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Fig. 1 - Measuring climate change

Which countries are most resilient in the face of rising climate risks - our methodology

Green opportunities	Weight	Energy, carbon and the macro economy	Weigh
Climate revenues	7%	Economic carbon intensity	12.59
Industrial potential to produce cleantech	7%	Economic diversification and	
Key minerals	7%	fossil fuel dependence	12.5%
Corporate climate policies	2%		
Technological innovation	2%		



Policy and governance Weight Climate finance 6.25% Temperature Institutional quality and information flow 6.25% Water scarcity Decarbonisation policy outlook 12.5% Air pollution
nstitutional quality and information flow 6.25% Water scarcity
ecarbonisation policy outlook 12.5% Air pollution
Land and food
Extreme weather events

Source: HSBC



Fig. 2 - From resilience to vulnerability

Greater resilience

Finland



- 3rd on climate risks and adaptation, with very low air pollution
- Top on control of corruption and rule of law
- 5th on technological innovation with high number of patents

Germany



- 1st on emissions reduction policy outlook
- 3rd best on growth of cleantech industry, vs GDP
- Corporate awareness high level of corporate policies (4th highest per GDP)

Sweden



- Joint lowest emissions per GDP (with Switzerland)
- Low reliance on fossils and second highest share of alternative energy in GDP
- Cheap money very low equity risk premium, with the US,
 Canada and other Nordics

More vulnerable

Nigeria



- Most fatalities from air pollution
- Water scarcity, land metrics and extreme weather data pulls Nigeria down on physical climate risks
- Lowest ranking on government effectiveness and rule of law

Bangladesh



- Low scores on potential to respond to climate risks, across wealth, corruption and press freedom
- Very low green opportunities potential at present
- But the lowest emissions per capita of all 67 countries

Oman



- 3rd highest share of fossil fuels in economy
- Higher increase in frequency of extreme weather events
- Low potential to profit from cleantech as the world decarbonises

Source: HSBC

This report replaces the one of the same title and date, to correct the rankings in the Energy, carbon and the macroeconomy section. These cascade through to smaller changes to the overall country rankings. The countries were previously incorrectly ranked due to a calculation error in the underlying model.



Executive summary

Fragile Planet 2020

Climate change poses risks to all countries. A global drive to reduce carbon emissions brings challenges to energy systems and economies. And adaptive responses are necessary as populations suffer the negative impacts. Strong institutions, information and money are all part of the response. For economies capable of producing cleaner technologies, opportunities abound. We rank 67 countries from the most resilient to the most vulnerable.

We are entering a crucial decade for climate change. Worsening impacts have focused attention – extreme weather events have proven to be more severe and, in many geographies, more widespread due to warming, including wildfires and floods (as we have seen recently in Australia and Indonesia). However, policy-making has looked increasingly detached from scientific evidence in many countries, as we discussed in *The climate in 2020*, 6 January 2020.

Yet, despite some political headwinds in certain countries, and disappointingly slow progress at the most recent 'COP' in Madrid (<u>COP 25: Intransigence</u>, 16 December 2019), we think the world as a whole is increasingly focused on climate change. Encouragingly, the improving economics of clean alternatives to fossil fuels mean rapid deployment in many countries.

We think all countries need to address climate risks. Some look better placed on this than others – more resilient, and less vulnerable. And so in this report, we seek to score and rank countries across a range of risk factors, as per the infographic in Fig. 1.

We have distilled this challenge into a single question:

Which countries are most resilient in the face of rising climate risks?

We focus on the same list of 67 developed (DM), emerging (EM) and frontier market (FM) countries as in previous Fragile Planet reports. We have brought together many of the learnings from the predecessor iterations, but also added several new indicators. Hence, the report is organised into

four sections, each seeking to answer a single question, which together feed into the main question above. The four section-related questions are as follows:

- How embedded is carbon in national economies?
- Which countries are at greater risk from physical impacts associated with global warming?
- Which countries have the policy, institutional quality, financial strength and informed population to respond to climate risks?
- How are countries placed to make economic profit from cleantech as the world decarbonises?

