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# Fragile Planet

## Scoring climate risks around the world

We rank 67 countries for their vulnerability to climate change

India and other South and South-East Asian countries are most at risk… while Nordic countries are best placed

We highlight the risks for investors as countries move towards a lower carbon future

Play interview with Ashim Paun

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# Executive Summary



- We rank 67 developed, emerging, and frontier market countries for their vulnerability to climate change risks
- Physical impacts, transition to low-carbon economies and the funds to respond to climate change are all key to this analysis
- India and other South and South-East Asian states are the most vulnerable to climate risks overall

## Climate risk exposure

All countries are being impacted by climate change but some are facing much more acute challenges than others. So we are returning to a theme we have addressed before: identifying and scoring the countries that are most exposed to climate change risks, as well as those best placed to respond to them.

**From physical factors to socio-economic risks**

Climate change manifests through rising temperatures, can alter hydrological (water) cycles and exacerbates extreme weather events. In turn this means higher risks to energy, food and water systems, populations and the global economy. Over 2030 to 2050, the World Health Organisation (WHO) expects 250,000 additional deaths per year due to climate change.

Furthermore, as the world seeks to limit climate change, we believe a combination of climate policy and disruptive cleaner technologies, which do not use fossil fuels (particularly in the power and transport sectors), mean that the peak for fossil fuel demand may arrive in the coming years. In this report, we look at which countries are most vulnerable to climate change – in terms of both the physical impacts and the associated energy transition risks – and which are better placed to respond to these pressures.

**South and SE Asian countries are most vulnerable overall**

Our key findings are as follows: **India, followed by Pakistan and the Philippines, are the most vulnerable countries to climate change**. **South and South-East Asian countries account for five of the ten most vulnerable countries. Countries from the Middle East, Latin America and Africa are also in this group.** The full rankings can be found on page 5.

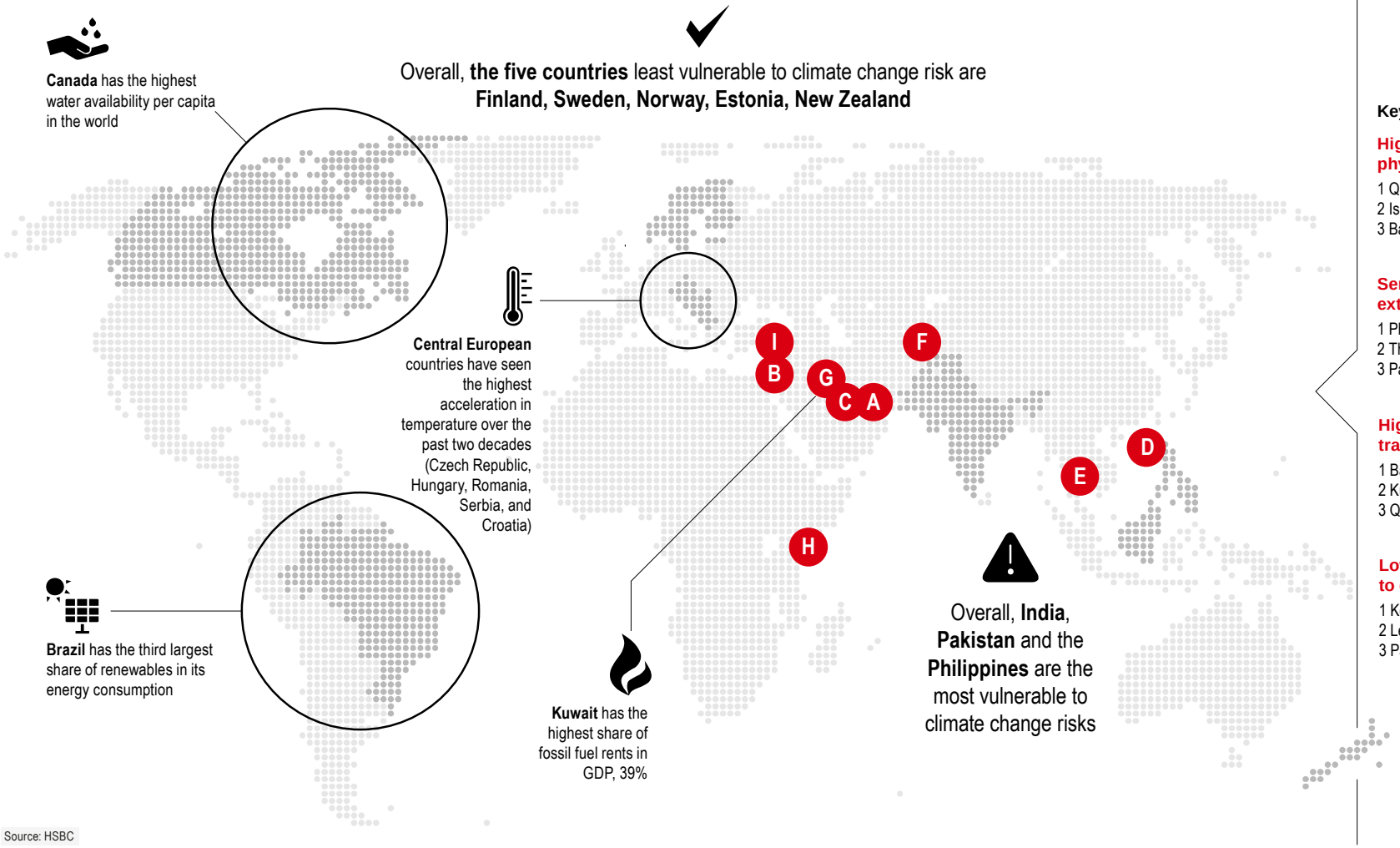
**Developed market countries in general rank better, with Israel (12th) the most vulnerable DM country and Australia next at 29th. Finland, Sweden and Norway, followed by Estonia and New Zealand, are the five least vulnerable countries.** The world map on page 2 picks out more of our key findings.

## What we've done in this report

**67 countries covered**

This is our most comprehensive assessment yet. In our last analysis, *Scoring Climate Risk*, 23 March 2016, we only looked at the G20 countries. This time, in response to client demand, we have broadened our coverage to all countries in the **MSCI Developed, Emerging and Frontier Market** definitions (except for Hong Kong and Taiwan, where some key data gaps would have skewed our rankings). **The 67 countries now captured represent almost one-third of the world's nation states, but 80% of the global population and 94% of global GDP.**

# Fragile planet: climate vulnerability around the world




**Key to map:**

**Highest exposure to physical climate risks**

1 Qatar (A)
2 Israel (B)
3 Bahrain (C)

**Sensitivity to extreme events**

1 Philippines (D)
2 Thailand (E)
3 Pakistan (F)

**Highest energy transition risk**

1 Bahrain (C)
2 Kuwait (G)
3 Qatar (A)

**Lower ability to respond to climate risks**

1 Kenya (H)
2 Lebanon (I)
3 Pakistan (F)

Source: HSBC

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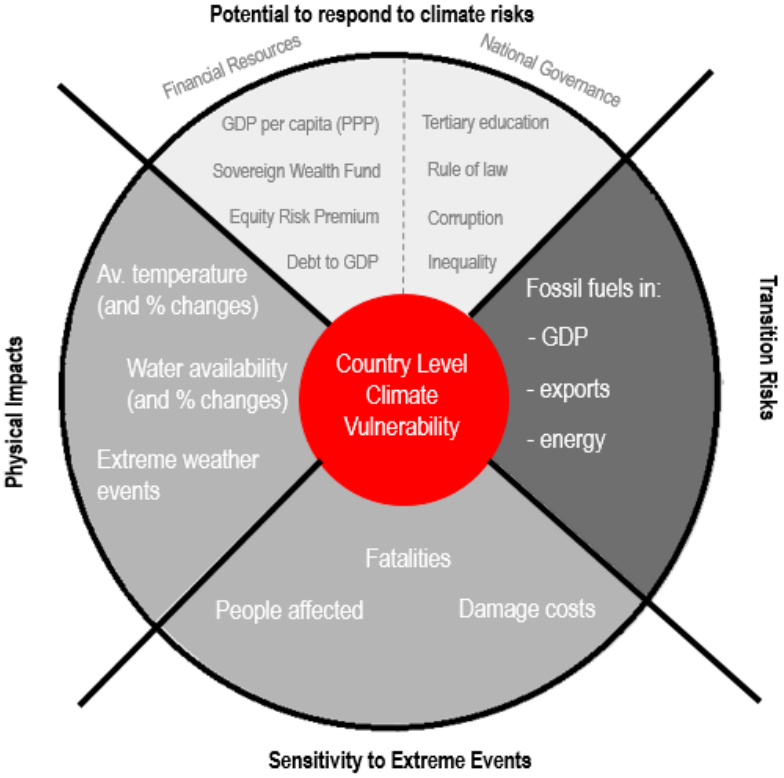
**Four categories for our factor analysis**

The other big change is in our methodology. We calculate a country's overall vulnerability by assigning equal weights (25%) to each of four indicators: (1) physical impacts; (2) sensitivity to extreme weather events; (3) energy transition risks; and (4) a country's potential to respond to climate change, covering financial resources and national governance indicators (see Figure below).

**HSBC methodology for scoring *climate vulnerability***




Source: HSBC

The main addition from last time is *transition risk* – the challenges faced by countries around the world as they attempt to mitigate climate change risks and move towards a lower carbon economy. We attempt to gauge this by looking at the diversification of the economy, energy consumption and exports away from carbon and towards clean energy forms.

**An overall ranking**

**To conclude this work we want to understand which countries are most vulnerable to climate change *overall***. We have assigned each country a score under each of the four indicators. We pull all our findings together to provide an overall climate vulnerability ranking, which can be found in Table 1 on page 5[1]. The full methodology is discussed in detail in Appendix 1, with a full set of indicators in Appendix 3.

**Commonality with the Paris Agreement**

**An analysis to complement global climate initiatives**

We believe this work will aid understanding of climate risk profiles in light of the Paris Agreement adopted in December 2015 by Parties to the UNFCCC and ratified in 2016. The Agreement aims to strengthen the global response to the threat of climate change, including by: **holding the increase in global average temperature to well below 2°C** above pre-industrial levels (in 2100);

[1] A lower score implies a higher vulnerability for any indicator. For the overall score, we have weighted the four categories of scores equally, and added them together, to arrive at a final vulnerability score for each of the 67 countries. This enables us to rank the countries from most to least vulnerable.

**increasing the ability to adapt to the adverse impacts** of climate change and foster climate resilience, and; **making finance flows** consistent with a pathway towards low greenhouse gas emissions and climate resilient development. Our analysis covers these three core pillars.

The Intergovernmental Panel on Climate Change (IPCC) characterises climate vulnerability as a function of exposure to climate impacts and sensitivity to these, as well as the capacity to adapt. Meanwhile, the Financial Stability Board Task Force on Climate-related Financial Disclosures (TCFD), established to develop climate-related financial risk disclosures, considers physical *and* transition risks (as well as liability risks) associated with climate change. We believe our analysis captures the essence of these definitions and therefore allows an understanding of broad national climate vulnerability, which is aligned with the focus of these important institutions.

**A valuable analysis for investors**

We therefore believe this analysis will be useful for investors, highlighting the challenges which lie ahead for countries in transitioning economies onto lower-carbon trajectories and adapting to the physical impacts of climate change. In our view, investors can use our analysis to gain a fuller understanding of national risk profiles, potential for disruption to supply and demand, risks to operations, capital expenditure, supply chains and customers, and broadly the challenges to the long-term sustainable development of countries and protection of their people, environment and economies.

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**Table 1: Overall climate vulnerability (lower score = higher vulnerability)**

| | Physical impacts | | Sensitivity to extreme events | | Energy transition risk | | Potential to respond to climate risks | | Overall climate vulnerability | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Country | Score | Rank | Score | Rank | Score | Rank | Score | Rank | Score | Rank | Market |
| *Weights* | *25%* | | *25%* | | *25%* | | *25%* | | | | |
| India | 3.84 | 17 | 1.67 | 7 | 4.34 | 20 | 2.54 | 10 | **3.10** | **1** | EM |
| Pakistan | 3.55 | 13 | 0.93 | 3 | 6.43 | 58 | 1.87 | 3 | **3.19** | **2** | EM |
| Philippines | 3.64 | 15 | 0.37 | 1 | 6.17 | 52 | 2.63 | 11 | **3.20** | **3** | EM |
| Bangladesh | 4.49 | 24 | 1.16 | 5 | 5.17 | 34 | 2.48 | 8 | **3.33** | **4** | FM |
| Oman | 2.89 | 7 | 2.09 | 9 | 2.85 | 4 | 5.62 | 45 | **3.36** | **5** | FM |
| Sri Lanka | 3.99 | 19 | 1.04 | 4 | 6.42 | 57 | 2.03 | 4 | **3.37** | **6** | FM |
| Colombia | 6.11 | 49 | 2.16 | 10 | 3.05 | 8 | 2.72 | 16 | **3.51** | **7** | EM |
| Mexico | 4.43 | 23 | 3.10 | 15 | 4.38 | 22 | 2.37 | 7 | **3.57** | **8** | EM |
| Kenya | 2.90 | 8 | 3.15 | 16 | 6.63 | 61 | 1.74 | 1 | **3.60** | **9** | FM |
| S Africa | 3.80 | 16 | 4.39 | 29 | 3.90 | 14 | 2.63 | 12 | **3.68** | **10** | EM |
| Thailand | 5.43 | 37 | 0.82 | 2 | 5.37 | 40 | 3.36 | 22 | **3.74** | **11** | EM |
| Israel | 2.23 | 2 | 3.94 | 27 | 4.18 | 16 | 4.66 | 35 | **3.75** | **12** | DM |
| Lebanon | 3.30 | 12 | 6.06 | 44 | 3.86 | 13 | 1.81 | 2 | **3.76** | **13** | FM |
| Vietnam | 5.10 | 31 | 1.34 | 6 | 5.47 | 44 | 3.25 | 20 | **3.79** | **14** | FM |
| Nigeria | 3.01 | 9 | 5.25 | 38 | 5.09 | 32 | 2.54 | 9 | **3.97** | **15** | FM |
| Morocco | 4.02 | 21 | 4.67 | 33 | 5.07 | 30 | 2.69 | 14 | **4.11** | **16** | FM |
| Indonesia | 5.10 | 30 | 3.84 | 25 | 4.98 | 29 | 2.69 | 14 | **4.15** | **17** | EM |
| Egypt | 3.09 | 10 | 7.13 | 53 | 4.41 | 23 | 2.13 | 5 | **4.19** | **18** | EM |
| Brazil | 6.03 | 47 | 3.54 | 20 | 5.09 | 31 | 2.16 | 6 | **4.21** | **19** | EM |
| Serbia | 6.07 | 48 | 2.37 | 13 | 5.44 | 43 | 3.30 | 21 | **4.30** | **20** | FM |
| Malaysia | 5.10 | 32 | 4.72 | 34 | 3.00 | 7 | 4.44 | 31 | **4.32** | **21** | EM |
| Peru | 6.37 | 55 | 3.90 | 26 | 4.30 | 19 | 2.97 | 17 | **4.38** | **22** | EM |
| Bahrain | 2.31 | 3 | 8.52 | 61 | 1.84 | 1 | 5.02 | 37 | **4.42** | **23** | FM |
| S Arabia | 2.81 | 6 | 5.51 | 39 | 2.87 | 5 | 6.51 | 52 | **4.42** | **24** | EM |
| Greece | 5.59 | 40 | 4.54 | 30 | 4.21 | 17 | 3.38 | 23 | **4.43** | **25** | EM |
| China | 6.48 | 56 | 1.96 | 8 | 5.14 | 33 | 4.25 | 30 | **4.46** | **26** | EM |
| Tunisia | 4.05 | 22 | 7.13 | 53 | 4.11 | 15 | 2.65 | 13 | **4.49** | **27** | FM |
| Argentina | 6.15 | 50 | 4.58 | 32 | 5.26 | 37 | 3.00 | 19 | **4.75** | **28** | FM |
| Australia | 5.72 | 41 | 2.28 | 12 | 3.12 | 9 | 7.93 | 65 | **4.76** | **29** | DM |
| Mauritius | 4.00 | 20 | 6.67 | 48 | 4.81 | 27 | 3.84 | 25 | **4.83** | **30** | FM |
| UK | 4.95 | 29 | 3.66 | 23 | 5.37 | 41 | 5.43 | 41 | **4.85** | **31** | DM |
| Poland | 5.38 | 36 | 3.58 | 21 | 5.24 | 36 | 5.22 | 40 | **4.86** | **32** | EM |
| Qatar | 2.06 | 1 | 8.52 | 61 | 2.74 | 3 | 6.14 | 49 | **4.86** | **33** | EM |
| Czech Rep. | 3.92 | 18 | 3.28 | 18 | 6.37 | 55 | 5.97 | 46 | **4.88** | **34** | EM |
| Russia | 7.78 | 66 | 3.70 | 24 | 3.70 | 12 | 4.44 | 31 | **4.90** | **35** | EM |
| Portugal | 5.99 | 46 | 4.54 | 31 | 5.17 | 35 | 4.01 | 27 | **4.93** | **36** | DM |
| Kuwait | 2.51 | 4 | 8.52 | 61 | 2.50 | 2 | 6.34 | 50 | **4.97** | **37** | FM |
| Jordan | 3.24 | 11 | 8.52 | 61 | 5.32 | 38 | 2.97 | 18 | **5.01** | **38** | FM |
| USA | 6.78 | 58 | 2.18 | 11 | 4.58 | 24 | 6.60 | 54 | **5.04** | **39** | DM |
| Belgium | 4.51 | 25 | 5.21 | 37 | 4.76 | 26 | 5.97 | 46 | **5.11** | **40** | DM |
| Kazakhstan | 6.31 | 54 | 6.04 | 43 | 2.97 | 6 | 5.13 | 38 | **5.11** | **41** | FM |
| Japan | 5.93 | 45 | 5.03 | 36 | 4.36 | 21 | 5.15 | 39 | **5.12** | **42** | DM |
| France | 4.84 | 28 | 3.21 | 17 | 7.05 | 66 | 5.47 | 42 | **5.14** | **43** | DM |
| Hungary | 6.15 | 50 | 3.61 | 22 | 6.73 | 62 | 4.16 | 29 | **5.16** | **44** | EM |
| Romania | 6.30 | 52 | 4.03 | 28 | 6.17 | 53 | 4.57 | 33 | **5.27** | **45** | FM |
| Slovenia | 5.81 | 43 | 3.52 | 19 | 6.17 | 51 | 5.58 | 44 | **5.27** | **46** | FM |
| Italy | 5.24 | 33 | 6.30 | 46 | 5.95 | 48 | 3.71 | 24 | **5.30** | **47** | DM |
| Turkey | 4.53 | 26 | 7.01 | 52 | 5.62 | 45 | 4.05 | 28 | **5.30** | **48** | EM |
| UAE | 2.57 | 5 | 8.52 | 61 | 3.32 | 10 | 6.94 | 57 | **5.34** | **49** | EM |
| Croatia | 6.30 | 52 | 6.07 | 45 | 5.67 | 46 | 3.99 | 26 | **5.51** | **50** | FM |
| Chile | 7.50 | 64 | 2.82 | 14 | 6.57 | 59 | 5.54 | 43 | **5.61** | **51** | EM |
| Singapore | 3.56 | 14 | 8.52 | 61 | 4.21 | 17 | 7.20 | 60 | **5.87** | **52** | DM |
| Spain | 5.93 | 44 | 6.84 | 50 | 6.19 | 54 | 4.57 | 34 | **5.88** | **53** | DM |
| Germany | 5.57 | 38 | 5.69 | 40 | 5.97 | 49 | 6.40 | 51 | **5.91** | **54** | DM |
| Lithuania | 6.76 | 57 | 6.73 | 49 | 5.41 | 42 | 4.98 | 36 | **5.97** | **55** | FM |
| Netherlands | 5.58 | 39 | 7.78 | 56 | 3.63 | 11 | 6.92 | 56 | **5.98** | **56** | DM |
| S Korea | 5.28 | 35 | 6.46 | 47 | 4.98 | 28 | 7.44 | 64 | **6.04** | **57** | EM |
| Austria | 5.73 | 42 | 6.03 | 42 | 6.75 | 63 | 6.53 | 53 | **6.26** | **58** | DM |
| Canada | 8.22 | 67 | 4.91 | 35 | 5.32 | 39 | 6.96 | 58 | **6.35** | **59** | DM |
| Switzerland | 5.25 | 34 | 6.94 | 51 | 7.18 | 67 | 6.75 | 55 | **6.53** | **60** | DM |
| Denmark | 4.57 | 27 | 8.36 | 59 | 6.58 | 60 | 7.41 | 63 | **6.73** | **61** | DM |
| Ireland | 6.78 | 58 | 7.48 | 55 | 6.04 | 50 | 7.28 | 62 | **6.89** | **62** | DM |
| New Zealand | 7.07 | 60 | 5.69 | 40 | 6.78 | 64 | 8.19 | 66 | **6.93** | **63** | DM |
| Estonia | 7.24 | 63 | 8.34 | 58 | 6.80 | 65 | 5.97 | 48 | **7.09** | **64** | FM |
| Norway | 7.12 | 61 | 8.03 | 57 | 4.68 | 25 | 9.03 | 67 | **7.21** | **65** | DM |
| Sweden | 7.18 | 62 | 8.39 | 60 | 6.38 | 56 | 7.18 | 59 | **7.28** | **66** | DM |
| Finland | 7.50 | 64 | 8.52 | 61 | 5.94 | 47 | 7.26 | 61 | **7.30** | **67** | DM |

Source: HSBC; Note: DM= developed market, EM= emerging market, FM= frontier market

# Contents



*We acknowledge the contribution of Abhishek Kumar, Associate, Bangalore in the preparation of this report*

# Why is this important to investors?

**Understanding climate risks is important in understanding a raft of socio-economic country factors**

Monitoring individual country vulnerability to climate change factors is, in our view, important to investors for reasons including:

- **Inflation:** Climate effects could impact food or energy output, driving up prices (see *Less bread for your dough,* August 2012).
- **Attractiveness of foreign direct investment (FDI):** Smarter globalised companies are incorporating climate factors into operational growth strategies. Regions with low vulnerability to extreme events driven by climate change carry less risk.
- **Balance of payments:** Countries with high exposure to climate factors could face higher trade deficits as companies choose to source goods from other countries where climate risks are lower to mitigate supply chain disruption.
- **Short-run growth:** Damage costs from extreme climate events are a drag on economic growth, and create extra growth volatility. According to EMDAT, damage costs relating to extreme events in the G20 totalled USD309bn in the decade to 2014, up from USD260bn in the decade to 2012.
- **Long-run growth:** The depletion of natural capital hurts overall productivity (e.g. water depletion can increase the cost of energy), translating into the ability of generating long-term sustainable growth.
- **Supply chain disruption:** Provision of goods and services may be disrupted, putting pressure further along production chains. One such example we looked at was how water scarcity can disrupt production of soft commodities, specifically cotton (see *Cotton & Climate*, 19 June 2016).
- **Infrastructure investment requirements:** Countries will need to invest in power, transport, waste and buildings infrastructure to be resilient to high probability extreme weather events and slow-onset climate-driven physical factors. Water infrastructure is also very important. The consequences of 'water stress' depend to a great extent on how efficiently the resource is managed (see Appendix 2). HSBC economists have written about the need for an "infrastructure revolution" under a global low carbon transition in *Re-energising the world*, 8 January 2018.
- **Social risks:** Climate change has been given as one factor behind incidences of large-scale migration and conflict, such as in Syria and Mali, highlighting the requirements to understand the nature of exposure to countries where social impacts occur.
- **Inequality:** The poorer regions of the world, concentrated in the tropics, are more susceptible to climate impacts. Poorer populations *within* countries are also likely to be less able to adapt. Evidence also shows that women are often more affected by climate impacts in many developing nations.
- **Health issues:** Higher temperatures and changing water patterns increase the public health risk (see *Climate adaptation,* 4 October 2016).