In this report, we are focused on answering these questions and building an overall picture of resilience vs vulnerability, using 35 indicators – of which 12 are new – explored via 54 datapoints for each country. The 5 best-placed countries, identified in Fig. 2, are led by Northern European nations – Finland is first, Germany in 2nd place and Sweden in 3rd place. The most vulnerable countries, dominated by energy economies and those in warmer latitudes, are in descending order – Nigeria, Bangladesh, and Oman. However, while the final rankings are interesting, we believe digging into the detail is more illuminating; ie, the value in this report can be found in specific areas of risk and individual indicators, which we explore in detail in the full report.

And so we think investors should look at where they have asset exposure among their holdings, whether in corporate equity and debt, sovereign exposures or real assets. And then look at the specific areas of our analysis, to understand whether countries to which they are exposed pose a greater or lesser risk.

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Comments from Janet Henry, HSBC Global Chief Economist

long-term growth?

Growth forecasts by national governments and multilateral organisations – which are typically for two years, or at most five years, ahead - do not claim to account for the environmental impact of the projected growth. They only measure the direct impact on current GDP when, for instance, an extreme weather event such as a drought or hurricane occurs, whether it be from the likes of infrastructure damage, commodity price shocks or more general disruption to commerce.

HSBC's Australia economist, Paul Bloxham, estimates that even before the extreme and extensive bushfires an extended drought had already resulted in Australian farm GDP falling by around 10% over the year to Q3 2019, subtracting around 0.2ppts from overall GDP growth. The bushfires are likely to compound the effect of already dry conditions on rural output, particularly given the destruction of livestock, and at this point it is very difficult to estimate the likely full impact on tourism and retail spending more broadly.

In the event of future much more severe extreme weather events, the financial costs, for instance from asset price declines as a consequence of uninsured losses, could have much bigger broader influences on an economy. And the impact may not be confined to one country or region. For instance, disruptions to agricultural output in one region of the world can push up global food prices, squeezing real income growth in another.

Moreover, extreme weather events do not only affect the volatility, the level and/or the growth rate of GDP; they can also lead to misjudgements of 'potential' GDP. Some of this can be through the negative impact on productivity.

How does climate change impact short-term and Given their geographical location and the larger share of GDP accounted for by agriculture, developing countries tend to face greater growth risks from higher temperatures but recent studies have shown that the negative impact on growth in advanced economies from global warming could be widespread too. By examining changes in temperature by season and across US states, researchers at the Richmond Fed ¹ estimated that higher summer temperatures in 1998-2012 had lowered GDP growth not just in agriculture, forestry and fishing but in a whole range of larger sectors - from construction and real estate to a range of services - which more than offset some positive effects on utilities and mining. Admittedly the effects were very small in the short term. However, they also found evidence the rising temperatures could lower overall US growth significantly: assuming no action to mitigate the effects of higher temperatures, they estimated that the US annual growth rate could be lowered by 0.2%-0.4% on a low emissions scenario and up to 1.2% per year on a high emissions scenario by 2070-2099.

> While these estimates of the likely impact may seem way off in the future, as the urgency to address climate change intensifies, academics and policymakers are aware that policy decisions will have to take account of the environmental impact on growth much sooner. This also includes the extent to which current growth is occurring at the expense of future growth. For instance, Diane Coyle² has argued that the depletion of natural resources needs to be accounted for in measures of national income in the same way as the depreciation of machinery, equipment and infrastructure.

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¹ Federal Reserve Bank of Richmond. *The Impact of Higher Temperatures on Economic Growth* by R. Colacito, B. Hoffman, T. Phan and T. Sablik, August 2018.

² GDP: A brief but affectionate history. Princeton University Press 2014.



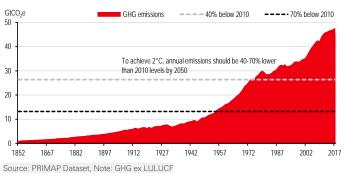
Energy, carbon and the macro economy

- The carbon intensity of countries varies hugely, Switzerland and France are best placed
- We also analyse fossil fuel dependence to understand transition risk
- Our analysis ranks MENA countries, as most vulnerable

Carbon intensity

To achieve the Paris Agreement goals of holding the increase in global average temperature to below 2°C above pre-industrial levels (in 2100) and limiting the temperature increase to 1.5°C above pre-industrial levels, virtually all countries around the world will need to remove carbon and other GHGs from their energy systems and broader economies³. Meanwhile, GHGs are still rising, with the International Energy Agency (IEA) reporting that 2018 CO₂ emissions were the highest yet (Fig. 3)

Fig. 3 - Global historical GHG emissions (pa)



How embedded is carbon in national economies?

We review a range of datapoints⁴ allowing us to analyse, at the country level, which countries are systemically more **carbon intensive** and those that are more exposed to the risks that economic **dependence on fossil fuels** brings. In other words, which countries have **higher transition risk**. (Fig. 4 lists the full range of metrics utilised here).

The findings show European countries dominating the list-they have lower transition risk. The UK has low emissions per GDP, France generates the vast majority of its power from nuclear reactors; and Romania has built out more hydro power and scores well on emissions relating to its sizeable, largely intact forests. At the other end of the spectrum, the oil-rich Gulf states dominate, due to their

dependence on oil and gas for both economic output and domestic energy supply.

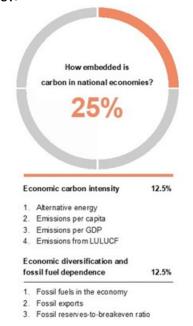
Economic diversification and fossil fuel dependence

Many scenarios for how the energy system might evolve see peaks in coal, oil and gas consumption in coming years or decades. We think achieving diversification is key to mitigating these downside risks and look at the extent to which the 67 countries are diversified in relation to fossil fuel, their exports and their economic production. Overall, EM and FM countries are on average notably more exposed to fossils. 2018 fossil fuel exports made up 4% of GDP and 15.3% of total export revenues in EM and FM countries on average, compared to 1.7% and 8.6% respectively in DM.

We look at the following institutional indicators:

- Fossil fuels in the economy (Level and change)
- Fossil exports (Level and change)
- Ratio of reserve to breakeven-prices in 2030

Fig. 4 - Energy, carbon and the macro economy



Source: HSBC

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³ At the most recent annual conference of parties to the UNFCCC (COP25), progress was limited, in our opinion – see COP 25: Intransigence, 16-Dec-19.

⁴ We repeat our methodology from Fragile Planet – The politics and economics of the low-carbon transition, 10 April 2019, with updated datapoints.



Climate risks and adaptation

- Climate impacts are here this year already we've seen serious floods in Indonesia and wildfires in Australia
- MENA countries are hottest (and driest) but the temperature has risen faster in Eastern Europe in recent decades
- Air pollution is highest in the cities of Pakistan and India, while SE Asia suffers the impacts of extreme weather events more acutely

Living with climate impacts

The impacts of climate change are no longer a future risk – they're happening here and now. This is reflected in scientific evidence, which shows rising temperatures in a majority of countries, changes to the hydrological cycle leading to water scarcity, and increasing severity and likely also frequency of natural events. Almost all regions were affected by extreme weather events in 2019, and records are now seemingly broken quickly in succession all around the world. As we discuss in *The climate in 2020*, 6 January 2020, the effects of these record breaking events are going well beyond physical damage and highlight the inadequacy of social infrastructure and welfare mechanisms in many areas.

We have observed that the rise in impacts and the need to adapt to these has become more prevalent on the global climate policy agenda. A key pillar of the Paris Agreement captures this:

 Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production

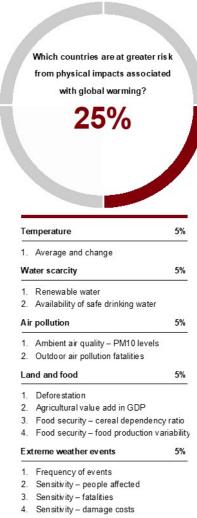
Which countries are at greater risk from physical impacts associated with global warming?