# Physical impacts

- Climate change manifests through rising temperatures, can alter water cycles and exacerbates extreme weather events
- For the majority of countries, these metrics are worsening
- We find Qatar to be most exposed and a similar trend across the MENA region

**Scientific and policy focus on the impacts of climate change**

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. 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

In this section we look at the countries which are most exposed to the impact of rising temperatures, changes to the hydrological cycle leading to water scarcity, and increases in the severity and frequency of natural events.

**METHODOLOGY:** We have based our scoring of physical climate impacts on three main parameters: **temperature levels (35% of the score), water availability (50%) and extreme weather events (15%)**. We have assigned a higher weight to water as the impact of climate change on water resource will be experienced by almost every region. *Our methodology is described in greater detail in Appendix 1.*

**FINDINGS: Qatar is most exposed to physical impacts overall, followed by Israel, and then Bahrain**, with the seven *most* exposed all in the MENA region. We find that the *least* exposed country is Canada, followed by Russia and then neighbouring Finland. Table 3 gives the indicators and overall rankings for physical risk exposure. (Overall physical risk data is captured in Appendix 6.)

## Exposure to higher temperatures

**METHODOLOGY:** We've incorporated two metrics in our analysis – the average absolute temperature in the decade 2006-2015 and the change in average temperatures between 1996-2005 and 2006-2015. We have used country level temperature data provided by the World Bank which averages values recorded at multiple stations.

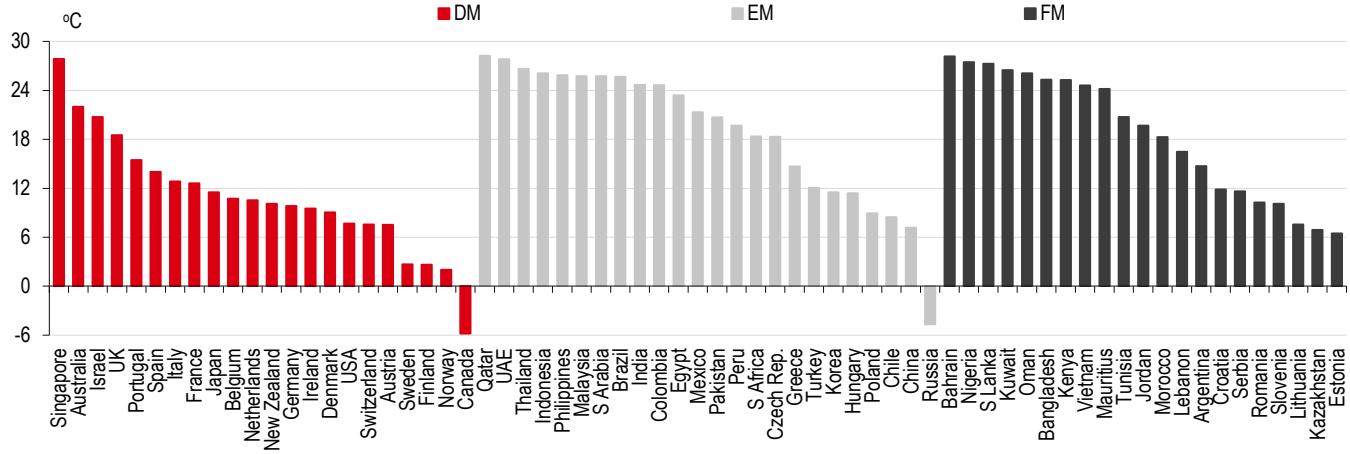
***Absolute temperature levels:*** As described in the methodology section (Appendix 1), for the purpose of scoring in this report, we have considered higher average temperatures as an indicator of higher climate exposure. Chart 1 shows absolute average temperature levels of sample countries recorded during 2006-2015. High temperatures mean higher risks. **Qatar and Bahrain experienced the highest average annual temperatures from our sample at 28.2ºC, with Singapore third at 27.9ºC.**

**Higher temperatures bring associated health risks**

There are several reasons to consider countries in hotter regions to be more exposed than those in colder regions, in our view. Countries in the tropics experience a lower seasonal variation in temperature than those in temperate (colder) regions. There are a number of associated impacts. Warmer temperatures and wetter conditions can drive the spread of diseases, including insect-borne diseases like malaria and dengue fever, tick-borne Lyme's disease and a number of waterborne parasites (we described and discussed climate-exacerbated health risks in *Climate adaptation*, 4 October 2016).

Large-scale subsistence farming in the tropics, where many EM and FM countries are, means larger populations are exposed to climate impacts on agriculture. We think that even though the cost of climate change will vary between the regions, it will be disproportionately high for countries in the tropics, many of which are classified emerging and frontier. According to the UN Intergovernmental Panel on Climate Change (IPCC), crop yields could decline as much as 50% in such countries in the next 30-35 years. (Conversely, warmer conditions in cold countries mean crop growing seasons *can* be longer, a potential benefit.) As the weather in temperate regions rises, energy demand for heating may decline, but extreme heat in more populous regions closer to the equator may see energy demand for cooling soar.

**Chart 1: Average temperature over 2006-2015**




Source: World Bank

**Getting hotter… 57 countries recorded a decadal rise in temperature, 10 saw a decline**

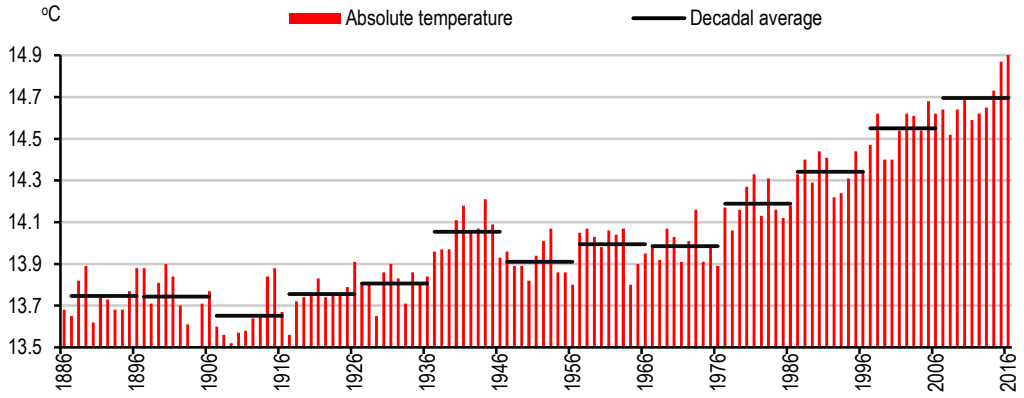
***Temperature change between decades:*** Among the countries analysed, 57 witnessed an increase in the average temperature during the 2006-15 period over previous decade while 10 saw a decline during the time period (chart 3). Temperature *declines* were smaller in magnitude than temperature *rises*. **Across the countries analysed here, the change in temperature was the highest in Czech Republic at 1.4ºC and the lowest in Ireland at -0.2ºC.**

**High temperatures present a challenge, rising temperatures exacerbate this**

If a country experiences high temperatures, this requires an adaptive response. If it is getting hotter, then this presents an adaptation challenge as the country must be prepared for conditions which are changing and associated factors are also increased. Chart 2 shows temperatures rising over time since the late 19th century.

> **"The global temperature is making new highs almost every year − eight of the 10 highest global average temperature records were registered over 2007-2016.**

**Chart 2: Average global temperature**

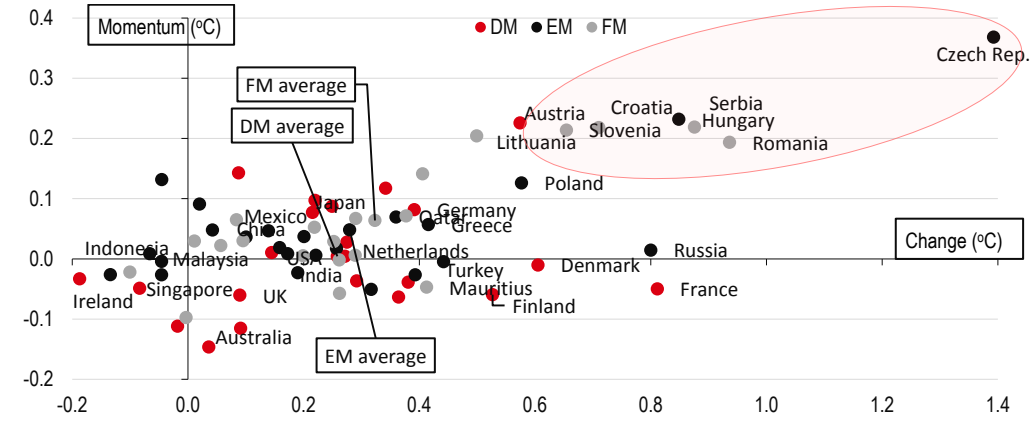



Source: NOAA

**Highest acceleration in temperatures seen in Central and Eastern Europe**

Eight of the ten hottest years were in the past decade, although the rate of increase is lower during 2007-2016 at 0.15ºC compared to 0.21ºC during 1997-2006. For most of our sample countries, the average temperature is on an upward trajectory that aligns closely with the global trend shown in Chart 2. Chart 3 captures the change in temperature for countries in our sample, as well as the momentum. If the rate at which it is getting hotter is increasing, this will present an even bigger challenge for systems, structures and planning. The highest acceleration was observed in Central European countries − Czech Republic, Hungary, Austria, Serbia and Croatia are the top five where the temperature increase sped up the most, i.e. the momentum was greatest, in the range of 0.2-0.4ºC. Overall temperature data is captured in Table i in Appendix 6.

**Chart 3: Temperature − change vs. momentum**




Source: World Bank; Note: not all countries are labelled here. Change related to % changed in decadal averages (1996-2005 and 2006-2015).

## Water availability

**Higher weighting for water – it's fundamental for growth and stability**

**METHODOLOGY:** This report measures exposure to water stress by evaluating the amount of water resources available per person. The impact of climate change on water resource availability will be felt through a change in the water-cycle that will be experienced by almost every region. Consequently we have **assigned a higher weight to water than the temperature metrics or extreme events.** Data is taken from the Food & Agriculture Organisation (FAO). We use two indicators in scoring: annual renewable water resource available per capita in 2016, and; an assessment of the change in water resources between decades.

The impact of climate change on water resource availability will be felt through a change in the water-cycle that will be experienced by almost every region. We believe water availability is key to economic growth, social stability and the preservation of natural capital like flora and fauna. The impacts of water supply disruption are felt quickly by societies, through impairment of subsistence agriculture and economic activity. Availability of water resources forms an important part of our assessment – we believe it is harder to adapt to lack of water than to inclement temperatures, at least in a shorter timeframe, although of course the two are linked.

We have measured 'water stress' by the amount of water resources available per person. The UN classifies the regions having annual water availability below 1,700m$^3$ per person as water stressed, below 1,000m$^3$ per person as facing water scarcity and below 500m$^3$ as facing 'absolute scarcity'.

**700m**

**Population experiencing water scarcity, projected to hit 1.8bn by 2025**

**Soaring number of people expected to face water shortages globally**

Around 700m people currently suffer from water scarcity (UN[2]) – estimates suggest that, by 2025, 1.8bn people will suffer from scarcity, while two-thirds of the world's population will be under water-stressed conditions. The UN has stated that climate change means almost half the world's population will be living in areas of high water stress by 2030. Sub-Saharan Africa has the largest number of water-stressed countries of any region.

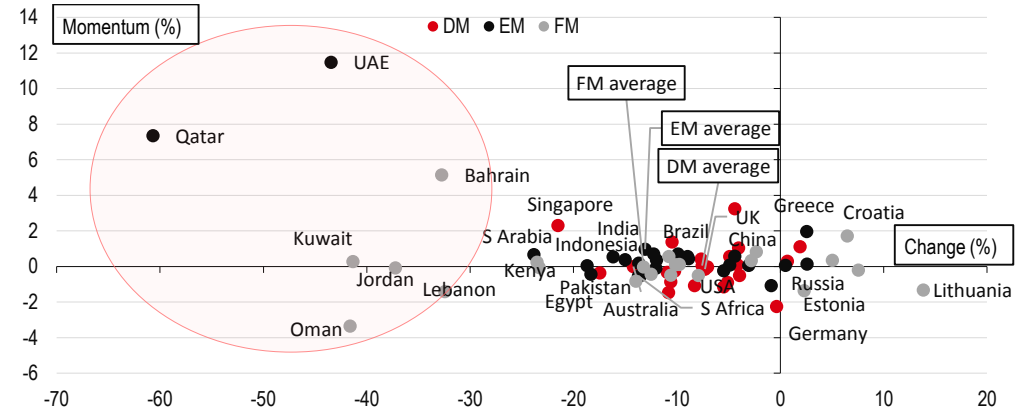
We score exposure to water stress by evaluating two factors: level of annual renewable water resource available per capita and the change over time. Chart 4 gives a detailed analysis of water resources per capita, their changes and the rates of change.

**(1) Water availability per capita**

**Kuwait is the country in our sample with the lowest water-availability per capita, with a value of 5m$^3$/person/year**. **Among the developed and emerging markets Singapore (107m$^3$/person/yr) and the UAE (16m$^3$/person/yr) respectively have the lowest per capita water availability**. Water availability can change because of *demand or supply variation*. On the demand side, this can be due to a growing population and/or a population with higher water use (for instance a more affluent country). In terms of supply, droughts and changing hydrological patterns can limit supply, while investment in water infrastructure, changes in economic activity and higher rainfall can increase supply (see Note 1 in Appendix 2).

The 67 countries analysed here had an average decline in per person water availability of 10% between 2006 and 2016. Overall, levels were 2% below the 2014 value we reported in our 2016 Scoring Climate Risk report. Overall water availability is captured in Chart 5 and further data is in Table ii in Appendix 6.

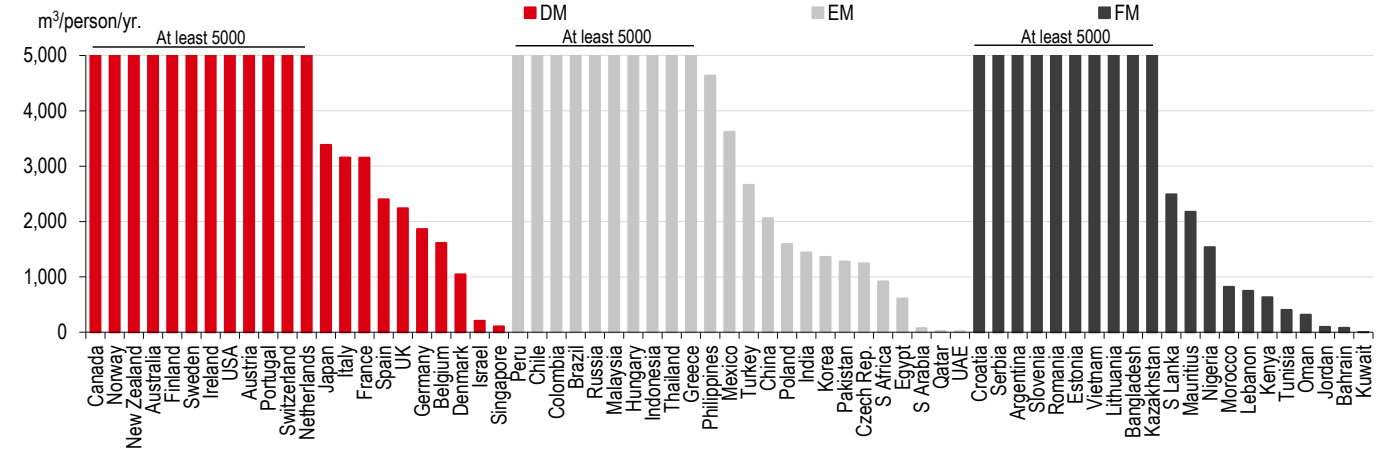
**Chart 4: Water availability − change vs. momentum**




Source: Aquastat, FAO, World Bank.

2 International Decade for Action ' Water for Life' 2005-2015, UNDESA, Weblink: http://www.un.org/waterforlifedecade/scarcity.shtml; accessed on 30 January 2018

**Chart 5: Water availability per capita**




Source: Aquastat, FAO, World Bank; Note: the y-axis values are shown between 0-5,000m³/person/yr. The actual values for several countries are higher than the upper limit shown in the chart

### (2) Change of water availability per capita

**Worsening MENA water scarcity**

**Eight of the ten countries that saw the highest decline in water availability over the last decade are located in the Middle East,** as denoted by the pink circle in chart 4. Kuwait's *renewable* water availability is ~5m³/capita/year, and yet its people consume 34 times this amount. These countries witnessed a c20-60% decline in available resources over the past decade, due mostly to rapid increases in their population. Several countries have water abundance of over 5,000 m³ per capita (which the vertical Y axis on the chart goes up to). For example, Canada has the most water resources, at c.80,000 m³ per capita, 978 times more than in Saudi Arabia and 16,000 times more than Kuwait[3]. Such countries' very high levels of water scarcity mean they need to make greater efforts to increase water availability, conserve it and use it more efficiently. Kuwait largely secures its requirement of potable water through desalination. Saudi Arabia has also increased its desalination capacity greatly over the past decade (see *Scoring Climate Risk 2013*). Table ii in Appendix 6 gives data water availability based on the 2016 and 2018 results.

Globally, the population is projected by the United Nations to continue to increase for the rest of this century, exacerbating pressures on global per capita water availability.

**16,200x**

**Canada's renewable water resources per capita vs Kuwait's**

**Water pressures can play out at the sub-national level**

Country level water statistics, which show water availability per capita on a country basis, are important for gauging broad structural risks faced. In many cases, centralised policy-making will indeed provide remedies to scarcity, in our view. However, we think the distribution of water resources within a country, and crucially whether water is located in the regions with high water demand from competing sectors, poses specific risks to local communities and economic activity. We think understanding localised operating risks and reputational risks associated with

[3] Internal Renewable Water Resources (IRWR): Long-term average annual flow of rivers and recharge of aquifers generated from endogenous precipitation. Double counting of surface water and groundwater resources is avoided by deducting the overlap from the sum of the surface water and groundwater resources.

companies is crucial for investors, especially where companies are using scarce water resources in operations, as well as measures taken by companies to manage their water-related risks. We discussed water supply and demand dynamics in *No water, more trade-offs*, 24 August 2015, and also looked at the pressures of sub-national water availability on cotton production in India and China in *Cotton and climate*, 19 July 2016.

## Extreme weather events

**METHODOLOGY:** We look at the frequency of extreme weather events for our scoring analysis. For our analysis, we have observed the number of extreme events over a ten-year period, defined as droughts, floods, extreme temperatures, storms and wildfires, normalised by adjusting for land mass. Overall numbers per country can be seen in Chart 6.

**Frequency of extreme events likely to be increasing with climate change**

Scientists are increasingly studying evidence for the growing anthropogenic influence on extreme weather events (rather than that of natural factors). A paper from the American Meteorological Society shows that of 30 events examined in 2016, 21 (70%) were found to have had anthropogenic influence, of which 18 had were more likely to have occurred as a result of climate change – see table 2 on page 15. The increasing severity of climate-related events is pushing physical impacts up the global agenda, in our view.

**556x…**

**…more extreme events in Mauritius (per sq km) over the past decade than Russia**

Climate change can increase the probability of specific extreme weather related events, as discussed in detail in the IPCC Synthesis Report 2014[4]. For example, it is *likely* (probability >66%) that the frequency of heat waves has increased in large parts of Europe, Asia and Australia and that human influence on the climate (i.e. via GHG emissions) has doubled the probability of its occurrence in some locations. The report also highlights that there are *likely* more land regions where the number of heavy precipitation events has increased more than where it has decreased. **Mauritius suffers the highest number of extreme events among the countries analysed here, followed by the Philippines** (see Table iii in Appendix 6). We think this highlights the greater requirements for building resilience in small island nations.

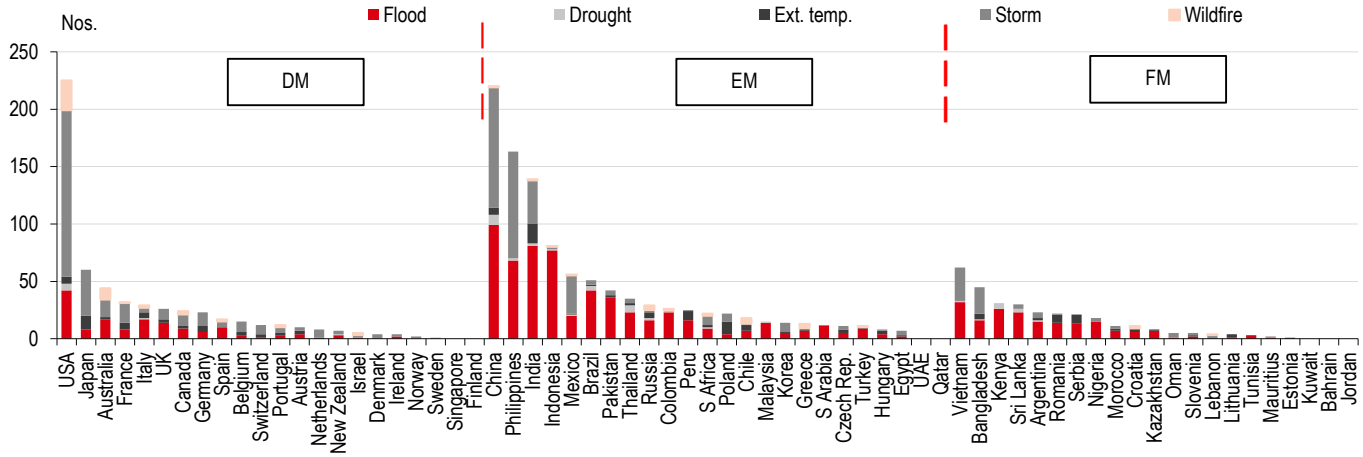
4 Intergovernmental Panel on Climate Change (IPCC)Climate Change 2014, Synthesis Report, Summary for Policymakers

### Table 2: Attributing 2016 extreme events to climate change

| Extreme event | Location | Anthropogenic influence on event |
|---|---|---|
| Atmospheric circulation | Europe | Not found or uncertain |
| Cold | China | Decrease |
| Coral Bleaching | Great Barrier Reef | Increase |
| Coral Bleaching | Central Equatorial Pacific | Increase |
| Drought | Brazil | Not found or uncertain |
| Drought | Southern Africa | Increase |
| Ecosystem Function: disruption of crop yields | Southern Africa | Decrease |
| Ecosystem Function: disruption of fauna | Central Equatorial Pacific | Decrease |
| El Niño | Southern Africa | Increase |
| El Niño variability | Equatorial Pacific | Not found or uncertain |
| Failed rains | Southern California | Not found or uncertain |
| Frost | Western Australia | Increase |
| Heat | France | Increase |
| Heat | Iberian Peninsula, Europe | Increase |
| Heat | Asia, Southeast Asia | Increase |
| Heat | Arctic | Increase |
| Heavy Precipitation | Yangtze-Huai, South China | Increase |
| Heavy Precipitation | Wuhan, China | Increase |
| Heavy Precipitation | Yangtze River, China | Increase |
| Heavy Precipitation | Southeastern Australia | Not found or uncertain |
| Heavy Precipitation | Australia | Not found or uncertain |
| Marine Heat | Central Equatorial Pacific | Increase |
| Marine Heat | Eastern Equatorial Pacific | Not found or uncertain |
| Marine Heat | Pacific Northwest | Increase |
| Marine Heat | Australia | Increase |
| Marine Heat wave | North Pacific Ocean/Alaska | Increase |
| Record Global 2016 heat | Global | Increase |
| Stagnant air | Western Europe | Not found or uncertain |
| Wildfires | Canada & Australia | Increase |
| Winter Storm "Jonas" | Mid-Atlantic U.S. | Not found or uncertain |

Source: Explaining extreme events of 2016 from a climate perspective, Bulletin of the American Meteorological Society

### Chart 6: Number of extreme weather events (total over 2007-2016)




Source: EMDAT

### Overall exposure to physical impacts of climate change

Overall, our modelling of physical risk exposure via absolute levels and change indicators for temperature, water availability and extreme events, ranks **Qatar as most vulnerable, as discussed at the beginning of the chapter.** Table 3 gives rankings for each indicator, and overall rankings, for physical risk exposure. (Underlying data on physical impacts is captured in Table ii in Appendix 6.)

**Table 3: Exposure to physical risk: ranking and overall scores (lower score = higher exposure)**

| Country | Temperature | | Water availability | | Ext. events | Overall score | Overall rank | Markets |
|---|---|---|---|---|---|---|---|---|
| | Abs. | Change | Abs. | Change | Freq. | | | |
| Weights | 20% | 15% | 25% | 25% | 15% | | | |
| Qatar | 1 | 23 | 3 | 1 | 61 | 2.06 | **1** | EM |
| Israel | 24 | 20 | 8 | 14 | 11 | 2.23 | **2** | DM |
| Bahrain | 2 | 21 | 5 | 6 | 61 | 2.31 | **3** | FM |
| Kuwait | 8 | 32 | 1 | 4 | 61 | 2.51 | **4** | FM |
| UAE | 4 | 42 | 2 | 2 | 61 | 2.57 | **5** | EM |
| S Arabia | 13 | 33 | 4 | 8 | 55 | 2.81 | **6** | EM |
| Oman | 9 | 48 | 9 | 3 | 49 | 2.89 | **7** | FM |
| Kenya | 16 | 41 | 12 | 9 | 32 | 2.90 | **8** | FM |
| Nigeria | 5 | 31 | 21 | 10 | 45 | 3.01 | **9** | FM |
| Egypt | 21 | 18 | 11 | 13 | 52 | 3.09 | **10** | EM |
| Jordan | 28 | 28 | 6 | 5 | 61 | 3.24 | **11** | FM |
| Lebanon | 33 | 65 | 13 | 7 | 5 | 3.30 | **12** | FM |
| Pakistan | 26 | 43 | 18 | 12 | 31 | 3.55 | **13** | EM |
| Singapore | 3 | 64 | 7 | 11 | 61 | 3.56 | **14** | DM |
| Philippines | 11 | 61 | 35 | 16 | 2 | 3.64 | **15** | EM |
| S Africa | 30 | 25 | 15 | 19 | 48 | 3.80 | **16** | EM |
| India | 17 | 44 | 20 | 23 | 33 | 3.84 | **17** | EM |
| Czech Rep. | 31 | 1 | 17 | 53 | 16 | 3.92 | **18** | EM |
| Sri Lanka | 6 | 53 | 29 | 39 | 4 | 3.99 | **19** | FM |
| Mauritius | 20 | 16 | 26 | 55 | 1 | 4.00 | **20** | FM |
| Morocco | 32 | 38 | 14 | 22 | 39 | 4.02 | **21** | FM |
| Tunisia | 25 | 34 | 10 | 30 | 47 | 4.05 | **22** | FM |
| Mexico | 23 | 40 | 34 | 20 | 37 | 4.43 | **23** | EM |
| Bangladesh | 15 | 58 | 42 | 28 | 6 | 4.49 | **24** | FM |
| Belgium | 46 | 29 | 23 | 42 | 3 | 4.51 | **25** | DM |
| Turkey | 40 | 14 | 30 | 21 | 50 | 4.53 | **26** | EM |
| Denmark | 53 | 9 | 16 | 45 | 23 | 4.57 | **27** | DM |
| France | 39 | 5 | 31 | 47 | 29 | 4.84 | **28** | DM |
| UK | 29 | 50 | 27 | 41 | 19 | 4.95 | **29** | DM |
| Indonesia | 10 | 66 | 43 | 25 | 35 | 5.10 | **30** | EM |
| Vietnam | 19 | 57 | 47 | 33 | 12 | 5.10 | **31** | FM |
| Malaysia | 12 | 63 | 54 | 15 | 34 | 5.10 | **32** | EM |
| Italy | 38 | 24 | 32 | 51 | 21 | 5.24 | **33** | DM |
| Switzerland | 58 | 35 | 40 | 29 | 7 | 5.25 | **34** | DM |
| S Korea | 43 | 60 | 19 | 43 | 15 | 5.28 | **35** | EM |
| Poland | 54 | 10 | 22 | 58 | 25 | 5.38 | **36** | EM |
| Thailand | 7 | 62 | 39 | 48 | 26 | 5.43 | **37** | EM |
| Germany | 51 | 19 | 24 | 57 | 27 | 5.57 | **38** | DM |
| Netherlands | 47 | 30 | 36 | 52 | 10 | 5.58 | **39** | DM |
| Greece | 36 | 15 | 38 | 62 | 20 | 5.59 | **40** | EM |
| Australia | 22 | 49 | 57 | 17 | 54 | 5.72 | **41** | DM |
| Austria | 59 | 11 | 45 | 44 | 18 | 5.73 | **42** | DM |
| Slovenia | 50 | 8 | 52 | 54 | 8 | 5.81 | **43** | FM |
| Spain | 37 | 51 | 28 | 49 | 36 | 5.93 | **44** | DM |
| Japan | 44 | 39 | 33 | 59 | 14 | 5.93 | **45** | DM |
| Portugal | 34 | 37 | 41 | 60 | 17 | 5.99 | **46** | DM |
| Brazil | 14 | 36 | 61 | 36 | 53 | 6.03 | **47** | EM |
| Serbia | 42 | 3 | 58 | 64 | 9 | 6.07 | **48** | FM |
| Colombia | 18 | 46 | 62 | 34 | 43 | 6.11 | **49** | EM |
| Argentina | 35 | 27 | 55 | 35 | 51 | 6.15 | **50** | FM |
| Hungary | 45 | 4 | 49 | 63 | 24 | 6.15 | **50** | EM |
| Croatia | 41 | 7 | 59 | 65 | 13 | 6.30 | **52** | FM |
| Romania | 48 | 2 | 50 | 66 | 22 | 6.30 | **52** | FM |
| Kazakhstan | 61 | 52 | 37 | 18 | 57 | 6.31 | **54** | FM |
| Peru | 27 | 56 | 64 | 24 | 46 | 6.37 | **55** | EM |
| China | 60 | 47 | 25 | 46 | 44 | 6.48 | **56** | EM |
| Lithuania | 57 | 13 | 44 | 67 | 28 | 6.76 | **57** | FM |
| Ireland | 52 | 67 | 51 | 31 | 30 | 6.78 | **58** | DM |
| USA | 56 | 45 | 46 | 40 | 40 | 6.78 | **58** | DM |
| New Zealand | 49 | 59 | 65 | 27 | 38 | 7.07 | **60** | DM |
| Norway | 65 | 22 | 66 | 26 | 56 | 7.12 | **61** | DM |
| Sweden | 63 | 26 | 53 | 38 | 59 | 7.18 | **62** | DM |
| Estonia | 62 | 17 | 48 | 61 | 42 | 7.24 | **63** | FM |
| Chile | 55 | 54 | 63 | 37 | 41 | 7.50 | **64** | EM |
| Finland | 64 | 12 | 56 | 50 | 61 | 7.50 | **64** | DM |
| Russia | 66 | 6 | 60 | 56 | 60 | 7.78 | **66** | EM |
| Canada | 67 | 55 | 67 | 32 | 58 | 8.22 | **67** | DM |

Source: HSBC; Note: DM= developed market, EM= emerging market, FM= frontier market; scores are between 0-10

The occurrence of an extreme weather event in one part of the world will not have the same social and economic ramifications as a similar event elsewhere. In the next section, we build on our analysis of extreme weather events and look at the sensitivity of countries to these.

# Sensitivity to extreme events

- Socio-economic effects of extreme weather events include deaths, loss of livelihoods and post-event rebuild costs
- The Philippines has the highest sensitivity followed by neighbouring Asian countries
- The US saw a significant increase in people affected by extreme weather events and is the most sensitive DM country overall

Previously, we examined the physical impacts of climate change and occurrence of extreme weather events. Events such as these will not have the same social and economic ramifications in some areas as similar events which strike elsewhere. To capture this, we now measure *sensitivity to physical impacts by* examining impacts on people, in terms of economic costs, lives lost and livelihoods affected.

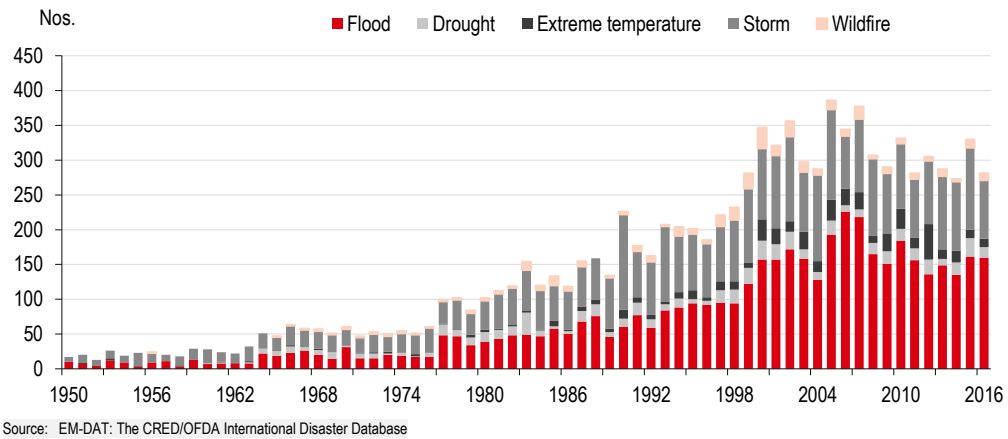
**METHODOLOGY:** We define sensitivity as the impacts felt by society and the economy, specifically to extreme weather events which are linked to climate change − droughts, floods, extreme temperatures, storms and wildfires. We combine three factors: **cost of damage (40% weighting), number of deaths (30%) and number of people affected (30%).** *Our methodology is described in greater detail in Appendix 1.*

**FINDINGS:** We find that the **Philippines has the highest sensitivity, followed by Thailand and Pakistan**, as South and South-East Asian countries take all the eight most vulnerable places in this category. The US is the highest ranking DM in terms of sensitivity.

## Economic costs associated with extreme weather events

The frequency of natural extreme weather events has been increasing (Chart 7 captures a broad rise, particularly this century).

**Chart 7: Global occurrences of extreme weather events**




Source: EM-DAT: The CRED/OFDA International Disaster Database

Average annual costs incurred globally, attributable to climate-related weather events, amounted to 0.14% of GDP during 2007-2016, an increase of 7% above the level experienced in the previous decade. **Annual costs are highest in Thailand, Pakistan, Vietnam, Philippines and Oman,** averaging about 1% of GDP over the 2007-2016 period. The increase in costs vs 1997-2006 has also been higher in these countries (see Table iii, Appendix 6). In large economies like China, India and the US, costs range between 0.2% and 0.3% of total GDP.

## People affected and fatalities

**Asian countries have higher sensitivity to weather events**

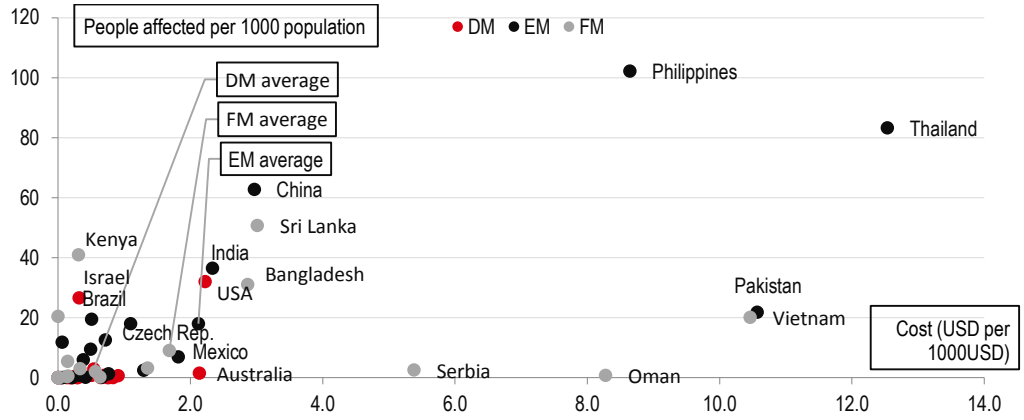
**The Philippines, Thailand, China, Sri Lanka and Kenya saw the highest share of their population affected annually by disaster events** on average over 2007-2016. In the Philippines, the figure is highest at 102 people per 1,000 population. Next is Thailand at 83/1,000 and China at 63/1,000. It is worth noting that there may be double counting in these numbers if the same group of people is affected by two different extreme weather events, and so the actual number of people impacted could be smaller. But irrespective of this, it does give a strong indication of the adaptation challenge faced by certain countries.

The trend is worsening in some countries. For example, in the Philippines the average annual number of people affected jumped from 46 during 1997-2006 to 102 during 2007-2016. Additionally, the country also saw the highest absolute increase. Chart 8 captures the higher levels of Asian sensitivity to extreme weather events, with Thailand, the Philippines, Vietnam and Pakistan all stand-out examples in terms of both the number of people affected *and* the costs. The US also saw a significant jump to 32 people per 1,000 population during the last decade compared to 3.6 in the previous decade, which we believe highlights that climate change affects economies of all size and affluence.

**9x**

**Decadal increase in proportion of US population affected by extreme weather events**

**Chart 8: Extreme weather events − average cost vs. people affected over 2007-2016**




Source: EMDAT, World Bank; Note: some sample countries are not named

**The number of deaths associated with extreme weather events over 2007-16 was highest in Russia, followed by the Philippines and then Peru.** We think this again highlights the fact that events have high impacts in geographically disparate regions.

## Flooding events dominant again in 2017

**Hurricane Harvey showed how damaging rainfall can be**

It is likely that the **severity** of future storms, and their impacts, will have been magnified because of climate change.

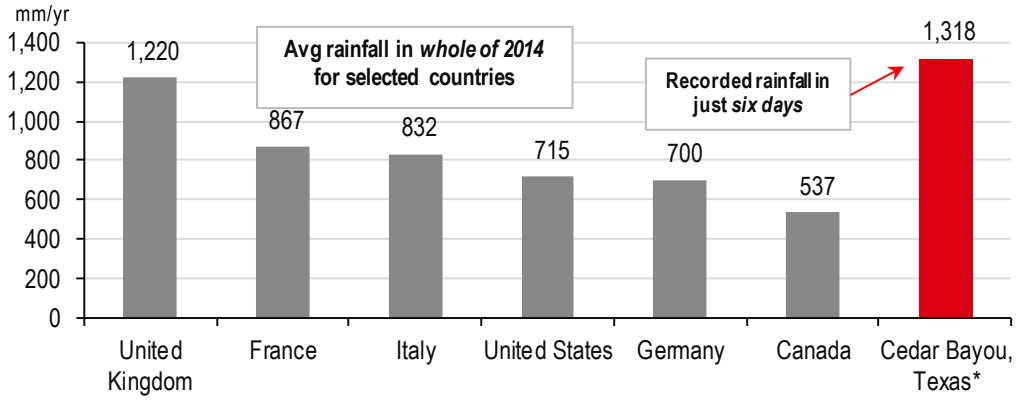
The second half of 2017 was marked by a series of hurricanes in the Atlantic. Climate change can increase the severity of storms and act as a *threat multiplier*. It does this in two main ways: first, rising sea levels mean there is more storm surge; secondly, higher temperatures (on land and at sea) cause more evaporation and increase the ability of the air to hold water – so there is more moisture in the air which falls as precipitation. This was the case with Hurricane Harvey, where 27trn gallons (over 100km$^3$) of rain fell over Texas and Louisiana in six days. In Cedar Bayou, Texas, 51.88 inches (1,318mm) of rainfall was recorded for this storm – the highest ever for a single storm in the US (Chart 9). The average *annual* rainfall for Houston is around 43 inches (1,092mm) (see '*Harvey accentuates role of adaptation and resilience*', 1 September 2017). In our view, the availability and prevalence of protection against flooding, either physically or through insurance, is an issue that local and national governments will be reconsidering in the wake of Harvey's record rainfall.

**Greater frequency, and more severe…**

Major 2017 storms in South Asia, the Caribbean and the United States brought into focus the social element of such disasters. Soon after Harvey came Hurricane Irma, causing massive physical destruction across many islands in the Caribbean. Many people in Barbuda and St. Martin not only lost homes, but also livelihoods in tourism and other sectors that were totally destroyed by the storm. We think this highlights the importance of building up *physical* resilience, but also that of *social* resilience – ensuring that livelihoods, exposed populations and indigenous peoples, as well as health, are adequately safeguarded.

> **South and South-East Asian countries are more sensitive – in terms of people affected and financial costs – to extreme weather events**

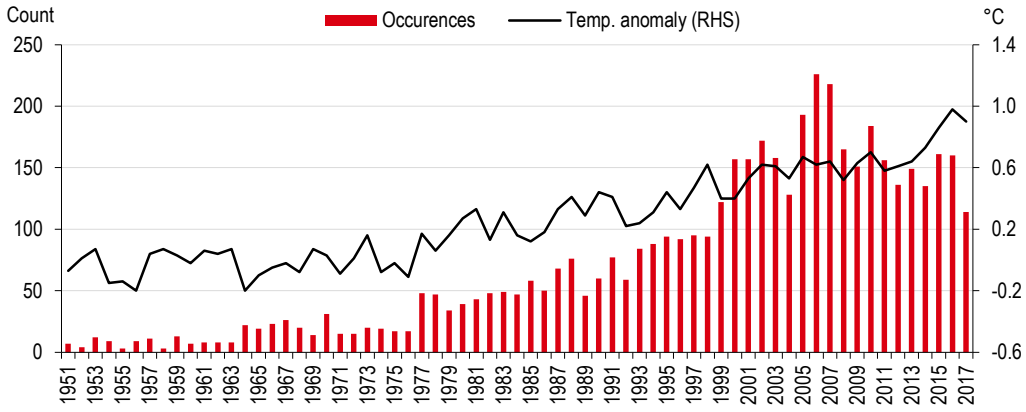
**Chart 9: Extreme rainfall from Harvey, compared to country annual figures**




Note: * Rainfall for Cedar Bayou recorded over the period 2000hrs on 24 Aug to 2100hrs on 30 Aug 2017
Source: World Bank; NCEP, NOAA

The rise in floods globally has been marked over recent decades. Chart 10 shows how this correlates with the rise in global temperatures.

**Chart 10: Rise in floods closely correlated with rise in temperature**



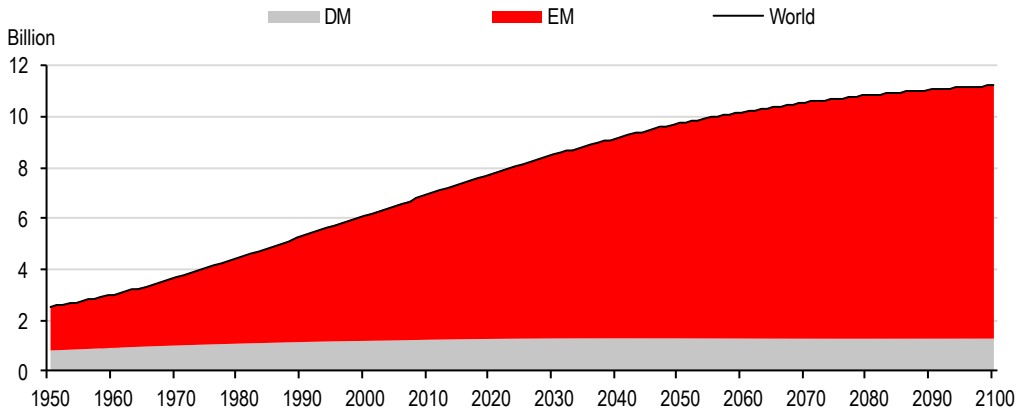

Source: UK MET; EM-DAT; HSBC

**…as flooding events continue globally**

There were also many other floods across the world in 2017, particularly in south Asia. Many areas saw significant loss of life as well as severe damage to property and assets. Hundreds of casualties were reported in Sri Lanka, and over 10m people were affected by floods in India alone. Developed markets are not immune − in Switzerland, a 2017 mudslide event caused major damage as well as loss of life, and the Federal Office for Environment stated that permafrost weakening because of average temperature increases, caused rocks to topple and the resulting mudslide. More recently, in January this year California suffered severe mudslides with 21 confirmed deaths.

Globally, the population is projected by the United Nations to continue to increase (Chart 11) for the rest of this century (albeit with slowing momentum), exacerbating pressures on populations as global per capita water availability goes down and more people face higher temperatures and must adapt to extreme weather events. We think such pressures will be felt more acutely by the elderly and the young, as well as the poor and disenfranchised communities around the world.

**Chart 11: World population trend**




Source: HSBC, UN Population Division

**Table 4: Sensitivity to physical risk: ranking and overall scores (lower score = higher sensitivity)**

| Country | Extreme events: Cost | Extreme events: No. of deaths | Extreme events: People effected | Overall score | Overall rank | Markets |
|---|---|---|---|---|---|---|
| Weights | 40% | 30% | 30% | | | |
| Philippines | 4 | 2 | 1 | 0.37 | **1** | EM |
| Thailand | 1 | 15 | 2 | 0.82 | **2** | EM |
| Pakistan | 2 | 8 | 10 | 0.93 | **3** | EM |
| Sri Lanka | 7 | 10 | 4 | 1.04 | **4** | FM |
| Bangladesh | 9 | 6 | 8 | 1.16 | **5** | FM |
| Vietnam | 3 | 14 | 12 | 1.34 | **6** | FM |
| India | 10 | 18 | 6 | 1.67 | **7** | EM |
| China | 8 | 30 | 3 | 1.96 | **8** | EM |
| Oman | 5 | 11 | 29 | 2.09 | **9** | FM |
| Colombia | 16 | 13 | 14 | 2.16 | **10** | EM |
| USA | 11 | 27 | 7 | 2.18 | **11** | DM |
| Australia | 12 | 9 | 26 | 2.28 | **12** | DM |
| Serbia | 6 | 22 | 23 | 2.37 | **13** | FM |
| Chile | 15 | 19 | 24 | 2.82 | **14** | EM |
| Mexico | 13 | 34 | 18 | 3.10 | **15** | EM |
| Kenya | 37 | 16 | 5 | 3.15 | **16** | FM |
| France | 29 | 5 | 28 | 3.21 | **17** | DM |
| Czech Rep. | 22 | 29 | 15 | 3.28 | **18** | EM |
| Slovenia | 14 | 39 | 21 | 3.52 | **19** | FM |
| Brazil | 30 | 26 | 13 | 3.54 | **20** | EM |
| Poland | 24 | 12 | 36 | 3.58 | **21** | EM |
| Hungary | 35 | 4 | 30 | 3.61 | **22** | EM |
| UK | 23 | 20 | 31 | 3.66 | **23** | DM |
| Russia | 32 | 1 | 39 | 3.70 | **24** | EM |
| Indonesia | 20 | 32 | 27 | 3.84 | **25** | EM |
| Peru | 51 | 3 | 16 | 3.90 | **26** | EM |
| Israel | 36 | 31 | 9 | 3.94 | **27** | DM |
| Romania | 27 | 17 | 37 | 4.03 | **28** | FM |
| S Africa | 33 | 35 | 19 | 4.39 | **29** | EM |
| Greece | 25 | 28 | 40 | 4.54 | **30** | EM |
| Portugal | 19 | 33 | 43 | 4.54 | **31** | DM |
| Argentina | 28 | 40 | 25 | 4.58 | **32** | FM |
| Morocco | 34 | 37 | 22 | 4.67 | **33** | FM |
| Malaysia | 31 | 47 | 17 | 4.72 | **34** | EM |
| Canada | 17 | 55 | 32 | 4.91 | **35** | DM |
| Japan | 40 | 25 | 34 | 5.03 | **36** | DM |
| Belgium | 43 | 7 | 52 | 5.21 | **37** | DM |
| Nigeria | 46 | 36 | 20 | 5.25 | **38** | FM |
| S Arabia | 42 | 23 | 44 | 5.51 | **39** | EM |
| Germany | 18 | 52 | 51 | 5.69 | **40** | DM |
| New Zealand | 21 | 53 | 46 | 5.69 | **40** | DM |
| Austria | 26 | 46 | 54 | 6.03 | **42** | DM |
| Kazakhstan | 45 | 42 | 33 | 6.04 | **43** | FM |
| Lebanon | 55 | 51 | 11 | 6.06 | **44** | FM |
| Croatia | 47 | 38 | 35 | 6.07 | **45** | FM |
| Italy | 38 | 43 | 47 | 6.30 | **46** | DM |
| S Korea | 49 | 41 | 38 | 6.46 | **47** | EM |
| Mauritius | 54 | 24 | 53 | 6.67 | **48** | FM |
| Lithuania | 55 | 21 | 56 | 6.73 | **49** | FM |
| Spain | 41 | 50 | 48 | 6.84 | **50** | DM |
| Switzerland | 39 | 48 | 55 | 6.94 | **51** | DM |
| Turkey | 50 | 49 | 41 | 7.01 | **52** | EM |
| Egypt | 52 | 45 | 45 | 7.13 | **53** | EM |
| Tunisia | 55 | 44 | 42 | 7.13 | **53** | FM |
| Ireland | 48 | 54 | 49 | 7.48 | **55** | DM |
| Netherlands | 44 | 59 | 56 | 7.78 | **56** | DM |
| Norway | 55 | 56 | 50 | 8.03 | **57** | DM |
| Estonia | 55 | 57 | 56 | 8.34 | **58** | FM |
| Denmark | 53 | 60 | 56 | 8.36 | **59** | DM |
| Sweden | 55 | 58 | 56 | 8.39 | **60** | DM |
| Qatar | 55 | 61 | 56 | 8.52 | **61** | EM |
| Bahrain | 55 | 61 | 56 | 8.52 | **61** | FM |
| Kuwait | 55 | 61 | 56 | 8.52 | **61** | FM |
| UAE | 55 | 61 | 56 | 8.52 | **61** | EM |
| Jordan | 55 | 61 | 56 | 8.52 | **61** | FM |
| Singapore | 55 | 61 | 56 | 8.52 | **61** | DM |
| Finland | 55 | 61 | 56 | 8.52 | **61** | DM |

Source: HSBC; Note: DM= developed market, EM= emerging market, FM= frontier market; scores are between 0 and 10

**In geographic terms, climate change vulnerability on both exposure and sensitivity indicators is spread around the world. Countries in Eastern Europe, South and South East Asia, North and Sub-Saharan Africa and the Middle East are all within the top half of most vulnerable countries in both the categories.** Table 4 gives rankings for each indicator, and overall rankings, for physical risk exposure. (Underlying data on sensitivity to extreme weather events is captured in Table iii in Appendix 6.)