To answer this, we look at metrics which explore warming temperatures, water scarcity, air pollution, deforestation and food security, and extreme weather events.

The **Nordics** do well, again, as do other wealthy European nations. Although the **US** ranks reasonably well overall in this section (16th), it places a lowly 61st on both people affected and damage costs, relating to extreme

weather events, over the past decade. At the other end of the table, EM and FM countries dominate. Bottomranked **Nigeria** shows vulnerability in relation to water metrics, air pollution and land degradation, in particular, as well as on increases in sensitivity metrics on extreme weather events.

Fig. 5 - Climate risk and adaptation



Source: HSBC

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Policy and governance

- Facing transition and physical risks, we think some countries are better placed to respond
- Western European countries dominate in this part of the analysis...
- ...their resilience buoyed by wealth, strong climate policies, effective governments and strong democratic metrics

The climate response

We now move from the focus of the previous two sections – which essentially analysed the first two pillars of climate change, namely mitigating emissions and addressing the impacts – to an analysis of which countries are better placed to address climate risks.

Which countries have the policy, institutional quality, financial strength and informed population to respond to climate risks?

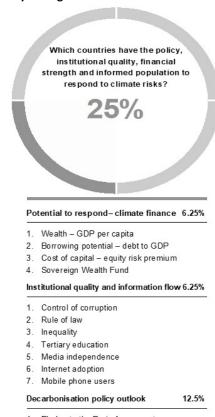
The wealthy **Nordics** again fare well in this part of the analysis, buoyed also by strong showings on institutional quality and social indicators. At the other end of the spectrum, **African** and **South Asian** economies dominate.

Potential to respond to climate risks

Which countries are better placed to *respond* to the transition and physical risks analysed in earlier sections? We answer this by looking at *capital available*, and at which countries are stronger on *institutional indicators* as a guide to being well placed to use this capital:

- Wealth (Level and change)
- Borrowing potential (Level and change)
- Cost of capital (Level and change)
- Sovereign wealth funds (Level and change)
- Control of corruption
- Rule of law
- Inequality
- Education
- Media independence
- Internet adoption
- Mobile phone penetration

Fig. 6 - Policy and governance



- 1. Pledge to the Paris Agreement
- Government effectiveness

Source: HSBC

Decarbonisation policy outlook

For the outlook on decarbonisation policy, we build on previous analyses by considering which countries have a stronger existing policy outlook for limiting greenhouse gas emissions. We use a point-scoring method for the pledges countries made towards the Paris Agreement, incorporating the existence of long-term targets and carbon pricing schemes. Plus we use the World Bank's Government Effectiveness indicator to understand in which countries governments are more likely to be able to turn policy into reality.

- Pledge to the Paris Agreement
- Government effectiveness

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Green opportunities

- Opportunities abound as the world invests to address climate change
- China tops the list with high and increasing revenues and many companies adopting climate policies
- Patents granted in relevant industrial areas are an indicator of innovation – Japan and the US top the ranks

Greater resilience through climate revenues

Displaying resilience through the low-carbon transition is not only about being better placed to transition away from high-carbon activities or having the policy outlook to move away from fossil fuels. We see the transition as an opportunity for those able to sell the products and technologies which allow it to happen. Indeed, we believe those countries that can generate more revenues as the global economy decarbonises are likely to be among the most resilient.

Climate change revenues

We look at national exposure to revenues from climate change themes. We think countries will benefit as their companies earn revenues from products and services which enable the low-carbon transition. To do this, we analyse revenues earned by publicly listed companies incorporated within countries, using HSBC Global Research's proprietary Climate Solutions Database ('the Database')⁵,

Using the Database, we calculate the total climate revenue of the 67 countries for the year 2017/18, and look for interesting trends in climate integration. We aggregate climate revenues of companies in these markets to compute their overall climate revenue exposure, enabling us to compute markets' absolute climate revenues and their climate revenue growth rates. Separately, we re-run the exercise to compute the climate share of revenues in total GDP of markets and look at how the share of climate revenues in countries' GDP has changed.