Next, we think about which countries are more at risk as the world moves to limit climate change and global warming. Fossil fuels produce greenhouse gas emissions when burned for energy and so mitigating climate change requires a transition away from their use. In the next section, we look at which countries have energy systems and economies that are more dependent on fossil fuels.

# Energy transition risks

- Fossil fuels still underlie most energy consumption – c.85% – but this needs to change if Paris Agreement goals are to be achieved
- Some countries remain heavily dependent on this 'old energy economy', with high coal, oil and gas consumption and revenues
- To gauge transition risks, we consider energy, export and GDP diversification – Bahrain and MENA states are least diversified

In this chapter, we move from looking at physical impacts to looking at the energy *transition* risks which countries face as they attempt to decarbonise their economies and combat the cause of climate change. We focus particularly on major fossil-fuel producing countries, as we believe the transition risks to such countries are higher.

**METHODOLOGY:** We have modelled to capture overall exposure to the transition risks of climate change by looking at diversification of exports, energy and GDP away from fossil fuels. We consider the level and change over the past ten years for the following indicators: **fossil rents (economic profit) as a percentage of GDP (one-third weighting), share of fossil fuels in exports (one-third) and share of fossil fuels in primary energy use (one-third).** We rank countries based on these indicators – essentially setting out which face greater transition risk. *Our methodology is described in greater detail in Appendix 1.*

**FINDINGS: Bahrain comes out as most vulnerable on our energy transition indicators, followed by neighbouring MENA countries**. Unsurprisingly, other fossil fuel-producing states from around the world complete the top ten, including Colombia, UAE, Kazakhstan and Malaysia. **Australia (9th place) is the DM country with highest transition risk**, according to our modelling, and **the Netherlands is the next most vulnerable DM in 11th place.**

## Fossil fuels and the Paris Agreement

To further progress on mitigating climate change, the world must lower its greenhouse gas emissions. The main way of achieving this is by lowering emissions from the energy system. The transition to a new energy system aligned with climate goals means using less fossil fuels.

The headline goal of the Paris Agreement, in our view, is as follows:

- **Holding the increase in global average temperature to well below 2°C** above pre-industrial levels (in 2100) and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognising that this would significantly reduce the risks and impacts of climate change;

To achieve this, virtually all countries around the world will need to remove carbon from their energy systems and broader economies. The Paris Agreement includes text which outlines the need to move to net zero emissions – i.e. a balance between anthropogenic emissions and the amount absorbed by 'sinks' such as forests – by the second half of the 21st century. All

countries consume energy, for use in homes, services, industry and transport. A high proportion – over 85% – of energy consumed comes from burning fossil fuels coal, gas and oil. Moving away from energy and economic systems underpinned by abundant fossil fuels is where the idea of *transition risk* resides. HSBC's Senior Economic Advisor, Stephen King, has written on the economics of this transition in *Re-energising the world*, 8 January 2018.

**A natural resource dividend**

Fossil fuels have brought great wealth opportunities to many countries. Some countries have fossil fuels in abundance and can produce enough domestically to cover their energy requirements. Many states have an excess of commercially viable reserves – i.e. they can supply more fossil fuels at current market prices than needed to meet domestic demand – and therefore export to countries which do not produce enough to meet their needs. **15 of our sample of 67 countries are *net* exporters of hydrocarbons, in economic terms.**

**Development challenges and peak demand**

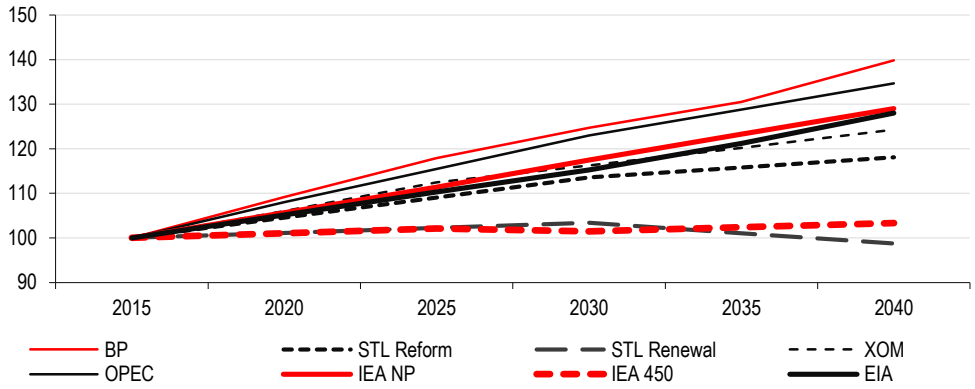
In some cases, broad *development* off the back of these energy resources has also been strong, with Norway an oft-cited example of successful stewardship of natural resources. However, there are challenges to managing commodity-wealth with evidence showing what commentators have called the 'resource curse': relative underperformance by commodity-rich economies. A further challenge comes from the risk of a decline in fossil fuel demand, which some energy system scenarios now project. We believe the challenges to fossil fuel producing countries are particularly acute – they face higher transition risks.

## Looking forward – *energy* growth, but *fossils* contraction?

**Near-consensus opinion on rising total energy demand through 2040**

Most projections see total energy demand rising in coming decades, as the global population increases and affluence levels broadly rise. We looked at eight scenarios from energy companies, as well as the International Energy Agency, through to 2040, and see projections for rising total energy demand over the same period, in seven of eight scenarios (Chart 12)[5].

**Chart 12: Global energy consumption (Index 2015 = 100)**




Source: various providers, HSBC. Note: STL = Statoil, XOM = Exxon, IEA NP = International Energy Agency New Policies, IEA 450 = International Energy Agency 450 scenario, EIA = US Energy Information Administration. Original data in mtoe.

**Peak oil – demand *not* supply**

Although most scenarios include the idea that energy use will rise, there is much more of a question mark over fossil fuels.

5 In the case of the outlier, the Statoil Renewal scenario, the pathway is consistent with the 2°C target for global warming, with emphasis on green technology development and deployment, which ensures faster energy efficiency improvements and an unprecedented pace of decline in energy intensity of GDP.

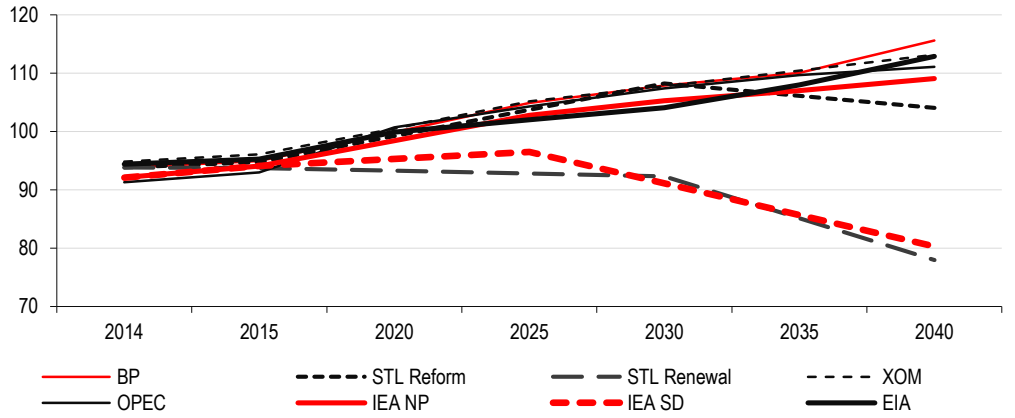
**Concerns about peak oil supply have receded…**

A perceived challenge to the development of states where the production and export of fossil fuels forms a large part of GDP has historically been identified via concerns around supply. In other words, sustainability in economic development is challenged by a point when the commercially extractable stock will be much less, even zero. This has been particularly the case in relation to oil. Within a paradigm of peak oil supply risk, producing countries would be expected to prepare for when the oil runs out, considering how to use oil wealth prudently, and how to allocate wealth across generations. Indeed for some producers, commercially extractable reserves have declined notably.

**…and been replaced by projections of peak demand**

Rising affluence and growing populations, in emerging and frontier markets in particular, have meant for many commodity market participants, commentators and investors, a common expectation, in our view, that demand for fossil fuels would continue to rise. However, energy system models are, with certain input constraints, now generating scenarios in which a peak-and-decline in global oil and coal demand is a core feature. This would mark a major change in the energy system and requires an understanding of which countries are more exposed to these downside peak fossil fuel demand risks. Chart 13 shows liquids (crude oil and natural gas liquids) demand trajectories under eight scenarios from energy companies, as well as the International Energy Agency, through to 2040, with three in decline by 2030. Of these three, both the Statoil Renewal and the IEA Sustainable Development scenario assume the world moves to limit warming to 2ºC at century-end, while the Statoil Reform scenario sees high electric vehicle penetration post-2030.

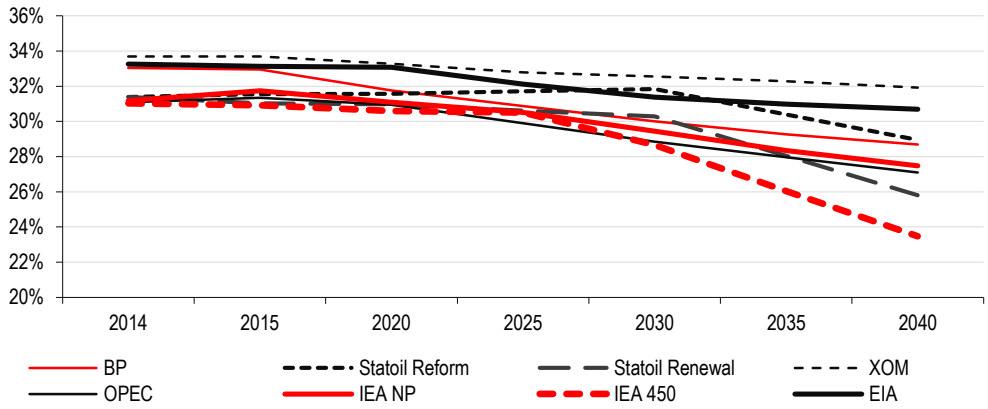
**Chart 13: Global liquids demand, 2014-2040e, mbd**




Source: various providers, HSBC. Note: STL = Statoil, XOM = Exxon, IEA NP = International Energy Agency New Policies, IEA SD = International Energy Agency sustainable development, EIA = US Energy Information Administration. Original data in mtoe

The dominance of fossil fuels is at greater risk than absolute levels of demand, in our view. Chart 14, meanwhile, shows how *liquids' share of total energy* demand is forecast to fall under all eight scenarios.

**Chart 14: Liquids share of total energy demand**

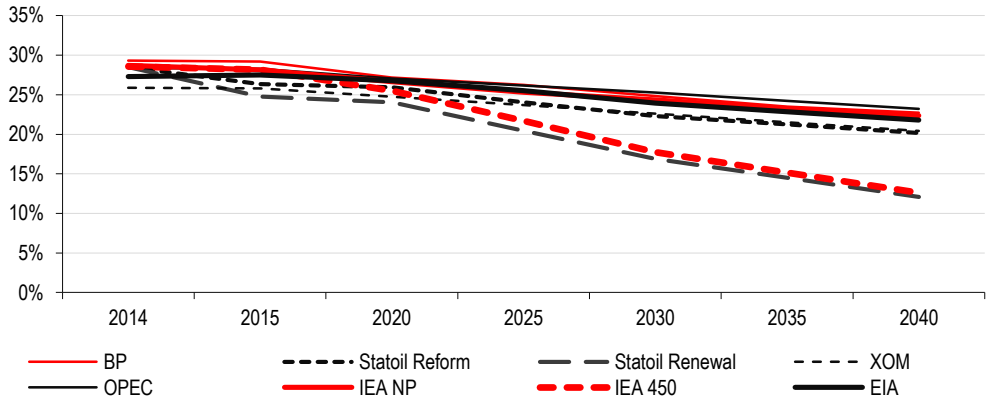



Source: various providers, HSBC. Note: STL = Statoil, XOM = Exxon, IEA NP = International Energy Agency New Policies, IEA 450 = International Energy Agency 450 scenario, EIA = US Energy Information Administration. Original data in mtoe

**Coal's share of energy demand looks set to fall further**

Similarly, coal's share is predicted to decline in all scenarios (Chart 15). In absolute terms, some scenarios see consumption down by over half over this period, while in our 2ºC-aligned scenario analysis in *A Global Energy Vision for a 2ºC World*, 7 February 2017, we see a decline of around four-fifths by 2050. This occurs as alternative power generation technologies become cheaper and the sector is increasingly the focus of decarbonisation actions. This small but arguably meaningful consensus highlights the importance of alternatives to coal, in our view.

**Chart 15: Coal's share of total energy demand**




Source: various providers, HSBC. Note: STL = Statoil, XOM = Exxon, IEA NP = International Energy Agency New Policies, IEA 450 = International Energy Agency 450 scenario, EIA = US Energy Information Administration. Original data in mtoe

**Technological advances and policy drivers**

The drivers underlying such scenarios include technological development in road transport increasing efficiency and moving fuel away from oil derivatives, increasing climate and environmental policy and cheaper low carbon alternative energy sources, as well as concerns around localised pollution and associated public health concerns. Under such scenarios, long-term lower demand means lower prices could therefore also be expected, and so for some high-production-cost nations, this may mean leaving resources and reserves untapped.

**Shouldn't mineral resources be a good thing?**

**The resource curse**

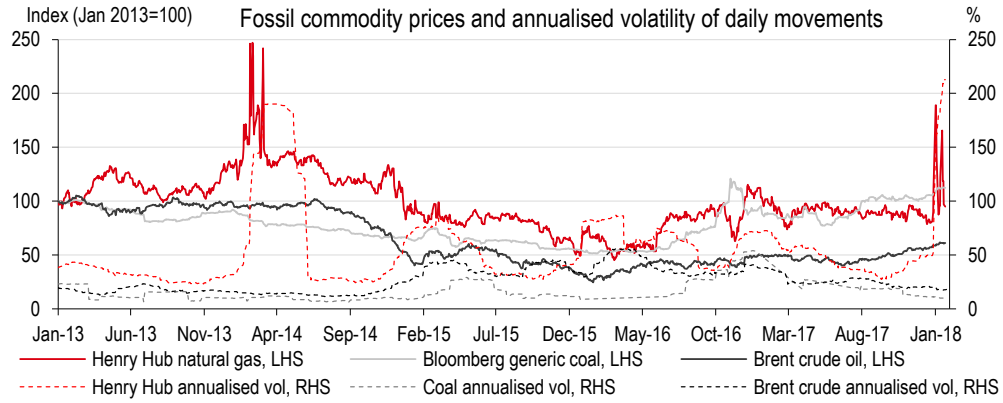
A peak in fossil fuel demand is one challenge. But successfully managing fossil fuel *wealth* is another. The resource curse is the term used to describe the phenomenon of natural resource economies growing slower over time than comparable economies that are less natural resource-intensive. We believe the challenges associated with the resource curse are a strong economic reason for many countries to embrace a move away from them.

The resource curse can appear at first glance to be a counter-intuitive relationship – 'owning' a monetisable asset base would seem to be preferable to not owning one – though many empirical studies have found in favour of its existence[6]. There are a number of factors:

**Volatility…**

**Government investment and expenditure:** Mineral wealth, if properly managed, affords a country the luxury of being able to sustain a potentially sizable primary non-fossil budget deficit but its market price has a profound influence on investment and economic development. Hence, compounding slower growth is the volatility dynamic – many academic studies have found that natural resource abundance also allows countries to engage in unsustainable consumption, meaning a fall in welfare when resources become scarce[7]. Chart 16 shows fossil commodity price volatility.

**Chart 16: Volatile times**




Source: Thomson Reuters Datastream, Bloomberg, HSBC. Annualised volatility: annualised 3mo rolling standard deviation of daily movements
Note: spot prices, Henry hub natural gas (USD per m Btu), Bloomberg generic coal (USD per m tonne), Brent crude oil (USD per BBL)

Managing price volatility is difficult, particularly so for countries that are price takers in a market and dependent on natural resources as a major source of income and foreign exchange. Governments are predisposed to increase expenditure rapidly in line with revenue during a resource-driven boom. However, once underway, expenditure can be difficult to reverse, resulting in heavy fiscal deficits and associated problems, when resource prices collapse.

**…unemployment…**

There is a large body of academic evidence linking natural resource wealth to lower levels of government accountability and democracy. Simply put, where governments rely on economic rents from natural resources for state expenditure, rather than fiscal take from the general population, they are less accountable to the population than in a state where people demand to certain outcomes from their taxes.

**…lower FDI and conflict…**

Furthermore, there is evidence of greater conflict risk in countries with high resource wealth. One study by Paul Collier[8] examined the likelihood of civil war in African countries that have resource wealth. The paper found that, in any given five-year period, countries *without* resource wealth have less than a 15% probability of civil war, which compares starkly with countries that have resource wealth, where the probability of civil war rises to nearly 25%.

**…specialisation…**

**Trade dynamics:** Resource-rich countries are also more prone than resource-abundant countries to 'Dutch disease', whereby periods of booming commodity revenues leading to higher domestic foreign exchange rates, diminishing the value of other tradable/exportable goods and services. Furthermore, oil is a capital-intensive industry and when it provides a sizeable part of national income, this can be to the detriment of employment levels and also of overall skill levels – another Dutch Disease symptom – leading to greater dependence on hydrocarbon revenues and reducing the exports that contribute to long-term, sustainable growth.

6 Ranis and Mahmood 1991, Lal and Myint 1996, Luong and Weinthal 2001, Auty 2001a
7 Rodriguez and Sachs (1999) and Atkinson and Hamilton (2003) (El Serafy 1996)
8 Collier and Hoeffler (2004)

Skills imbalances can also result in economies experiencing spikes in revenues associated with natural resources during periods of commodity booms. The workforce can specialise in resource sectors when highly profitable, but then lose employment during the down-cycle. Shortages in skilled workers in other areas which could fill the gap are likely as they have trained in the resource-related area, limiting the potential for offsetting declines.

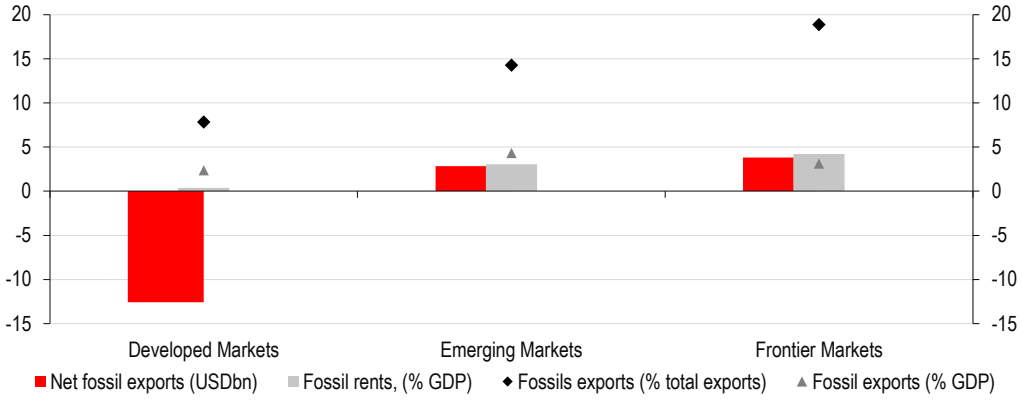
**…and reduced self-sufficiency**

A 'gold rush' towards commodity wealth can mean local economic activities diminishing. This can include commercial and subsistence agriculture. Imported foods then cost more and become less affordable when the commodity boom is over. However, the ability to return to food production may take some time. Other effects can include lower levels of private sector investment, where a country is more dependent on state-controlled natural resources. Coupled with weaker national institutions, this has been shown to mean lower levels of foreign direct investment in non-resource sectors.

## Diversification as a response

In view of the demand declines and broad resource curse risks facing fossil producers, managing the transition to a lower carbon economy is key to mitigating downside risks. We think achieving diversification is key and look here at the extent to which the 67 countries under consideration are diversified in relation to fossil fuels in their energy, their exports and their economic production. Overall, emerging and frontier market countries are on average notably more exposed to fossils. Chart 17 shows emerging and frontier markets with positive net fossil fuel exports in dollar terms on average. Fossil fuel exports make up 3.7% of GDP in emerging and frontier market countries on average, compared to 2.4% in developed market countries. On average, fossil fuel exports make up nearly 17% (16.6%) of total export revenues in emerging and frontier markets. In developed markets, it is less than half of that number, with only 7.8% of total exports coming from fossils.

**Chart 17: Developed markets are less exposed to fossils in exports and GDP**



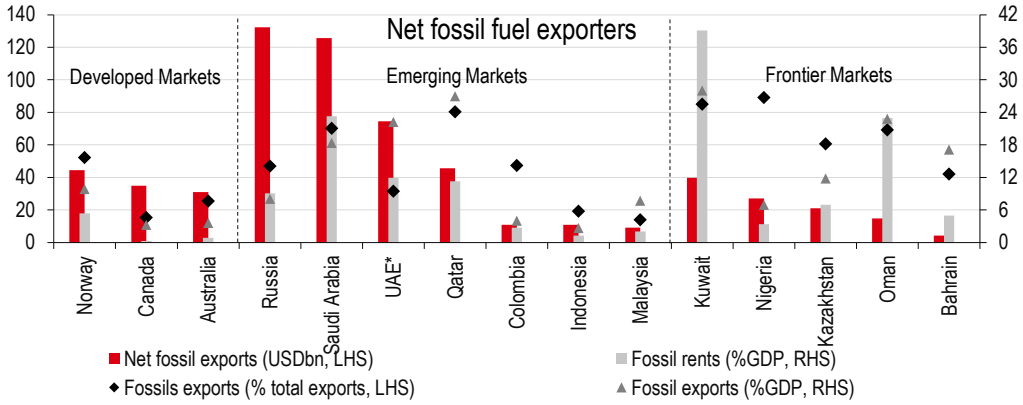

Source: World Bank, UNCTAD, HSBC
Note: Fossil rents as % GDP is 2015 data, all else 2016

Amongst the net fossil fuel exporters, the largest dollar flows (red bars on Chart 18) are to EM countries, with Russia, Saudi Arabia, UAE and Qatar higher than any DM or FM countries. In terms of economic dependence on fossil revenues, the grey bars show rents relative to the size of the economy, with MENA hydrocarbon states highest – Kuwait (39.1% of GDP), Oman (22.9%), Saudi Arabia (23.3%), UAE (12.0%) and Qatar (11.3%).

**39%**

**Fossil fuel rents in Kuwait's GDP, the highest in our sample**

**Chart 18: Export and economic dependence amongst the fossil exporters**




Source: World Bank, UNCTAD, HSBC. *United Arab Emirates
Note: Fossil rents as % GDP is 2015 data, all else 2016. Bahrain and Oman GDP numbers use 2015 data and HSBC estimates for 2016

**Net production or consumption: who is more dependent?**

Another way to think about which countries are better placed in terms of diversification versus fossil-dependence, and therefore in relation to their energy transition risk, is to consider the *extent to which national fossil production is surplus to domestic consumption*. The argument here is that the greater the surplus, the bigger the risk that the country in question is overly dependent on fossil fuel production and not sufficiently diversified, and thus facing greater transition risk.

**China and US produce most fossil energy but remain net importers**

The biggest fossil fuel producers worldwide are China (mostly coal), and then the US (a mixture of oil, gas and coal), as shown in Table 5 in million tonnes of oil equivalent (MTOE). The advantage of considering this in pure energy terms is that it cuts out market price fluctuations and FX impacts, and shows more 'purely' the dependence on fossil energy. This table captures 40 of our sample list of 67 countries, where data is available. With the largest economies and large populations, China and the US consume more than they produce – i.e. they're net importers – suggesting relatively economic and trade diversification. On the other hand, as net consumers these countries are more exposed to global commodity price dynamics and have lower energy security – greater renewables deployment and efficiency would help mitigate these two areas of risk.

**Russia is the next largest producer and exports more than half of its fossil energy**

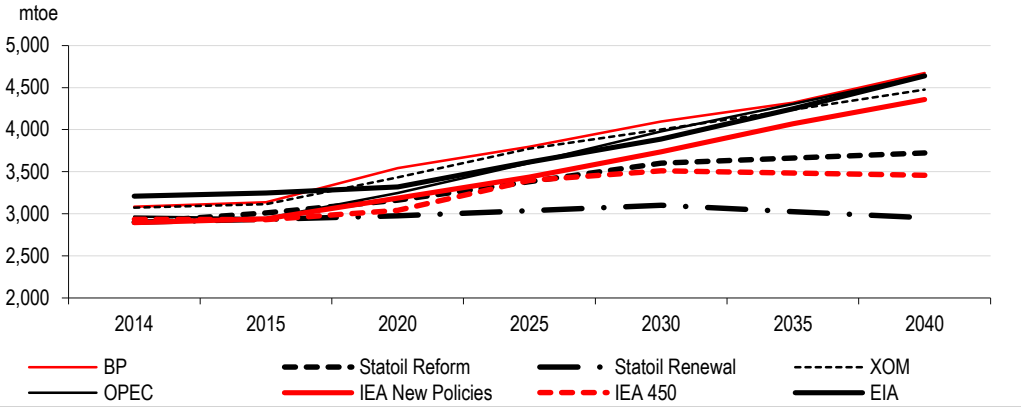
After China and the US, the next largest producer is Russia, which in contrast to these two countries produces more than twice what it consumes. Other countries have a much higher ratio here – Norway produces over 12 times more fossils than it consumes. Declining global dependency on fossil fuels, and resultant price drops, would hurt such countries' trade economics, but over the medium term would also reduce some of the challenges caused by resource abundance.

> **The drop in oil and gas prices has refocused attention on how exporters of these resources can transition to more diversified, resilient economies**
>
> **C.S.Hendrix, International Review of Applied Economics**

**What about natural gas?**

In the shorter term, gas demand is forecast to grow by all scenarios we've considered. However, in the longer term, we believe gas production is at risk in an energy system which transitions to meet the 2ºC warming target at the core of the Paris Agreement. In our modelling with University College London for the *A Global Energy Vision for a 2ºC World*, we found a peak in gas consumption in around 2035, with the 2050 level some 8% lower. Similarly the IEA World Economic Outlook's 450-scenario sees gas demand peaking at some point in the 2030s. Chart 19 shows that for the eight mainstream scenarios, two see the peak around 2030.

**Chart 19: Total energy demand for gas (mtoe)**




Source: various providers, HSBC. Note: STL = Statoil, XOM = Exxon, IEA = International Energy Agency, EIA = US Energy Information Administration. Original data in mtoe

We think those countries which are substantial gas producers – such as Norway, Qatar and Russia – are better placed amongst the net fossil producers in the short to medium term. This is particular the case when compared with those more focused on coal, such as China, Australia, Indonesia and South Africa, and on oil, such as Kuwait and the UAE.

**The countries with a *2016 production and consumption ratio* >1, i.e. they run a fossil fuel production surplus in energy terms, are Kuwait, Saudi Arabia, UAE and Malaysia, which have decreased their production/consumption ratio over the past two decades. However, some countries running a surplus have become *more* dependent on fossil fuels: Qatar, Colombia, Australia, Russia, Indonesia and Canada.**

**Norway is a significant producer of fossils *and* consumer of renewables**

Such high production and consumption ratios can, in part, be explained by relatively lower fossil consumption numbers. In Norway's case, a large share of the primary energy mix comes from renewable energy, reducing the need for fossil consumption. Of the 40 countries in the table, Norway has the largest share of renewables in its primary energy mix, at 68%; no other country has over a 50% share. New Zealand, Brazil and Canada have the next largest shares of renewables in energy (39%, 37% and 37% respectively). This lessens transition risks to some extent.

**Table 5: Who's producing fossils, and who's in surplus**

| Country | Production by country (2016, MTOE) | | | | Consumption (2016, MTOE) | Product/Cons ratio 1996 | Product/Cons ratio 2006 | Product/Cons ratio 2016 | % REN* in prim energy (2016) | Av y-o-y chg (2006-2016) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Oil | Gas | Coal | Total | | | | | | |
| Norway | 90.4 | 105.0 | - | **195.4** | 15.6 | 13.8 | 13.9 | **12.5** | **67.9** | 0.1 |
| Qatar | 79.4 | 163.1 | - | **242.6** | 49.2 | 2.8 | 4.7 | **4.9** | **0.0** | 0.0 |
| Kuwait | 152.7 | 15.4 | - | **168.1** | 41.7 | 7.4 | 5.0 | **4.0** | **0.0** | 0.0 |
| Colombia | 48.8 | 9.4 | 62.5 | **120.6** | 30.0 | 2.9 | 3.8 | **4.0** | **27.0** | -1.6 |
| Australia | 15.5 | 82.0 | 299.3 | **396.9** | 128.6 | 1.8 | 2.4 | **3.1** | **6.8** | 5.6 |
| Saudi Arabia | 585.7 | 98.4 | - | **684.1** | 266.5 | 4.8 | 3.5 | **2.6** | **0.0** | - |
| Kazakhstan | 79.3 | 17.9 | 44.1 | **141.3** | 60.8 | 1.3 | 2.6 | **2.3** | **3.5** | -0.9 |
| Russia | 554.3 | 521.5 | 192.8 | **1268.6** | 587.1 | 1.6 | 1.9 | **2.2** | **12.9** | 1.3 |
| Indonesia | 43.0 | 62.7 | 255.7 | **361.4** | 169.2 | 1.7 | 1.9 | **2.1** | **3.3** | 1.0 |
| UAE | 182.4 | 55.7 | - | **238.0** | 113.7 | 3.3 | 2.8 | **2.1** | **0.1** | - |
| Canada | 218.2 | 136.8 | 31.4 | **386.4** | 209.5 | 1.6 | 1.6 | **1.8** | **36.5** | 1.1 |
| South Africa | - | - | 142.4 | **142.4** | 116.7 | 1.1 | 1.3 | **1.2** | **4.6** | 5.9 |
| Malaysia | 32.7 | 66.5 | - | **99.1** | 94.9 | 1.6 | 1.3 | **1.0** | **4.6** | 8.2 |
| Mexico | 121.4 | 42.5 | 4.5 | **168.3** | 173.2 | 1.7 | 1.5 | **1.0** | **7.1** | 1.8 |
| Peru | 5.6 | 12.6 | - | **18.2** | 19.3 | 0.8 | 0.8 | **0.9** | **23.5** | -2.2 |
| Vietnam | 16.0 | 9.6 | 22.0 | **47.7** | 51.0 | 1.3 | 1.9 | **0.9** | **21.2** | 6.3 |
| Brazil | 136.7 | 21.1 | 3.5 | **161.3** | 188.3 | 0.5 | 0.8 | **0.9** | **36.8** | -0.3 |
| Denmark | 6.9 | 4.0 | - | **11.0** | 13.0 | 0.8 | 1.3 | **0.8** | **23.8** | 7.5 |
| USA | 543.0 | 690.8 | 364.8 | **1598.7** | 1937.9 | 0.7 | 0.7 | **0.8** | **14.7** | 2.4 |
| Egypt | 33.8 | 37.6 | - | **71.5** | 87.2 | 1.5 | 1.3 | **0.8** | **4.1** | -1.1 |
| Argentina | 28.8 | 34.4 | - | **63.2** | 77.6 | 1.3 | 1.3 | **0.8** | **12.7** | -1.6 |
| Bangladesh | - | 24.8 | - | **24.8** | 32.2 | 0.7 | 0.8 | **0.8** | **0.8** | 2.5 |
| China | 199.7 | 124.6 | 1685.7 | **2009.9** | 2655.5 | 0.5 | 0.8 | **0.8** | **13.0** | 8.1 |
| Romania | 3.8 | 8.2 | 4.3 | **16.3** | 24.4 | 0.7 | 0.6 | **0.7** | **26.1** | 5.9 |
| Poland | - | 3.6 | 52.3 | **55.9** | 91.6 | 1.1 | 0.8 | **0.6** | **5.3** | 17.4 |
| UK | 47.5 | 36.9 | 2.6 | **87.1** | 153.1 | 1.2 | 0.8 | **0.6** | **18.6** | 6.9 |
| Pakistan | - | 37.4 | 1.8 | **39.2** | 73.8 | 0.5 | 0.7 | **0.5** | **11.3** | -0.5 |
| India | 40.2 | 24.9 | 288.5 | **353.6** | 669.7 | 0.6 | 0.7 | **0.5** | **7.5** | 0.7 |
| Czech Rep. | - | - | 16.3 | **16.3** | 32.3 | 0.7 | 0.6 | **0.5** | **19.0** | 2.8 |
| Thailand | 17.6 | 34.7 | 4.3 | **56.6** | 120.2 | 0.4 | 0.5 | **0.5** | **2.9** | 4.7 |
| Netherlands | - | 36.1 | - | **36.1** | 80.4 | 0.8 | 0.6 | **0.4** | **4.8** | 5.7 |
| Greece | - | - | 4.1 | **4.1** | 22.6 | 0.3 | 0.3 | **0.2** | **12.7** | 13.9 |
| Germany | - | 6.0 | 39.9 | **45.9** | 260.7 | 0.3 | 0.2 | **0.2** | **19.2** | 2.1 |
| New Zealand | - | - | 1.7 | **1.7** | 13.1 | 0.2 | 0.3 | **0.1** | **38.9** | 1.5 |
| Turkey | - | - | 15.2 | **15.2** | 117.5 | 0.2 | 0.2 | **0.1** | **14.8** | 5.2 |
| Hungary | - | - | 1.5 | **1.5** | 17.4 | 0.2 | 0.1 | **0.1** | **20.4** | 3.9 |
| Italy | 3.8 | 4.7 | - | **8.5** | 127.0 | 0.1 | 0.1 | **0.1** | **16.0** | 9.8 |
| Spain | - | - | 0.7 | **0.7** | 98.1 | 0.1 | 0.0 | **0.0** | **27.3** | 6.1 |
| S Korea | - | - | 0.8 | **0.8** | 244.7 | 0.0 | 0.0 | **0.0** | **14.5** | -0.4 |
| Japan | - | - | 0.7 | **0.7** | 404.3 | 0.0 | 0.0 | **0.0** | **9.2** | -2.7 |

Source: BP Statistical Review, HSBC. Note: excludes some countries due to lack of data. *REN: renewable energy, includes nuclear

Positive fossil production to consumption ratio

Although a high renewables share is positive, it is also important to highlight those countries making efforts to *improve* from a lower renewables share, as momentum towards a lower carbon economy bodes well for avoiding transition risks in future. Just over three-quarters of the 40 countries increased their share of green energy with positive average year-on-year growth between 2006 and 2016. Poland, Greece and Italy have demonstrated higher momentum (17%, 14% and 10% average rates-of-change respectively).

**MENA states have low renewables levels and build-out momentum**

The MENA oil-producing states have the lowest share of renewables in their economies currently: UAE, Kuwait, Saudi Arabia and Qatar all have under 1% renewables in their energy systems, consuming almost entirely fossil fuels. Further, these counties have extremely low rates of growth in capacity build-out, suggesting low momentum to date *towards* renewables in the energy mix either (see table 5). However, on a more positive note, policy catalysts are being introduced in many MENA countries (see *MENA: Hydrocarbon giants prepare for low-carbon future*, 4 September 2017).

### Diversifying into what?

The *type* of diversification achieved is also important. An academic paper[9] looked at Bahrain's historical attempts to diversify the risks of its oil production by entering a joint venture in Saudi Arabia's oil, as well as by opening a refinery and by beginning producing natural gas.

**Diversifying within fossil fuels is an imperfect hedge, in our view**

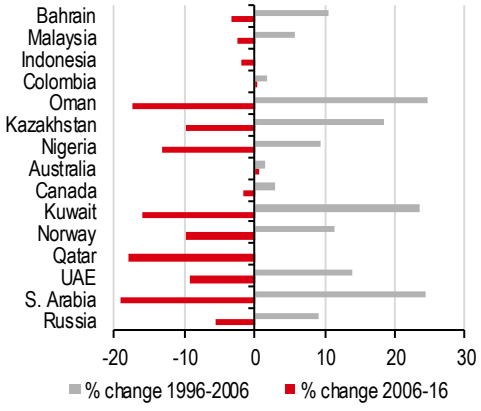
Diversifying *within* oil production gives some protection against local cost and depletion factors. Natural gas production gives diversification within fossil energy supply. Meanwhile, refining gives diversification along the value chain and broadens commodity price volatility exposure. However, there is still residual risk, in this example, to some of the flows of the transition underway in the energy system. In a future where oil demand from the transport sector is negatively catalysed by new technologies – particularly electrification of road transport – then oil production in different geographies and refining businesses are all exposed to this trend.

Natural gas reserves are also at risk from climate change policy. However, most scenarios see growth in demand, even where there is 2-degree alignment, so this could be broadly diversifying for the transition. Further exposure for countries within the oil value chain would be into petrochemicals, where there is currently projected to be growth in demand in *all* scenarios. Greater diversification, with minimal correlation, would see growth in manufacturing and other economic sectors in relation to both the economy and to exports, as well as growth in low-carbon energy.

**Trade in parts and components behind South East Asian diversification success**

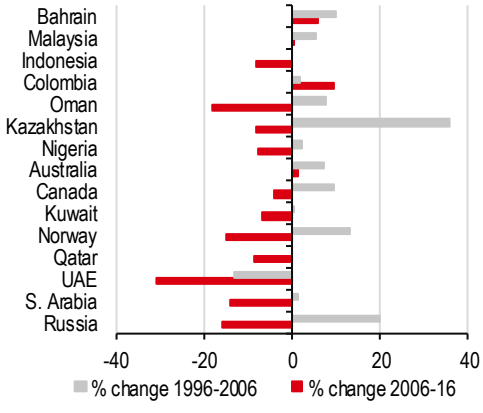
Some studies have also found that diversification has helped economies where there has been growth in the trade in parts and components (otherwise known as global production sharing). One paper looked at the current growth success stories of South-East Asia as underpinned by the successful exploitation of these trade networks. We think any viable diversification strategy for an energy-rich state based on industrialisation and sustainable development should include effective participation in the global production sharing network[10].

**Chart 20: Fossil fuel exports as % of GDP**




Source: World Bank, UNCTAD

**Chart 21: Fossil fuel exports as % of total exports**



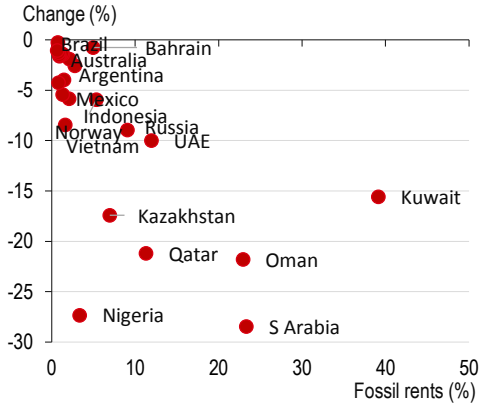

Source: World Bank, UNCTAD

*Fossil fuels in GDP:* Kuwait, Saudi Arabia and Oman are the top three countries in terms of earnings from fossil production, oil in these cases. However, these three countries have also seen among the greatest relative decline in fossil rents in the last ten years (Chart 22).

9 Preparations for income after oil: Bahrain's example, JS Birks and CA Sinclair, British Society for Middle Eastern Studies, 1979

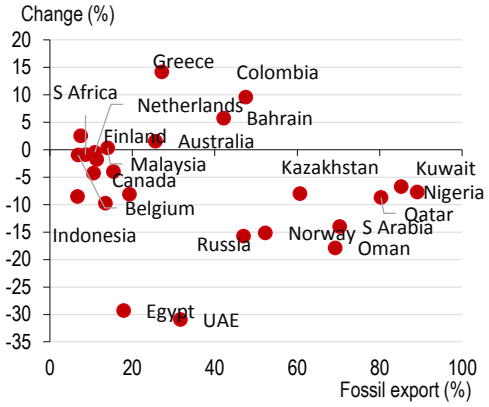
10 Hydrocarbon, trade networks and the road to economic diversification, Yeats (1998) and Yi (2003)

**Chart 22: Fossil rents: actual vs. change (2015)**




Source: World Bank

**Chart 23: Fossil fuels in exports: actual vs. change (2016)**




Source: World Bank

**…and to balance trade accounts**

*Fossil fuels in exports*: Major fossil-producing countries have typically experienced a positive current account balance due to high fossil exports. However, such countries are susceptible to price inflation of other essential goods when their current account balance reduces due to decline in energy price or export volume. The opposite is true with heavy dependence on fossil imports, however, as such countries typically have more diversified trade baskets that lower their exposure to energy commodity prices. To understand dependence on fossil exports, we have looked at the value of fossil exports and calculated their share in total goods and services exports. Chart 23 shows that **Nigeria, Kuwait and Qatar have heavy dependence on exports although these shares have declined in the last ten years.** Charts 20 and 21 show the change in the value of fossil fuels in GDP and in exports – this suggests recent diversification away from fossil fuels for a number of countries, particularly in the MENA region, where positive increases over 1996-2006 turned to contractions in the following decade. Russia has moved in the opposite direction, becoming more specialised over the past decade.

*Fossil fuels in primary energy use*: Fossil fuels account for c85% of primary energy demand and over 60% of total greenhouse gas (GHG) emissions. To reduce global GHGs, we think fossil fuels must be reduced in energy use where technology makes this possible and it is commercially viable. To assess the level and pace of decarbonisation (reducing emissions related to economic activity) we have looked at the share of fossil fuels in total primary energy demand and the change in it during the last decade (Chart 24).

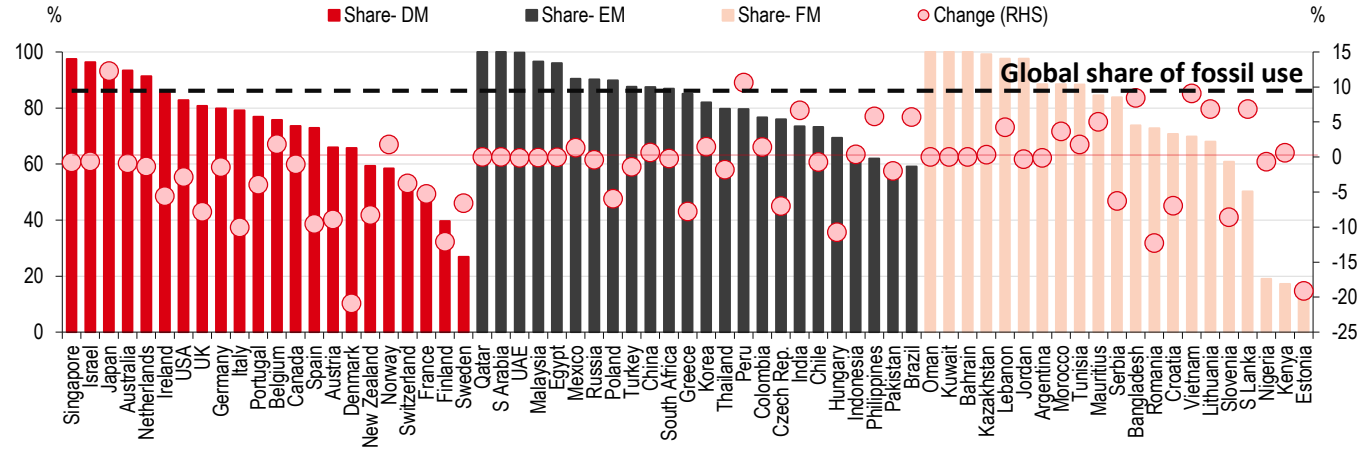
### Transition risks findings – MENA states most vulnerable

**Bahrain comes out as most vulnerable on our energy transition indicators, as discussed at the beginning of this chapter.** Table 6 gives rankings for each indicator, and overall rankings, for energy transition risk. (Underlying data on physical impacts are captured in Table iv in Appendix 6.)

**For countries which have used fossil wealth more prudently, the focus turns to managing transition risks**

Resource curse characteristics are not universally applicable to all fossil states, as some may find resource-abundance to be a blessing. So for those countries that have used oil production positively, resilience to peak demand becomes about managing the transition risk. In the next section, we analyse which countries are best placed to respond, i.e. with the resources to address both their energy transition and physical impacts.