The cleantech growth opportunity

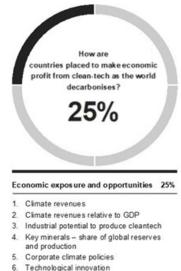
Combatting specialisation means achieving diversification but the *type* of diversification achieved is also important. Diversifying *within* oil production gives some protection against local cost and depletion factors. And so we think diversification should occur in non-hydrocarbon sectors, particularly for economies which are dependent on fossil fuels. Furthermore, we believe national diversification will

benefit in coming years from expansion into climate themed products and services.

Mineral endowments

As sectors decarbonise over time, this will bring about an

Fig. 7 - Green opportunities



Technological innovation

Source: HSBC

energy transition, entailing a reduction in the use of fossil fuels to generate energy, in favour of electrification. In our forecasting for the cost-optimal pathway to achieving an emissions trajectory consistent with limiting global warming to 2°C at century end, we see global power demand c2.5x higher in 2050 than today. And given the ambition is to limit greenhouse gas emissions, the power will increasingly need to come from renewable resources.

Corporate climate planning

In addition to countries having cleantech production and the technologies the world needs to decarbonise, we also look for evidence of companies setting policies to address climate change and patent data for sectors where technologies may be relevant to the low carbon transition.

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⁵ We acknowledge that this database only covers publicly-listed companies and excludes private and state-owned enterprises, and so is in effect a partial analysis of total climate revenues available to countries.



Final rankings

To recap, in this report, we've looked at four areas and in each tried to address one question:

- How embedded is carbon in national economies?
- Which countries are at greater risk from physical impacts associated with global warming?
- Which countries have the policy, institutional quality, financial strength and informed population to respond to climate risks?
- How are countries placed to make economic profit from cleantech as the world decarbonises?

We focused on answering these questions and building an overall picture of resilience vs vulnerability, using 35 indicators – of which 12 are new – explored via 54 datapoints for each country.

This enables us to then rank 67 DM, EM and FM countries on their resilience and, at the other end of the spectrum, vulnerability in relation to this one, overarching question:

Which countries are most resilient in the face of rising climate risks?

In our final rankings, all four **Nordic** countries are in the top 10. The **US** and **Canada** place well overall, while **New Zealand** and **Australia** also rank top quartile.

We break these into four quartiles – the **Czech Republic** (17th place) is the only non-DM country in the top quartile. **China** (18th) and **Korea** (19th) are the next best-placed EMs. **Chile** is the best-placed **LatAm** country, in 25th.

Eight MENA countries are in the bottom quartile, and the other five in the third quartile, with Israel the lowest ranked DM in 31st.

To understand climate resilience, we've used 12 new indicators in this report, taking the total to 35, with 54 datapoints analysed per country

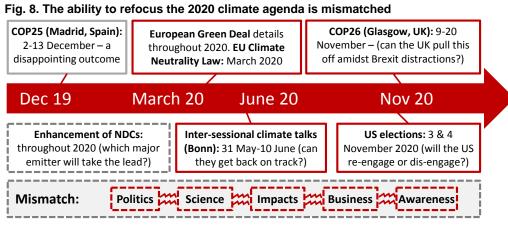
In the near term, there are a number of watch points coming in 2020, as captured in Fig. 8.

And in the short, medium and long term, all countries face climate risks of different types and will need to build resilience in this changing world.

There are levers which can be pulled to encourage lagging economies, including trade conditionality. Meanwhile, transfer of finance, technology, policy expertise and information can also help less developed countries and those that face greater risks. We believe these will all form part of the climate response of the 2020s.

We think consideration of all four areas of this report – transition risks, physical impacts, the potential of countries to respond and the green opportunity set – are essential to understand resilience, at the country level.