**Chart 24: Fossil fuel share in primary energy (value in 2016 and change over 2006-2016)**




Source: World Bank

HSBC

**Table 6: Transition risk: ranking and overall scores (lower score = higher transition risk)**

| | Fossil rents (% GDP) | | Fossil in export (%) | | Fossil in energy (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Country | 2015 | Chg. (2005-15) | 2016 | Chg. (2006-16) | 2016 | Chg. (2006-16) | Overall score | **Overall rank** | Markets |
| *Weights* | *22%* | *11%* | *22%* | *11%* | *22%* | *11%* | | | |
| Bahrain | 9 | 38 | 10 | 3 | 4 | 24 | 1.84 | **1** | FM |
| Kuwait | 1 | 62 | 2 | 50 | 3 | 27 | 2.50 | **2** | FM |
| Qatar | 5 | 64 | 3 | 57 | 1 | 26 | 2.74 | **3** | EM |
| Oman | 3 | 65 | 5 | 64 | 1 | 25 | 2.85 | **4** | FM |
| S Arabia | 2 | 67 | 4 | 61 | 5 | 23 | 2.87 | **5** | EM |
| Kazakhstan | 7 | 63 | 6 | 54 | 7 | 22 | 2.97 | **6** | FM |
| Malaysia | 13 | 57 | 17 | 13 | 11 | 29 | 3.00 | **7** | EM |
| Colombia | 11 | 51 | 8 | 2 | 38 | 17 | 3.05 | **8** | EM |
| Australia | 21 | 43 | 13 | 8 | 15 | 39 | 3.12 | **9** | DM |
| UAE | 4 | 61 | 11 | 66 | 6 | 31 | 3.32 | **10** | EM |
| Netherlands | 28 | 26 | 20 | 24 | 16 | 41 | 3.63 | **11** | DM |
| Russia | 6 | 60 | 9 | 63 | 18 | 34 | 3.70 | **12** | EM |
| Lebanon | 57 | 3 | 41 | 7 | 8 | 11 | 3.86 | **13** | FM |
| S Africa | 16 | 47 | 22 | 30 | 25 | 32 | 3.90 | **14** | EM |
| Tunisia | 12 | 50 | 32 | 51 | 22 | 15 | 4.11 | **15** | FM |
| Israel | 38 | 1 | 53 | 10 | 12 | 35 | 4.18 | **16** | DM |
| Singapore | 57 | 3 | 19 | 41 | 10 | 38 | 4.21 | **17** | DM |
| Greece | 47 | 25 | 12 | 1 | 27 | 56 | 4.21 | **17** | EM |
| Peru | 27 | 39 | 28 | 38 | 35 | 2 | 4.30 | **19** | EM |
| India | 18 | 45 | 21 | 46 | 43 | 7 | 4.34 | **20** | EM |
| Japan | 54 | 14 | 50 | 12 | 14 | 1 | 4.36 | **21** | DM |
| Mexico | 15 | 53 | 35 | 59 | 17 | 18 | 4.38 | **22** | EM |
| Egypt | 57 | 3 | 15 | 65 | 13 | 28 | 4.41 | **23** | EM |
| USA | 36 | 42 | 26 | 4 | 30 | 46 | 4.58 | **24** | DM |
| Norway | 8 | 58 | 7 | 62 | 59 | 14 | 4.68 | **25** | DM |
| Belgium | 56 | 2 | 24 | 32 | 40 | 13 | 4.76 | **26** | DM |
| Mauritius | 57 | 3 | 49 | 9 | 28 | 10 | 4.81 | **27** | FM |
| S Korea | 55 | 15 | 33 | 31 | 31 | 16 | 4.98 | **28** | EM |
| Indonesia | 17 | 56 | 14 | 55 | 53 | 21 | 4.98 | **29** | EM |
| Morocco | 50 | 16 | 61 | 14 | 21 | 12 | 5.07 | **30** | FM |
| Brazil | 20 | 48 | 29 | 36 | 58 | 9 | 5.09 | **31** | EM |
| Nigeria | 10 | 66 | 1 | 53 | 65 | 36 | 5.09 | **32** | FM |
| China | 26 | 52 | 57 | 25 | 24 | 19 | 5.14 | **33** | EM |
| Bangladesh | 24 | 34 | 62 | 20 | 41 | 4 | 5.17 | **34** | FM |
| Portugal | 57 | 3 | 31 | 11 | 37 | 48 | 5.17 | **35** | DM |
| Poland | 32 | 36 | 45 | 37 | 19 | 51 | 5.24 | **36** | EM |
| Argentina | 22 | 55 | 44 | 60 | 20 | 30 | 5.26 | **37** | FM |
| Jordan | 49 | 22 | 64 | 22 | 9 | 33 | 5.32 | **38** | FM |
| Canada | 33 | 54 | 16 | 45 | 42 | 40 | 5.32 | **39** | DM |
| Thailand | 25 | 41 | 39 | 43 | 34 | 44 | 5.37 | **40** | EM |
| UK | 31 | 37 | 30 | 44 | 32 | 57 | 5.37 | **41** | DM |
| Lithuania | 48 | 31 | 18 | 58 | 50 | 5 | 5.41 | **42** | FM |
| Serbia | 34 | 40 | 48 | 14 | 29 | 52 | 5.44 | **43** | FM |
| Vietnam | 14 | 59 | 65 | 14 | 48 | 3 | 5.47 | **44** | FM |
| Turkey | 44 | 29 | 46 | 42 | 23 | 42 | 5.62 | **45** | EM |
| Croatia | 30 | 28 | 27 | 52 | 47 | 54 | 5.67 | **46** | FM |
| Finland | 57 | 3 | 23 | 5 | 63 | 64 | 5.94 | **47** | DM |
| Italy | 42 | 21 | 43 | 34 | 36 | 62 | 5.95 | **48** | DM |
| Germany | 46 | 27 | 52 | 28 | 33 | 43 | 5.97 | **49** | DM |
| Ireland | 53 | 18 | 60 | 18 | 26 | 50 | 6.04 | **50** | DM |
| Slovenia | 57 | 3 | 40 | 6 | 55 | 59 | 6.17 | **51** | FM |
| Philippines | 41 | 33 | 54 | 33 | 54 | 8 | 6.17 | **52** | EM |
| Romania | 23 | 44 | 38 | 49 | 46 | 65 | 6.17 | **53** | FM |
| Spain | 52 | 19 | 36 | 27 | 45 | 61 | 6.19 | **54** | DM |
| Czech Rep. | 39 | 35 | 56 | 26 | 39 | 55 | 6.37 | **55** | EM |
| Sweden | 57 | 3 | 34 | 19 | 64 | 53 | 6.38 | **56** | DM |
| Sri Lanka | 57 | 3 | 65 | 14 | 60 | 6 | 6.42 | **57** | FM |
| Pakistan | 19 | 49 | 65 | 14 | 56 | 45 | 6.43 | **58** | EM |
| Chile | 45 | 23 | 59 | 40 | 44 | 37 | 6.57 | **59** | EM |
| Denmark | 29 | 46 | 37 | 48 | 52 | 67 | 6.58 | **60** | DM |
| Kenya | 57 | 3 | 42 | 47 | 66 | 20 | 6.63 | **61** | FM |
| Hungary | 37 | 32 | 55 | 29 | 49 | 63 | 6.73 | **62** | EM |
| Austria | 43 | 20 | 58 | 23 | 51 | 60 | 6.75 | **63** | DM |
| New Zealand | 35 | 30 | 51 | 35 | 57 | 58 | 6.78 | **64** | DM |
| Estonia | 40 | 24 | 25 | 56 | 67 | 66 | 6.80 | **65** | FM |
| France | 51 | 17 | 47 | 39 | 62 | 49 | 7.05 | **66** | DM |
| Switzerland | 57 | 3 | 63 | 21 | 61 | 47 | 7.18 | **67** | DM |

Source: HSBC

# Potential to respond to climate risks

- Capital available is an important part of the response – we look at income, debt, sovereign wealth funds and cost-of-capital
- *But money isn't everything*…we consider corruption, equality, law, education – as indicators of countries being equipped to use funds
- We find Kenya, Lebanon and Pakistan to be *least* well equipped to respond to climate risks

In the first section, we considered exposure to physical climate risks, including extreme weather events. In the second section, we examined sensitivity to these events, in terms of people affected, lives lost and dollar costs. Next, we considered energy transition risks, identifying countries that are highly dependent on fossil fuels for their economy and energy use.

**Which countries are better placed to respond?**

Now we think about which countries are better placed to *respond* to the aforementioned physical and transition risks. We do this by looking at *capital available*, and at which countries are stronger on *governance and social indicators* as a guide to being well placed to use this capital.

**METHODOLOGY:** We have used metrics to capture financial well-being (50% weight, including: GDP per capita at PPP, public debt, sovereign wealth funds, cost of capital) and the strength of institutions (50%, including: rule of law, corruption, inequality and tertiary education.) *Our methodology is described in greater detail in Appendix 1.*

**FINDINGS: We find the most vulnerable countries here are Kenya, Lebanon and Pakistan.** FM and EM countries from around the world dominate here. We find the *best*-placed countries are Norway, New Zealand and Australia. The best placed EM or FM countries are South Korea (4th best), the UAE (11th), Saudi Arabia (16th), Kuwait (18th), and Qatar (19th). The hydrocarbon states amongst these have strong financial indicators that offset any relatively lower scores in national governance metrics.

## Who can fund climate ambition?

We've previously talked about climate finance, or "2ºC finance", as the third pillar of addressing climate change. We defined 2ºC finance as **the allocation of capital for the development and provision of a low-carbon economy that minimises and is resilient to the impacts of climate change** (*Keeping it cool – Financing a 2ºC world*, September 2014). A goal of the Paris Agreement is:

- **Making finance flows** consistent with a pathway towards low greenhouse gas emissions and climate resilient development

**There are many sources of climate finance – here we look at that available to governments and the people**

Climate finance can come from a number of capital sources, including capital markets, asset owners, private wealth, corporate cash flows, and can be raised through many instruments including grants and loans, project finance and balance sheet financing. Here we focus on the finance available to governments – public financing – as well as to companies, and the broader level of wealth amongst the population, recognising that much of the climate response will be bottom-up, particularly in terms of responding to the physical impacts. We utilise the following metrics to look at financial resources in the 67 countries in our sample:

1. **Gross domestic product per capita at purchasing power parity (PPP GDPpc)** – This is an indicator of the ability of *the general population* to respond to climate change. PPP GDPpc gives an indication of the wealth of the country's population; the rationale here is that the less wealthy a country is, the less likely it will be able to channel available capital specifically towards adaptation. We chose the 'PPP version' of this per capita indicator given much adaptation spend would occur within the local economy. This is different to the GDPpc indicator, which we considered in the section on transition risk. There we chose the non-PPP version as we were concerned with energy and commodities in the economy and these are therefore exposed to *global* pricing, rather than local factors.
2. **Public debt** – This is an indicator of the ability of *governments* to respond to climate change. Debt requires payment of interest and repayment of capital. Hence if an entity owes money, this limits the capital available to be deployed elsewhere, in this case in investing to achieve climate adaptation and low carbon transition.
3. **Sovereign Wealth Funds (SWFs)** – This is also an indicator of the ability of *governments* to respond to climate change. SWFs are established with variance in mandates – from shorter term stabilisation of government finances during commodity revenue volatility (see note 2 in Appendix 2 for examples), to ongoing contributions to public spending from dividends and interest, and through to seeking to establish a base of wealth for the future (inter-generational equity) – but typically act as a bank for excess commodity revenues until they can be efficiently invested. We believe SWFs will increasingly be part of the equation for countries in transitioning to lower carbon and adapting to climate. By investing outside the domestic economy and by investing in non-fossil fuel companies, as some funds have pledged to, SWFs effectively offer diversification. Here we look at SWFs on a per capita basis – i.e. how much is theoretically available to spend on addressing climate change, per person. However, we note that the mandates according to which SWFs are managed vary from country-to-country. In our modelling we do not allow for variance of mandate and instead assume funds could be made available for adaptation and energy system transition.
4. **Cost-of-equity** – This is primarily an indicator of the ability of *companies* to respond to climate change. The cost of capital can be defined as the rate of return required to persuade the investor to make a given investment, and that could have been earned by financing a different investment with equal risk (the opportunity cost). Here we look at the equity risk premium – the rate which investors expect above the risk-free rate, typically that provided by a 10-year US Treasury Bond. A high equity risk premium means investors see investments in a country as more risky and so they are less likely to commit capital to projects which can include those which enable climate adaptation and mitigation.

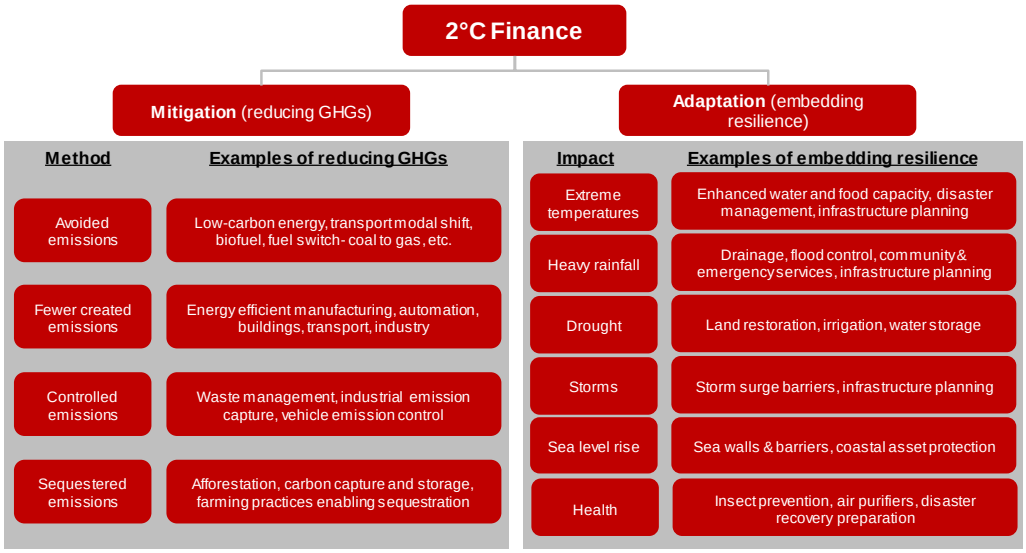
(See the table in Appendix 6 for a full breakdown of data on these financial metrics.)

**Greater resilience costs more, but the losses associated with more warming are greater**

If mitigation efforts in aggregate are not enough to limit warming to 2°C, then the consequences – the impacts for the environment, society and the global economy – are likely to be far more severe. The IPCC, for instance, has stated that "losses accelerate with greater warming" – however, the relationship is not linear because how events will play out at higher temperatures (i.e. what the tail risk is) becomes less clear. More often than not, embedding *extra* resilience (e.g. able to withstand 4°C vs 2°C) *costs more*, and the costs are borne upfront today.

For example, adapting a city's flood defences able to withstand 1-in-25 year storms (i.e. bigger and more severe with greater floods) will cost more now than one which is only able to withstand, say, 1-in-10 year storms (see *Keeping it cool – Financing a 2ºC world*, 10 September 2014). The decision will need to factor in the potential for rebuild within 25 years and the disruption to the local population and economy caused by the more severe storm. The costs of disasters have also been rising. Since 1990, 5.6bn people have been affected by natural weather-related disasters (such as floods, storms, wildfires, droughts and extreme temperatures). Estimated global damage costs over this period are USD2.28trn, of which USD1.31trn was in developed markets, USD0.74trn in emerging markets and USD0.07trn in frontier markets, and the USD0.16trn balance in the remainder of smaller economies around the world. Climate finance can be used in a number of specific ways (for example, see Figure below.)

**Examples of 2°C financing based on mitigation and adaptation**




Source: HSBC (adapted from Quantifying Greenhouse Gas Mitigation Measures, CAPCOA, California (2010), Greenhouse Gas Protocol)

## Institutional quality metrics to gauge national governance potential

**National governance factors are crucial to understanding a country's potential to address risks**

Having the funds available to spend on adapting to and mitigating climate change is one part of a country's adaptive capacity. However, we think it is important to consider which countries have the potential to use funds prudently to adapt. Here we look at four socio-political indicators to capture a countries national governance potential:

1. **Rule of law:** captures the extent of confidence in the rules of society, and includes metrics on the quality of contract enforcement and property rights, as well as the likelihood of crime and violence. We have included this because we believe a country with relatively strong contract enforcement and property rights is more likely to be able to use the funds it has available to respond to climate change.
2. **Corruption:** represents the use of public power for private gain, as well as "capture" of the state by elites and private interests. A corrupt country is less likely to use funds for adapting to and mitigating climate change to the same degree as a less corrupt country, in our view.
3. **Education:** we look at levels of the population achieving tertiary education – a better educated population is more likely to have both the expertise to respond to climate change and an understanding of the risks faced.

4. **Inequality:** we look at the GINI Index, which measures the extent to which the distribution of income within an economy deviates from a perfectly equal distribution. We believe that in a more equal society, more of the population will be focused on the risks faced due to climate change and these risks will be more evenly spread, meaning a larger part of the electorate able to put pressure on governments to take action.

(See the table in Appendix 6 for a full breakdown of the underlying data for these national governance metrics.)

## Who has the potential to respond to climate change?

**Emerging and frontier market countries are least well-equipped to respond to climate risks**

**The countries scoring as most vulnerable in terms of their potential to respond to climate change are Kenya, then Lebanon, followed by Pakistan, as FM and EM countries from around the world dominate on this measure.** Table 7 breaks this down. Italy is the most vulnerable DM, ranked at 24 overall. At the other end of the spectrum, **the best-placed countries to respond to climate change are Norway, New Zealand and then Australia**. **The best placed EM or FM countries are South Korea (4th best), the UAE (11th), Saudi Arabia (16th), Kuwait (18th), and Qatar (19th).** The hydrocarbon states amongst these have strong financial indicators that offset any relatively lower scores in national governance metrics.

> **Emerging and frontier market countries, from around the world, dominate the list of *least* well-equipped to respond to climate change**

**In this fourth section, we've added an understanding of institutional and governance quality in responding to climate change to the previous sections which considered physical exposure, sensitivity to extreme weather events and transition risks.** Table 7 gives rankings for each indicator, and overall rankings, for the potential of countries to respond to climate change. (Underlying data on financial and governance metrics are captured in Table v in Appendix 6.) **In the next section, we look at *overall* climate vulnerability, collating the findings in each of these three sections.**

HSBC

**Table 7: Capacity to respond to climate change: ranking and overall scores (lower score = lower potential)**

| | GDP PPP pc | Pub. debt | SWF pc Eq. risk prem. | | GINI | Governance | | Education | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Country | 2016 | % GDP | USD | (%) | | Control of corrpt. | Rule of law | School enrol, tert. | Overall score | **Overall rank** | Markets |
| | | 2015 | | | | | | (%) | | | |
| *Weights* | *12.5%* | *12.5%* | *12.5%* | *12.5%* | *12.5%* | *12.5%* | *12.5%* | *12.5%* | | | |
| Kenya | 1 | 37 | 1 | 7 | 37 | 3 | 6 | 1 | 1.74 | **1** | FM |
| Lebanon | 17 | 3 | 1 | 2 | 50 | 2 | 2 | 20 | 1.81 | **2** | FM |
| Pakistan | 3 | 28 | 1 | 2 | 55 | 5 | 3 | 3 | 1.87 | **3** | EM |
| Sri Lanka | 13 | 20 | 1 | 7 | 19 | 20 | 21 | 8 | 2.03 | **4** | FM |
| Egypt | 10 | 14 | 1 | 2 | 50 | 9 | 10 | 18 | 2.13 | **5** | EM |
| Brazil | 19 | 22 | 1 | 15 | 2 | 11 | 19 | 27 | 2.16 | **6** | EM |
| Mexico | 22 | 35 | 1 | 35 | 4 | 8 | 7 | 15 | 2.37 | **7** | EM |
| Bangladesh | 2 | 54 | 1 | 13 | 46 | 7 | 5 | 5 | 2.48 | **8** | FM |
| Nigeria | 4 | 64 | 49 | 5 | 8 | 1 | 1 | 4 | 2.54 | **9** | FM |
| India | 6 | 24 | 1 | 26 | 29 | 19 | 20 | 11 | 2.54 | **10** | EM |
| Philippines | 7 | 52 | 1 | 26 | 17 | 10 | 11 | 17 | 2.63 | **11** | EM |
| S Africa | 15 | 40 | 1 | 21 | 1 | 30 | 26 | 7 | 2.63 | **12** | EM |
| Tunisia | 11 | 34 | 1 | 7 | 25 | 25 | 23 | 16 | 2.65 | **13** | FM |
| Indonesia | 12 | 57 | 1 | 21 | 18 | 14 | 12 | 9 | 2.69 | **14** | EM |
| Morocco | 8 | 27 | 1 | 17 | 37 | 24 | 17 | 13 | 2.69 | **14** | FM |
| Colombia | 16 | 39 | 1 | 26 | 3 | 16 | 14 | 31 | 2.72 | **16** | EM |
| Peru | 14 | 58 | 1 | 35 | 7 | 15 | 8 | 21 | 2.97 | **17** | EM |
| Jordan | 9 | 11 | 1 | 7 | 42 | 35 | 30 | 24 | 2.97 | **18** | FM |
| Argentina | 23 | 36 | 1 | 5 | 9 | 18 | 13 | 56 | 3.00 | **19** | FM |
| Vietnam | 5 | 32 | 48 | 7 | 30 | 13 | 25 | 14 | 3.25 | **20** | FM |
| Serbia | 18 | 19 | 1 | 13 | 57 | 17 | 18 | 34 | 3.30 | **21** | FM |
| Thailand | 21 | 46 | 1 | 32 | 20 | 12 | 22 | 26 | 3.36 | **22** | EM |
| Greece | 31 | 2 | 1 | 1 | 25 | 27 | 27 | 67 | 3.38 | **23** | EM |
| Italy | 43 | 4 | 1 | 26 | 31 | 29 | 28 | 37 | 3.71 | **24** | DM |
| Mauritius | 24 | 31 | 1 | 32 | 25 | 36 | 38 | 19 | 3.84 | **25** | FM |
| Croatia | 27 | 15 | 1 | 15 | 45 | 33 | 32 | 46 | 3.99 | **26** | FM |
| Portugal | 37 | 5 | 1 | 17 | 28 | 45 | 47 | 35 | 4.01 | **27** | DM |
| Turkey | 29 | 53 | 1 | 17 | 12 | 23 | 16 | 66 | 4.05 | **28** | EM |
| Hungary | 32 | 21 | 1 | 21 | 54 | 31 | 35 | 28 | 4.16 | **29** | EM |
| China | 20 | 44 | 54 | 41 | 10 | 21 | 15 | 23 | 4.25 | **30** | EM |
| Malaysia | 33 | 33 | 53 | 35 | 6 | 32 | 36 | 10 | 4.44 | **31** | EM |
| Russia | 25 | 62 | 52 | 17 | 21 | 4 | 4 | 53 | 4.44 | **31** | EM |
| Romania | 26 | 49 | 1 | 21 | 61 | 28 | 29 | 30 | 4.57 | **33** | FM |
| Spain | 41 | 9 | 1 | 26 | 24 | 40 | 41 | 63 | 4.57 | **34** | DM |
| Israel | 42 | 26 | 1 | 41 | 11 | 46 | 42 | 41 | 4.66 | **35** | DM |
| Lithuania | 36 | 45 | 1 | 35 | 21 | 41 | 43 | 45 | 4.98 | **36** | FM |
| Bahrain | 53 | 30 | 61 | 7 | 37 | 26 | 33 | 22 | 5.02 | **37** | FM |
| Kazakhstan | 30 | 59 | 60 | 21 | 65 | 6 | 9 | 25 | 5.13 | **38** | FM |
| Japan | 46 | 1 | 1 | 41 | 46 | 52 | 50 | 39 | 5.15 | **39** | DM |
| Poland | 34 | 38 | 1 | 39 | 46 | 42 | 37 | 43 | 5.22 | **40** | EM |
| UK | 48 | 13 | 1 | 50 | 34 | 58 | 55 | 32 | 5.43 | **41** | DM |
| France | 45 | 10 | 1 | 50 | 44 | 51 | 52 | 40 | 5.47 | **42** | DM |
| Chile | 28 | 61 | 1 | 47 | 5 | 47 | 46 | 62 | 5.54 | **43** | EM |
| Slovenia | 38 | 17 | 1 | 32 | 67 | 43 | 44 | 57 | 5.58 | **44** | FM |
| Oman | 47 | 63 | 58 | 26 | 37 | 37 | 31 | 2 | 5.62 | **45** | FM |
| Belgium | 51 | 6 | 1 | 47 | 60 | 54 | 51 | 50 | 5.97 | **46** | DM |
| Czech Rep. | 39 | 47 | 1 | 41 | 66 | 39 | 45 | 42 | 5.97 | **46** | EM |
| Estonia | 35 | 66 | 1 | 41 | 33 | 48 | 49 | 47 | 5.97 | **48** | FM |
| Qatar | 67 | 48 | 64 | 47 | 14 | 44 | 39 | 6 | 6.14 | **49** | EM |
| Kuwait | 65 | 65 | 65 | 50 | 37 | 22 | 24 | 12 | 6.34 | **50** | FM |
| Germany | 54 | 23 | 1 | 57 | 53 | 57 | 54 | 44 | 6.40 | **51** | DM |
| S Arabia | 59 | 67 | 62 | 41 | 14 | 34 | 34 | 38 | 6.51 | **52** | EM |
| Austria | 57 | 16 | 1 | 55 | 56 | 53 | 58 | 54 | 6.53 | **53** | DM |
| USA | 60 | 7 | 51 | 57 | 13 | 50 | 56 | 60 | 6.60 | **54** | DM |
| Switzerland | 62 | 41 | 1 | 57 | 43 | 61 | 64 | 33 | 6.75 | **55** | DM |
| Netherlands | 58 | 25 | 1 | 57 | 58 | 59 | 61 | 52 | 6.92 | **56** | DM |
| UAE | 64 | 60 | 66 | 50 | 14 | 49 | 40 | 29 | 6.94 | **57** | EM |
| Canada | 50 | 12 | 50 | 57 | 36 | 60 | 60 | 48 | 6.96 | **58** | DM |
| Sweden | 55 | 43 | 1 | 57 | 62 | 64 | 67 | 36 | 7.18 | **59** | DM |
| Singapore | 66 | 8 | 63 | 57 | 23 | 62 | 59 | 48 | 7.20 | **60** | DM |
| Finland | 49 | 29 | 1 | 55 | 63 | 66 | 65 | 61 | 7.26 | **61** | DM |
| Ireland | 63 | 18 | 55 | 39 | 49 | 55 | 53 | 58 | 7.28 | **62** | DM |
| Denmark | 56 | 42 | 1 | 57 | 59 | 65 | 62 | 55 | 7.41 | **63** | DM |
| S Korea | 40 | 50 | 56 | 50 | 52 | 38 | 48 | 65 | 7.44 | **64** | EM |
| Australia | 52 | 51 | 57 | 57 | 31 | 56 | 57 | 64 | 7.93 | **65** | DM |
| New Zealand | 44 | 55 | 59 | 57 | 35 | 67 | 63 | 59 | 8.19 | **66** | DM |
| Norway | 61 | 56 | 67 | 57 | 63 | 63 | 66 | 51 | 9.03 | **67** | DM |

Source: HSBC; Note: SWF value is assumed to be zero wherever it is unavailable and hence assigned rank of 1, implying low capacity for adaptive response

# Vulnerability – final thoughts

- A holistic response to climate vulnerability means managing physical and transition risks, enabled by the resources to do so
- Vulnerability is addressed at many levels, via nation states, international mechanisms, and by non-state actors
- We think investors should study vulnerability as key to long-term sustainable development of countries where they have exposure

## Wider features of the global climate response

To recap, we've analysed overall vulnerability to climate change amongst the 67 countries in the MSCI Developed, Emerging and Frontier Markets (ex- Hong Kong and Taiwan) as follows;

- **Physical impacts** faced by countries – their exposure to these and sensitivity to extreme weather events.
- **Sensitivity to extreme weather** events – via costs, people affected and fatalities
- **Transition risks** – how dependent countries are on the fossil fuel energy economy.
- **Potential to respond to climate change** – capturing the financial resources available to countries to spend on addressing their physical impacts and transition risks, as well as the national governance indicators which indicate how well placed they are to build a response.

We believe our methodology provides a robust means of understanding country climate vulnerability.

**International, national and sub-national…**

Additionally, there are a number of other drivers and mechanisms to consider, which add to our understanding of climate risk at the nation state level, in our view. These include:

- **Pledges to the Paris Agreement**

  All 197 Parties to the UN Framework Convention on Climate Change (UNFCCC) have now either signed or ratified the Paris Agreement. These countries made pledges towards the Paris Agreement. Known as Intended Nationally Determined Contributions, or INDCs, these pledges described the country's ambition for addressing climate change (see Appendix 5). Many set emissions reduction targets requiring transition in the energy system and plans for adapting to the impacts of climate change, while a large number also discuss the financial requirements of meeting these targets.

- **Green Climate Fund**

  The Green Climate Fund (GCF) is a UNFCCC-governed fund designed to finance adaptation and mitigation projects in developing countries. The GCF portfolio is currently estimated to be worth c. USD9.15bn. In 2017, it was announced that USD2.65bn had been approved for various climate change projects and programmes to be rolled out across 73 *developing* countries. Of the USD2.65bn, 31% will be allocated to climate adaptation, and 40% to mitigation, with 29% covering both.

- **UNFCCC Adaptation Committee**

  The UNFCCC's Adaptation Committee is responsible for helping countries deliver on the adaptation related pledges of the Paris Agreement (we estimate these feature in 127 of the 188 pledges submitted). This country level focus is in keeping with the pledges made towards the Paris Agreement, but is also reflective of the localised nature of climate related risks. In pledges towards the Paris Agreement, 56 countries requested financial support which specifically included the need for adaptation spending, with specific provisions requesting support towards adaptation coming to approximately USD 600bn.

- **Green bonds**

  Several EM governments have chosen to issue green bonds to fund emission reduction and adaptation. These include Poland, which has issued two green bonds, Indonesia with a green Sukuk, and Fiji and Nigeria, which have issued local currency green bonds. See *Green Bond Insights, So you want to set up a green bond fund*, 1 March 2018.

- **Non-state actors**

  The United Nations Framework Convention on Climate Change (UNFCCC) is embracing the actions of so-called non-state actors (NSAs) – cities, regions, companies, investors and civil society – as a means to raise ambition levels for climate action. These efforts continue to aggregate – the NAZCA (Non-State Actor Zone for Climate Action) portal, launched via the 2014 Lima Paris Action Agenda, recorded 12,549 initiatives as of February 2018 (up from 2,400 in March 2015).

  We think this is extremely important because NSAs can move more quickly in implementing climate change policies and measures, given: potential for faster decision-making; local governance meaning greater accountability to one's electorate for local decisions; and control over specific budgets to prioritise important outlays for meeting local policy ambition.

  We think city actions will be particularly relevant where domestic climate policy ambition weakens. In the US, where President Trump has signed an executive order to pull the US out of the Paris Agreement, it is encouraging from a climate standpoint that 93 US cities (as well as 17 states and 3 counties) have pledged commitments to climate action through the UN's NAZCA portal.

## Final thoughts: why countries must transition *and* adapt now

**Social impacts are mounting**

Climate impacts are already with us. But the thinking about adaptation is evolving as physical impacts – warming and altered hydrological cycles – translate into social impacts, including exacerbated health risks. Specific risks include heat stress, water-related illnesses, allergens, vector borne diseases, exacerbated air pollution, food security. Over 2030 to 2050, the World Health Organisation (WHO) expects 250,000 additional deaths per year due to climate change. Furthermore, climate change is disrupting ecosystems and biodiversity, with unknown long-term effects on the environment and society.

**250,000 pa**

**Additional deaths attributable to climate change over 2030-2050 (WHO)**

**Risks to the old energy economy mean risks to economies**

Meanwhile, transitioning to a lower-carbon economy and energy system is also key for the future prosperity of countries and the well-being of their citizens. Remaining invested in fossil fuels where global demand falls risks economic challenges, as already seen in recent years when volatile oil price benchmarks were lower over 2014 -16 in particular. Many countries and other actors are at risk of seeing parts of their old energy economy becoming effectively 'stranded assets' – or economically non-viable – given climate and environmental policies, the relative economics of alternatives and new breakthrough technologies.

Understanding climate change vulnerability is partly about interpreting data on physical impacts relating to temperatures, water and extreme weather events, in our view. It is also about understanding socio-economic sensitivity to such events. However, we believe that, for a fuller understanding of vulnerability, as the world moves towards a lower carbon future, energy transition risks must also be factored in. Lastly, having the funds available and the governance structures in place to prudently use such funds is key to national responses. With this report, we've brought these together to rank the world's larger economies and further understanding of country-level climate vulnerability.

**We think an understanding of climate vulnerability is important to investors across the economy**

We therefore believe this analysis will be useful for investors, highlighting challenges which lie ahead for countries in transitioning economies onto lower-carbon trajectories and adapting to the physical impacts of climate change. In our view, investors can use our analysis to gain a fuller understanding of national risk profiles, potential for disruption to supply and demand, risks to operations, capital expenditure, supply chains and customers, and broadly the challenges to the long-term sustainable development of countries and protection of their people, environment and economies.

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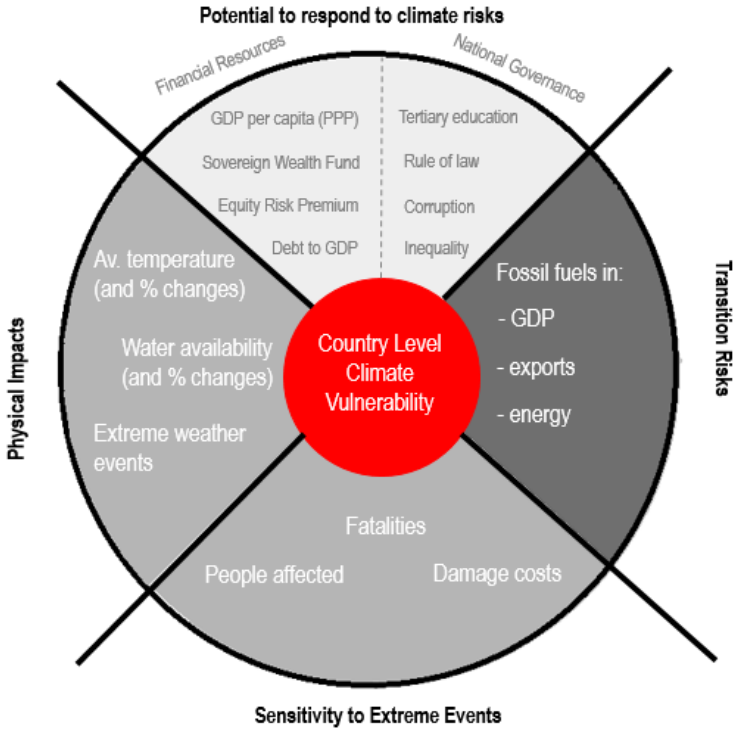
# Appendix 1 – Methodology

To gauge the vulnerability of countries to climate change risks, we use four sets of indicators.

We look at vulnerability to the *physical* impacts of climate change via two sets of indicators, one to measure *exposure* to risks – i.e. metrics on temperature, water and extreme weather events – and the other to measure *sensitivity* – how people and the economy are affected by extreme weather events. Third, we consider how well countries are placed on *transition risk* in terms of dependence on fossil fuels in their economy and energy system. Finally, a fourth set looks at countries' potential to respond to these physical and transition risks via indicators that capture both economic strength to deploy funds and the national governance potential to prudently do so. Individual metric scores are weighted and added to calculate a total score, per each set of indicators. The Figure below captures the indicators used.

We have calculated **overall vulnerability scores** by assigning equal weights (25%) to each of the four categories (*exposure to physical risk, sensitivity to extreme weather events, energy transition risk and potential to respond to climate change*). We are thus able to rank countries *within* categories *and* overall.

**HSBC methodology for scoring climate vulnerability**




Source: HSBC

## Measuring physical impacts

**Three factors in climate exposure**

To understand *exposure*, we have based our scoring of physical climate impacts on three main parameters, temperature levels (35% of the exposure score), water availability (50%) and extreme weather events (15%), detailed here:

**Temperature levels:** Rise in atmospheric temperature is a direct manifestation of climate change. However, local and global trends could vary greatly due to interaction of various elements of the earth's complex climate system[11]. We think, even though the cost of climate change will vary between the regions, it will be disproportionately high for countries in the tropics, many of which are classified as emerging and frontier. For the purpose of scoring in this report, we have considered higher average temperatures as an indicator of higher climate exposure. Data is taken from the World Bank. In this report, our analysis of exposure to temperature rise hinges on two factors:

1. **Level:** Average temperature in the decade 2006-2015
2. **Change** in average temperatures between 1996-2005 and 2006-2015

We have used country level temperature data provided by the World Bank which averages values recorded at multiple stations (Note 3 in Appendix 2 gives more detail).

**A higher weight to water**

**Water availability:** This report measures exposure to water stress by evaluating the amount of water resources available per person. The impact of climate change on water resource availability will be felt through a change in the water-cycle that will be experienced by almost every region. And so we have **assigned a higher weight to water than the temperature metrics or extreme events.** Data is taken from the Food & Agriculture Organisation (FAO). We use the following two indicators in scoring:

1. **Level:** Annual renewable water resource available per capita in 2016.
2. **Change:** An assessment of the change in water resources over the decades

**Extreme events:** We attribute a lower 15% for frequency of extreme events in scoring physical risk exposure because such events are also captured in the following section, where we look at *sensitivity* to storms, floods, droughts, wildfires and extreme temperatures. Data is taken from the EMDAT database.

**Total exposure ranking:** We have normalised indicators where needed to allow comparison – damage costs have been normalised with GDP, number of events with the country land area, and number of deaths and lives affected with the size of the population. Overall, scores are scaled to a decimalised value between 0 and 10 and all countries in our sample are then ranked.

## Measuring and scoring for sensitivity to extreme weather events

**Socio-economic impacts of droughts, floods, extreme temperatures, storms and wildfires**

We define sensitivity as the impacts felt by society and the economy, specifically to extreme weather events which are linked to climate change - droughts, floods, extreme temperatures, storms and wildfires. Data is taken from the World Bank and the EMDAT database. Our sensitivity scoring uses three areas:

1. **cost of damage** (40% weighting)
2. **number of deaths** (30% weighting)
3. **number of people affected** (30% weighting)

**Total sensitivity ranking:** We thus attempt to capture what the physical impacts of climate change actually mean at a socio-economic level. Overall, as with exposure, all sensitivity scores are scaled to a decimalised value between 0 and 10 and all countries in our sample are then ranked.

11 The Climate System, Working Group I: The Scientific Basis, Weblink: https://www.ipcc.ch/ipccreports/tar/wg1/040.htm, accessed 30 January 2018

## Measuring and scoring for energy transition risks

**Challenges in transitioning to a lower-carbon trajectory**

Our analysis in *Scoring Climate Risk*, 23 March 2016 looked at the physical impacts of climate change and how well placed countries were to adapt to these. We have developed our thinking since the 2016 report to look at *energy transition risk* – a concept which encapsulates the challenges faced by countries around the world associated with transitioning to a lower-carbon economy. We gauge transition risk by looking at the diversification of the economy, energy consumption and exports away from carbon and towards cleaner energy forms. Data are taken from the United Nations Conference on Trade and Development (UNCTAD) database.

We have modelled to capture overall exposure to the transition risks of climate change by looking at diversification of exports, energy and GDP away from fossil fuels. To do this we have considered three metrics, capturing diversification over the past ten years, with two indicators for each – the level and the change:

1. **Fossil rents (economic profit) as a % of GDP:** We have compared fossil rents – the 'economic profit' derived from the production of coal, oil and natural gas – with the size of the economy. Countries that rely heavily on fossil production to support fiscal spending risk macroeconomic destabilisation when the fossil price or demand goes down. *We capture the actual value for 2015 and the change over 2005-2015.*
2. **Share of fossil fuels in exports:** We have considered the value of fossil fuel exports relative to total exports. Significant net exports of fossil fuels puts countries' trade balances at risk in an environment where less are demanded in future. *We capture the actual value for 2016 and the change over 2006-2016.*
3. **Share of fossil fuels in primary energy use:** We use the consumption of fossil fuels relative to total primary energy consumption. Countries still heavily dependent on fossil fuels in their energy systems are less closely aligned with a 2ºC warming outcome. *We capture actual value for 2016 and change over 2006-2016.*

Our scoring of countries' energy transition risk assigns equal (one-third) weights to fossil rents, share of fossils in exports, and share of fossils in energy demand. Each parameter is captured in terms of absolute value and the change over the last decade – for each we have assigned twice the weighting of the level of that of the change. This is because we believe countries already at a lower level of fossil dependence should be 'rewarded', rather than equally scored with those moving from a high base level of carbon dependence, although the fact that some carbon-heavy economies are now beginning to transition towards cleaner energy should indeed be rewarded also. As per previous sections, scores are given between 1 and 10 according to positioning amongst the 67 countries and then aggregated for the overall score.

## Measuring and scoring for potential to respond to climate change

**Money and the ability to use it prudently**

This final section attempts to capture how well countries are placed to address the impacts of climate change and the need to transition their economies on to a lower-carbon trajectory.

To score countries, we have used metrics to capture financial well-being (allocated a 50% weight). We've also looked at the strength of countries' institutions (with a 50% weight) via inequality, corruption, rule of law and tertiary education.

**Funds available to government, society and companies**

### Climate finance

Climate finance can come from a number of capital sources, including capital markets, asset owners, private wealth and corporate cash flows, and can be raised through many instruments including grants and loans, project finance and balance sheet financing. Here we focus on the finance available to governments, the population and companies – public financing – and the broader level of wealth amongst the population, recognising that much of the climate response will be bottom-up, particularly in terms of addressing the physical impacts. Data are taken from the World Bank, the IMF and the Sovereign Wealth Fund Institute. We utilise the following metrics in the 67 countries under consideration in doing so, assigning equal weights to each:

1. **Gross domestic product per capita at purchasing power parity (PPP GDPpc)** –We chose the 'PPP version' of this per capita indicator given much adaptation spend would occur within the local economy. This is different to the GDPpc indicator which we considered in the section on transition risk, where we chose the non-PPP version as we were concerned with energy and commodities in the economy and these are therefore exposed to *global* pricing, rather than local factors.
2. **Public debt** − To allow for different overall economy sizes, here we consider the level of a country's public debt relative to the GDP of the country.
3. **Sovereign Wealth Funds (SWFs)** − Here we look at SWFs on a per capita basis, i.e. how much is theoretically available to spend on respond to climate change, per person.
4. **Cost-of-capital** – We utilise the equity risk premium, i.e. the rate which investors expect above the risk-free rate, typically that provided by a 10y US Treasury Bond. A high equity risk premium means investors see investments in a country as more risky and so they are less likely to commit capital to projects, which can include those which enable climate adaptation and mitigation.

**Socio-political indicators to understand national governance**

### National governance potential

Having the funds available to spend on adapting to and mitigating climate change is one part of a country's adaptive capacity. However, we think countries must also have the potential to use funds prudently to respond to climate change. Here we look at four socio-political indicators to capture a countries national governance potential (the datapoints we have utilised to capture the metrics below are taken from the World Bank and the IMF):

1. **Rule of law:** captures the extent of confidence in the rules of society, and includes metrics on the quality of contract enforcement and property rights, as well as the likelihood of crime and violence.
2. **Corruption:** represents the use of public power for private gain, as well as "capture" of the state by elites and private interests.
3. **Education:** we look at levels of the population achieving tertiary education – a better educated country is more likely to have both the expertise to respond to climate change and an understanding of the risks faced.

4. **Inequality:** we look at the GINI Index, which measures the extent to which the distribution of income within an economy deviates from a perfectly equal distribution. We believe that in a more equal society, climate risks are more evenly spread and there will be more equal opportunities for all to aim for a more resilient future, rather than their being a significant disparity in vulnerability.

**Governance indicators capture potential for positive behavioural change**

Where the rule of law is strong, corruption is lower, and a higher proportion of the population has received tertiary education, we assume the potential for stronger central governance of climate change is higher. Also from a bottom-up perspective, these three indicators, as well as inequality, together show greater potential for positive behavioural changes amongst the general population, in our view.

The distribution of weights within each of the two categories is given in Table v. As per previous sections, scores are given between 1 and 10 according to positioning amongst the 67 countries and then aggregated for the overall score.

## Overall climate vulnerability

The assessment of overall climate vulnerability integrates the four indicators discussed above. **Thus conceptually, vulnerability is a function of the exposure and sensitivity to physical impacts, energy transition risks and the potential to respond to climate change.** Our scoring method assigns scores to the four indicators, as mentioned before, such that a lower score implies a higher vulnerability for any indicator. We weight the four categories of scores equally and add them together, to arrive at a final vulnerability score for each of the 67 countries (see table 1).

# Appendix 2 – notes

1. *(Follows from page 9)* The time span of our analysis is too small to see a perceptible difference in water availability created by changes in hydrological cycles which can be attributed to climate change. As a result of which, the change in values (per capita availability) over time could solely be attributed to rising population. Irrespective of this, we believe that countries experiencing water stress face greater exposure to associated climate change related exposure, i.e. *water availability can change because of demand or supply variation*. On the demand side, this can be due to a growing population and/or a population with higher water use (for instance a more affluent country). In terms of supply, droughts and changing hydrological patterns can limit supply, while investment in water infrastructure, changes in economic activity and higher rainfall can increase supply. We have used *internal water resources* data to avoid double counting and political complexity relating to expropriation of water resources from neighbouring states, but there may be variability in absolute *external* resources available to countries – inflows from upstream countries (including groundwater and surface water, and part of the water of border lakes and rivers).
2. *(Follows from page 35)* Kuwait's General Reserve Fund was established in 1960 and replaced by the Reserve Fund for Future Generations in 1976. The Venezuelan Investment Fund was set up during the oil boom years of the 1970s and more recently President Chavez replaced it with the 1998 Macroeconomic Stabilisation Fund, to act as a buffer against volatile oil prices. The Oman Oil Fund was established in 1993 for the purpose of financing state investments in the sector. The Alaska Permanent Fund was established in 1976 and receives 50% of certain mineral revenues.
3. *(Follows from page 44)* This source differs from our previous reports on ranking G20 countries on climate risk, in which we used single station temperature data for countries provided by the US National Oceanic and Atmospheric Administration (NOAA). As a result of this, the temperature values are not comparable between this report and its conceptual predecessor, *Scoring Climate Risk*, 23 March 2016. The latest year of country level data available is 2015, which we use to measure country-wide temperature exposure (for individual stations it is 2016).