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Source: HSBC



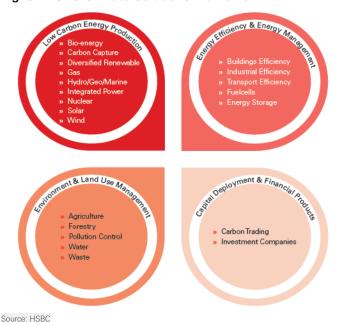
HSBC Climate Solutions Database

Explaining the HSBC Climate Solutions Database

The HSBC Climate Solutions Database (HCSD) comprises global companies that are focused on addressing, combatting and developing solutions to offset and overcome the effects of climate change, thus enabling the transition towards a low carbon economy. The HCSD includes companies with varying levels of exposure to climate-related businesses and defines investment opportunity set within the climate change space. We believe companies in the HCSD are best-placed to profit from the challenges of climate change.

We can then use our HSBC Climate Solutions Framework to screen the HCSD for companies that offer solutions – products and services – which have significant exposure to climate change solving activities. The framework defines four climate sectors, as per Fig. 9.

Fig. 9 - HSBC Climate Solutions Framework



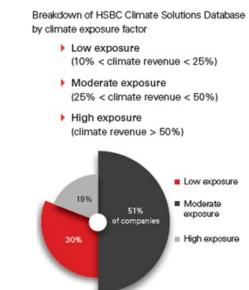
The Database was launched in 2007 and currently consists of over 3000 global companies across all major regions and markets. The climate exposure of companies in the HCSD is determined based on the proportion of revenues that these companies derive from climate change related solutions. Climate revenues are mapped across four climate sectors, 21 climate themes, over seventy climate subthemes and almost hundred fourth level classifications.

Companies' revenues are monitored on an annual basis and their climate exposure factors are revised, if necessary,

depending on changes in their relevant exposure to climate change related activities. The database allows for identifying trends in climate integration across various climate themes as well as across regions and countries. The HCSD therefore enables screening for markets based on their highest and lowest share of climate revenue as proportion of macroeconomic variables, such as GDP. It also helps in identifying countries with relatively higher or lower rate of change in climate integration compared to other markets.

After a detailed climate revenue mapping, companies in the HCSD are assigned with an HSBC climate factor based on their climate revenues as percentage of total revenues. Fig. 10 shows a breakdown per levels of revenue. Around half of companies in the Databases fall into the middle band of 25-50% revenue exposure. Companies are also assigned one climate sector and theme based on their largest exposure to those climate sectors and themes.

Fig. 10 - HSBC Climate Solutions Framework



Source: HSBC

In terms of geographic breakdown of revenue sources, there are notably more companies drawing revenues in the Asia-Pacific region, with Europe and North America are similar levels to each other, although listed companies are typically larger in Western markets.

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The target price is based on the analyst's assessment of the stock's actual current value, although we expect it to take six to 12 months for the market price to reflect this. When the target price is more than 20% above the current share price, the stock will be classified as a Buy; when it is between 5% and 20% above the current share price, the stock may be classified as a Buy or a Hold; when it is between 5% above the current share price, the stock will be classified as a Hold; when it is between 5% and 20% below the current share price, the stock may be classified as a Hold or a Reduce; and when it is more than 20% below the current share price, the stock will be classified as a Reduce.

Our ratings are re-calibrated against these bands at the time of any 'material change' (initiation or resumption of coverage, change in target price or estimates).

Upside/Downside is the percentage difference between the target price and the share price.

Prior to this date, HSBC's rating structure was applied on the following basis:

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*A stock was classified as volatile if its historical volatility had exceeded 40%, if the stock had been listed for less than 12 months (unless it was in an industry or sector where volatility is low) or if the analyst expected significant volatility. However, stocks which we did not consider volatile may in fact also have behaved in such a way. Historical volatility was defined as the past month's average of the daily 365-day moving average volatilities. In order to avoid misleadingly frequent changes in rating, however, volatility had to move 2.5 percentage points past the 40% benchmark in either direction for a stock's status to change.



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 Hold
 40% (33% of these provided with Investment Banking Services)
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 9% (29% of these provided with Investment Banking Services)

For the purposes of the distribution above the following mapping structure is used during the transition from the previous to current rating models: under our previous model, Overweight = Buy, Neutral = Hold and Underweight = Sell; under our current model Buy = Buy, Hold = Hold and Reduce = Sell. For rating definitions under both models, please see "Stock ratings and basis for financial analysis" above.

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Additional disclosures

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