# Appendix 3 – vulnerability indicators

### Summary of vulnerability indicators

| Indicator | Weight | Value | Summary rationale |
|---|---|---|---|
| **Exposure** | **25%** | | |
| 1) Avg. temperature | | Average °C 2006-15 | A higher starting average temperature indicates a greater vulnerability |
| 2) Temp. changes | | % change 1996-2005 to 2006-15 | A higher rate of increase in average temperature suggests a higher vulnerability |
| 3) Water availability | | Data for 2016 in m3 renewable/per capita/yr | A lower water availability per capita value indicates a greater vulnerability |
| 4) Water availability | | % change from 2006 to 2016 | A higher value negative percentage change of renewable water per capita indicates a greater vulnerability |
| 5) Extreme events | | Adjusted per land area | A high level of extreme events indicates a higher exposure |
| **Impact sensitivity** | **25%** | | |
| 1) People affected | | Number affected by weather events* | More people affected reflects a higher vulnerability |
| 2) Deaths | | Number killed by weather events | Higher number reflects a higher vulnerability |
| 3) Damage costs | | USD as a proportion of GDP | Higher proportional damage costs as a proportion of the economy reflect a higher vulnerability to climate change driven weather events |
| **Energy transition risk** | **25%** | | |
| 1) Fossil rents | | Share of earnings from fossil fuel production in GDP | Higher rents signify higher transition risk |
| 1) Fossil rents | | Change in share over 2006-2016 | An increase in share implies higher transition risk |
| 2) Fossil in export | | Share in total export of goods and services | A higher share of fossil in export reflects higher transition risk |
| 2) Fossil in export | | Change in share over 2006-2016 | An increase in share implies higher transition risk |
| 3) Fossil in energy | | Share in primary energy use | A higher share reflects higher transition risk |
| 3) Fossil in energy | | Change in share over 2006-2016 | An increase in share implies higher transition risk |
| **Capacity for adaptive response** | **25%** | | |
| 1) Wealth | | Income per capita (USDm ppp) | A lower GDP per capita indicates a higher vulnerability because of the lower ability to invest to adapt |
| 2) Budget | | Debt to GDP ratio | Higher debt indicates a lower capacity to pay for infrastructure build |
| 3) Sovereign Wealth Fund (SWF) | | SWF per capita in USD | Higher SWF per capita implies higher capacity for adaptive response |
| 4) Equity risk premium (ERP) | | Represents cost of raising equity funding | Higher ERP implies lower capacity for adaptive response |
| 5) Inequality index (GINI) | | Represents income distribution | Higher inequality implies lower capacity for adaptive response |
| 6) Rule of law | | Index to capture perception of confidence in rule of law | Higher rule of law indicates better governance and a better environment for deploying capital effectively |
| 7) Corruption | | Index to capture perception of control of governance | Better control of corruption indicates a greater likelihood of proper allocation of funds for adaptation |
| 8) Education | | Ratio of total enrolment to the population officially corresponding to tertiary education age | Higher education indicates a higher skills base to effect and demand change |

Source: HSBC; Note: * weather events considered are drought, extreme temperatures, flood, storm and wildfire

# Appendix 4 – MSCI market classifications

### MSCI Market Classification Framework

The MSCI's market classification criteria has three main parts: economic development, size and liquidity/market accessibility.

Economic development is used to identify whether a market is developed, and not to distinguish between emerging and frontier markets, as this can vary broadly between the two. Below is the full MSCI market classification criteria. MSCI reviews country status frequently, however reclassification only happens when changes are believed to be permanent.

### MSCI Market Classification criteria for DM, EM and FM markets

| Criteria | Frontier | Emerging | Developed |
|---|---|---|---|
| **Economic development** | | | |
| Sustainability of economic development | - | - | GNI per capita 25% above World Bank "high income" threshold* for three consecutive yrs |
| **Size and liquidity requirements** | | | |
| Min. number of companies at the below criteria: | 2 | 3 | 5 |
| *Company size (full market cap)*** | *USD763m* | *USD1.526m* | *USD3,053m* |
| *Security size (float market cap)*** | *USD65m* | *USD763m* | *USD1,526m* |
| *Security liquidity* | *2.5% ATVR**** | *15% ATVR* | *20% ATVR* |
| **Market accessibility criteria** | | | |
| Openness to foreign ownership | At least some | Significant | Very high |
| Ease of capital inflows/outflows | At least some | Significant | Very high |
| Efficiency of the operational framework | Modest | Good & tested | Very high |
| Competitive landscape | High | High | Unrestricted |
| Stability of the institutional framework | Modest | Modest | Very high |

Source: MSCI
Note: *Threshold – GNI per capita of USD12,476 in 2016. **Updated semi-annually, minimum in use for the November 2017 Semi-Annual Index Review. ***Annualised traded value ratio

# Appendix 5 – Country INDCs

### Country INDCs

| | Pledge | Target year | Base year | Long-term pledge | Comments | Adaptation policy (Y/N) and proposed strategy |
|---|---|---|---|---|---|---|
| **Developed Markets** | | | | | | |
| Australia | 26-28% | 2030 | 2005 | None | Reserves right to adjust target should it consider UCA inadequate | N | Australia has developed a National Climate Resilience and Adaptation Strategy |
| Canada | 30% | 2030 | 2005 | None | Intends to account for the land sector using a net-net approach | N | - |
| EU | 40% | 2030 | 1990 | Reduce emissions by 80-95% by 2050 from 1990 | No contribution from international credits | N | - |
| Israel | NA | 2030 | 2005 | None | Target 7.7tCO2e per capita by 2030, 26% below the 10.4tCO2e in 2005 | Y | National Adaptation Plan |
| Japan | 26% | 2030 | 2013 | None | Equivalent to 25.4% reduction from 2005 levels | N | - |
| New Zealand | 30% | 2030 | 2005 | 50% below 1990 by 2050 | The 30% target is comparable to a 11% reduction from 1990 | N | - |
| Norway | 40% | 2030 | 1990 | To become a low emission society by 2050 | Target to be met through collective delivery with the EU | N | - |
| Singapore | Peak | 2030 | NA | None | Aims to cut emissions intensity of GDP by 36% by 2030 (vs. 2005) | N | - |
| Switzerland | 50% | 2030 | 1990 | Reduce emissions 70-85% by 2050 from 1990 | Carbon credits from international mechanisms will partly be used | N | - |
| United States | 26-28% | 2025 | 2005 | Reductions of 80% or more by 2050 | Will aim to reduce emissions by 28% | N | - |
| **Emerging Markets** | | | | | | |
| Brazil | 37% | 2025 | 2005 | None | Equivalent to 6% below 1990; already achieved 41% below 2005 by 2012. Indicative target of 16% below 1990 by 2030 (equivalent) | Y | National Adaptation Plan, implement knowledge management systems, promote research and technology development for adaptation |
| Chile | NA | 2030 | 2007 | None | Unconditional reduction in emission intensity of GDP by 30% by 2030 (2007); conditional intensity reduction 35%-45% if financial support | Y | National Plan for Adaptation (including sector plans), develop an assessment exercise through vulnerability indicators and methodologies to determine the increasing adaptive capacity of individuals, communities and systems |
| China | Peak | 2030 | NA | None | Cut carbon intensity of GDP by 60-65% by 2030 from 2005 | N | - |
| Colombia | 20% | 2030 | BAU | None | Up to 30% from 2030 BAU with international support | Y | Strengthen agriculture, education and technology |
| Egypt | NA | 2030 | NA | None | Listed out 30 mitigation actions across different sectors at the national level | | Manage decreasing water resources through maintaining water level in Lake Nasser, increased water storage capacity, improved irrigation systems. Agricultural security, adaptation in coastal zones, affected populations relocated to safe zones |
| India | NA | 2030 | 2005 | None | Reduce emissions intensity of GDP by 33-35% from 2005 level; achieve 40% installed capacity from non-fossil fuel based energy resources; create additional carbon sink through forest cover | Y | Adaptation in agriculture, water, Himalayan ecosystems, forestry, capacity building, and knowledge management, strengthen adaptive capacities of vulnerable communities |

Source: Country INDCs; Note: Taken from country INCDs only. Some countries may have adaptation plans/long term pledges that are not mentioned in their INDC release and are therefore not showing in the table

## Country INDCs

| | Pledge | Target year | Base year | Long-term pledge | Comments | Adaptation policy (Y/N) and proposed strategy |
|---|---|---|---|---|---|---|
| **Emerging Markets** | | | | | | |
| Indonesia | 29% | 2030 | BAU | None | Conditional target totals -41%, subject to agreement & external support | Y Sustainable agriculture and plantations, reduce deforestation/forest degradation, use degraded land for renewable energy, improve energy efficiency and consumption patterns |
| Malaysia | NA | 2030 | 2005 | None | Cut emissions intensity of GDP by 45% by 2030 (2005)- includes 35% unconditional and additional 10% conditional targets | Y Water security, food security, protecting coastlines and health |
| Mexico | 25% | 2030 | BAU | Reduce 50% of emissions by 2050 from 2000 | Ambition could increase to 40%, subject to a global agreement | Y Improved resilience of strategic infrastructure and ecosystems. Focus on strengthening adaptive capacity in the most vulnerable municipalities, early warning systems, 0% deforestation by 2030 |
| Pakistan | NA | NA | NA | None | Committed to reduce emissions after reaching peak levels | N - |
| Peru | 20% | 2030 | BAU | None | Conditional total -30% on international financing | Y Increase water availability, reduce negative impacts on agriculture, livestock and forestry activities, reduce vulnerability of the fishery and aquaculture sectors, promote comprehensive land management, improve resilience to the health effects of climate change |
| Philippines | 70% | 2030 | BAU | None | Mitigation contribution conditional on technical, financial and capacity building support | Y Improve climate scenario-building, climate monitoring/observation, roll-out climate/disaster risk and vulnerability assessments, enhance resilience in key sectors – agriculture, water and health |
| Qatar | NA | 2030 | NA | None | Efforts to becoming a regional supplier of solar generated electricity | Upgrade wastewater treatment plants, increase use in public transport, improve waste management systems and processes |
| Russia | 25-30% | 2030 | 1990 | Use 2030 target as stepping stone towards a long-term objective | Commitment to the INDC will be based on the outcome of Paris; reduction is subject to absorption capacity of the Russian forests | Y Protect boreal forests as they protect water resources, prevent soil erosion and conserve biodiversity |
| S Korea | 37% | 2030 | BAU | None | Unclear whether target includes land use change and forestry | Y Improved climate monitoring infrastructure, management system for disaster prevention, stable water supply, accommodate impacts of climate change on health |
| Saudi Arabia | NA | 2030 | NA | None | Promote CCS; initiative to capture and purify ~1500 tons of $CO_2$ a day; operate on pilot testing basis a $CO_2$ enhanced oil recovery demonstration project | Water/waste water management, urban planning, marine protection, reduced desertification, integrated coastal zone management planning (ICZM), early warning systems |
| South Africa | NA (34%) | 2030 | NA (BAU) | None | Peak, plateau and decline (PPD) trajectory range; emissions by 2025-30 to be between 398-614 MtCO2e (2012 was 464MtCO2e [WRI]); Conditional Total -42% | Y National Adaptation Plan, improve climate change response planning and implementation, develop early warning/vulnerability and adaptation system for climate vulnerable sectors, develop a vulnerability/adaptation assessment framework |
| Thailand | 20% | 2030 | BAU | None | Conditional total -25% subject to financial and technical support | Y Strengthen Integrated Water Resources Management (IWRM) practices, safeguard food security, promote sustainable agriculture and Good Agricultural Practice (GAP), increase capacity to manage climate-related health impacts, increase national forest cover to 40% |
| Turkey | 21% | 2030 | BAU | None | Carbon credits from international market mechanisms will be used | N - |
| United Arab Emirates | NA | 2021 | NA | None | Increase clean energy to 24% in the total energy mix by 2021, from 0.4% in 2014 | Water conservation and desalination, Wetlands, Coastal and marine environment conservation, food security, research & development, training and public awareness |

Source: Country INDCs; Note: Taken from country INCDs only. Some countries may have adaptation plans/long term pledges that are not mentioned in their INDC release and are therefore not showing in the table

## Country INDCs

| | Pledge | Target year | Base year | Long-term pledge | Comments | Adaptation policy (Y/N) and proposed strategy |
|---|---|---|---|---|---|---|
| **Frontier Markets** | | | | | | |
| Argentina | 15% | 2030 | BAU | None | Conditional total -30%; subject to financial and technical support; | Y Early warning systems for extreme weather events, climate disaster response systems, sustainable forest management, increased irrigated crop areas, improved water resource management, improved decision making on crop management, strengthened health processes |
| Bahrain | NA | 2030 | NA | None | Aims to improve energy efficiency to reduce cumulative electricity consumption by 2030 | Y Upgrade water distribution networks, Mangrove Transplantation Project for the cultivation of plants and planting mangrove seedlings to rehabilitate degraded coastal areas |
| Bangladesh | 5% | 2030 | BAU | None | Only covers power, transport and industry. Conditional total -15% | Y Food and water security, livelihood and health protection, comprehensive disaster management, coastal zone management including flood control and erosion protection, building resilient infrastructure |
| Jordan (revised) | 2% | 2030 | BAU | None | Unconditional – 1.5%; conditional – 12.5% (Total – 14%) | Y Adaptation covering water, health, biodiversity, agriculture, socioeconomic development |
| Kazakhstan | 15% | 2030 | 1990 | None | Conditional total -25% on international investment | N - |
| Kenya | 30% | 2030 | BAU | None | Target subject to international support (finance, technology, etc.) | Y National Adaptation Plan focusing on energy, transport, and buildings. Enhanced resilience of ecosystems, water infrastructure and irrigation, urban populations, tourism, agriculture and fisheries |
| Kuwait | NA | 2035 | NA | None | Aims to transition into a low carbon economy in a BAU scenario | N - |
| Lebanon | 15% | 2030 | BAU | None | Conditional total -30% by 2030 (BAU) | Y Establish national monitoring sites and species to protect biodiversity. Prioritise coastal zones, implement the National Forest Programme, increase water availability and reduce water usage |
| Mauritius | 30% | 2030 | BAU | None | Conditional on support (USD1.5bn mitigation; USD4bn adaptation) | Y Enhanced infrastructure, disaster risk strategies, improved awareness, strengthened regulatory framework for the protection of beach, dunes and vegetation. Improved forecasting, management, protection of water resources |
| Morocco | 13% | 2030 | BAU | None | Target – 13% – unconditional; 19% – conditional; (Total 32%); Requires USD45bn; conditional upon USD35bn of int'l finance, a UCA | Protect populations in vulnerable coastal zones, desert and mountain areas. Protect ecosystems, agriculture, high-risk infrastructures and water resources. Focus on desalination, wastewater, new dams, flood protection, irrigation infrastructure. Increase monitoring and evaluation |
| Nigeria | 20% | 2030 | BAU | None | To be achieved through energy efficiency measures and 13GW of renewable energy sources; conditional target- 45 % below BAU by 2030 | Y Improve agricultural systems, strengthen the implementation of the national Community-Based Forest Resources Management Programme, increase protective margins in construction and placement of transportation and communications infrastructure, increase knowledge and awareness of climate change risks and opportunities |
| Oman | 2% | 2030 | BAU | None | Listed conditional adaptation and mitigation efforts subject to international support | Y Develop national adaptation plans. Focus on tropical cyclones, coastal erosion and sea levels, fisheries and marine environment, water scarcity and desertification, flood protection, energy security, food security |
| Serbia | 10% | 2030 | 1990 | None | Climate change strategy & action plan to be finalised by 2017 | N - |

Source: Country INDCs; Note: Taken from country INCDs only. Some countries may have adaptation plans/long term pledges that are not mentioned in their INDC release and are therefore not showing in the table

## Country INDCs

| | Pledge | Target year | Base year | Long-term pledge | Comments | Adaptation policy (Y/N) and proposed strategy |
|---|---|---|---|---|---|---|
| **Frontier Markets** | | | | | | |
| Sri Lanka | NA | 2030 | 2010 | None | Conditional - 7%; 20% (unconditional -4% conditionally -16%) in energy sector; 10% in other sectors (3% unconditional; 7% conditional) (other sectors include: transport, industry, forests and waste) | Y | National planning/development, ensure climate resilient human settlements, protect food security, safeguard natural resources and biodiversity, create strategies for vulnerable sectors |
| Tunisia | NA | 2030 | 2010 | None | Unconditional –13% in carbon intensity; conditional –28%; (total – 41%) | Y | Water resource, coastline, agriculture, ecosystem, tourism and health |
| Vietnam | 8% | 2030 | BAU | None | Conditional total -25% by 2030 from BAU. Carbon intensity of GDP could decline by 30% by 2030 from 2010 with external support | Y | Modernise the hydro-meteorological observatory and forecasting system, develop a climate and sea level assessment and monitoring system, integrated coastal zone management |

Source: Country INDCs; Note: Taken from country INCDs only. Some countries may have adaptation plans/long term pledges that are not mentioned in their INDC release and are therefore not showing in the table

# Appendix 6 – full datasets

**Table i: Temperature indicators** (*temp in ºC)*

| Country | Avg. temp (1995-2004) | Avg. temp (2005-2014) | Change (Δ1) | Avg. temp (1996-2005) | Avg. temp (2006-2015) | Change (Δ2) | Momentum (Δ2-Δ1) |
|---|---|---|---|---|---|---|---|
| *Weights in exposure scores* | | | | | *20%* | *15%* | |
| **Developed Market (DM)** | | | | | | | |
| Australia | 21.82 | 22.03 | 0.21 | 21.91 | 22.00 | 0.09 | -0.12 |
| Austria | 6.99 | 7.34 | 0.35 | 6.95 | 7.53 | 0.57 | 0.23 |
| Belgium | 10.47 | 10.72 | 0.25 | 10.48 | 10.75 | 0.27 | 0.03 |
| Canada | -5.95 | -5.77 | 0.18 | -5.86 | -5.83 | 0.04 | -0.15 |
| Denmark | 8.41 | 9.02 | 0.62 | 8.45 | 9.05 | 0.61 | -0.01 |
| Finland | 2.03 | 2.61 | 0.59 | 2.12 | 2.65 | 0.53 | -0.06 |
| France | 11.76 | 12.62 | 0.86 | 11.80 | 12.61 | 0.81 | -0.05 |
| Germany | 9.44 | 9.75 | 0.31 | 9.44 | 9.83 | 0.39 | 0.08 |
| Ireland | 9.73 | 9.57 | -0.15 | 9.72 | 9.53 | -0.19 | -0.03 |
| Israel | 20.30 | 20.72 | 0.42 | 20.37 | 20.75 | 0.38 | -0.04 |
| Italy | 12.49 | 12.71 | 0.22 | 12.50 | 12.84 | 0.34 | 0.12 |
| Japan | 11.29 | 11.43 | 0.14 | 11.30 | 11.51 | 0.22 | 0.08 |
| Netherlands | 10.23 | 10.50 | 0.27 | 10.26 | 10.53 | 0.27 | 0.00 |
| New Zealand | 10.06 | 10.16 | 0.09 | 10.12 | 10.11 | -0.02 | -0.11 |
| Norway | 1.54 | 1.97 | 0.43 | 1.65 | 2.01 | 0.36 | -0.06 |
| Portugal | 15.31 | 15.44 | 0.12 | 15.26 | 15.48 | 0.22 | 0.10 |
| Singapore | 27.93 | 27.89 | -0.03 | 27.97 | 27.89 | -0.08 | -0.05 |
| Spain | 14.00 | 13.95 | -0.06 | 13.94 | 14.03 | 0.09 | 0.14 |
| Sweden | 2.29 | 2.62 | 0.33 | 2.38 | 2.67 | 0.29 | -0.04 |
| Switzerland | 7.31 | 7.48 | 0.16 | 7.30 | 7.55 | 0.25 | 0.09 |
| UK | 18.43 | 18.58 | 0.15 | 18.44 | 18.53 | 0.09 | -0.06 |
| USA | 7.50 | 7.64 | 0.13 | 7.55 | 7.69 | 0.14 | 0.01 |
| **Emerging Market (EM)** | | | | | | | |
| Brazil | 25.43 | 25.65 | 0.22 | 25.47 | 25.69 | 0.22 | 0.01 |
| Chile | 8.42 | 8.41 | -0.01 | 8.43 | 8.47 | 0.04 | 0.05 |
| China | 7.04 | 7.10 | 0.06 | 7.06 | 7.16 | 0.10 | 0.04 |
| Colombia | 24.51 | 24.61 | 0.09 | 24.52 | 24.66 | 0.14 | 0.05 |
| Czech Rep. | 16.94 | 17.96 | 1.02 | 16.92 | 18.31 | 1.39 | 0.37 |
| Egypt | 22.98 | 23.40 | 0.42 | 23.03 | 23.42 | 0.39 | -0.03 |
| Greece | 14.25 | 14.61 | 0.36 | 14.27 | 14.68 | 0.42 | 0.06 |
| Hungary | 10.58 | 11.19 | 0.62 | 10.54 | 11.39 | 0.85 | 0.23 |
| India | 24.52 | 24.66 | 0.14 | 24.52 | 24.68 | 0.16 | 0.02 |
| Indonesia | 26.22 | 26.11 | -0.11 | 26.25 | 26.11 | -0.13 | -0.03 |
| S Korea | 11.58 | 11.40 | -0.18 | 11.56 | 11.52 | -0.05 | 0.13 |
| Malaysia | 25.82 | 25.74 | -0.07 | 25.84 | 25.77 | -0.07 | 0.01 |

| Country | Avg. temp (1995-2004) | Avg. temp (2005-2014) | Change (Δ1) | Avg. temp (1996-2005) | Avg. temp (2006-2015) | Change (Δ2) | Momentum (Δ2-Δ1) |
|---|---|---|---|---|---|---|---|
| | | | | | *20%* | *15%* | |
| **Emerging Market (EM) – cont.** | | | | | | | |
| Mexico | 21.13 | 21.29 | 0.16 | 21.12 | 21.32 | 0.20 | 0.04 |
| Pakistan | 20.51 | 20.67 | 0.16 | 20.53 | 20.70 | 0.17 | 0.01 |
| Peru | 19.68 | 19.61 | -0.07 | 19.66 | 19.68 | 0.02 | 0.09 |
| Philippines | 25.91 | 25.87 | -0.04 | 25.92 | 25.87 | -0.05 | 0.00 |
| Poland | 8.36 | 8.81 | 0.45 | 8.37 | 8.95 | 0.58 | 0.13 |
| Qatar | 27.86 | 28.15 | 0.29 | 27.89 | 28.25 | 0.36 | 0.07 |
| Russia | -5.49 | -4.70 | 0.79 | -5.49 | -4.69 | 0.80 | 0.01 |
| S Arabia | 25.45 | 25.69 | 0.24 | 25.50 | 25.75 | 0.26 | 0.02 |
| S Africa | 17.99 | 18.36 | 0.37 | 18.05 | 18.37 | 0.32 | -0.05 |
| Thailand | 26.66 | 26.64 | -0.02 | 26.70 | 26.66 | -0.05 | -0.03 |
| Turkey | 11.58 | 12.03 | 0.45 | 11.62 | 12.06 | 0.44 | 0.00 |
| UAE | 27.58 | 27.79 | 0.21 | 27.64 | 27.83 | 0.19 | -0.02 |
| **Frontier Market (FM)** | | | | | | | |
| Argentina | 14.44 | 14.66 | 0.22 | 14.43 | 14.72 | 0.29 | 0.07 |
| Bahrain | 27.76 | 28.07 | 0.31 | 27.80 | 28.17 | 0.38 | 0.07 |
| Bangladesh | 25.33 | 25.43 | 0.09 | 25.35 | 25.34 | 0.00 | -0.10 |
| Croatia | 11.19 | 11.68 | 0.49 | 11.16 | 11.87 | 0.71 | 0.22 |
| Estonia | 6.09 | 6.35 | 0.26 | 6.08 | 6.49 | 0.41 | 0.14 |
| Jordan | 19.35 | 19.63 | 0.28 | 19.39 | 19.68 | 0.29 | 0.01 |
| Kazakhstan | 6.85 | 6.86 | 0.02 | 6.82 | 6.90 | 0.08 | 0.06 |
| Kenya | 25.05 | 25.24 | 0.19 | 25.07 | 25.27 | 0.20 | 0.00 |
| Kuwait | 26.16 | 26.42 | 0.26 | 26.22 | 26.48 | 0.26 | 0.00 |
| Lebanon | 16.55 | 16.47 | -0.08 | 16.58 | 16.48 | -0.10 | -0.02 |
| Lithuania | 7.10 | 7.39 | 0.30 | 7.07 | 7.57 | 0.50 | 0.20 |
| Mauritius | 23.70 | 24.16 | 0.46 | 23.77 | 24.18 | 0.41 | -0.05 |
| Morocco | 18.08 | 18.25 | 0.17 | 18.08 | 18.29 | 0.22 | 0.05 |
| Nigeria | 27.15 | 27.47 | 0.32 | 27.20 | 27.46 | 0.26 | -0.06 |
| Oman | 26.01 | 26.07 | 0.07 | 26.02 | 26.12 | 0.10 | 0.03 |
| Romania | 9.32 | 10.06 | 0.74 | 9.32 | 10.25 | 0.94 | 0.19 |
| Serbia | 10.79 | 11.45 | 0.66 | 10.76 | 11.63 | 0.88 | 0.22 |
| Slovenia | 9.49 | 9.93 | 0.44 | 9.45 | 10.10 | 0.65 | 0.21 |
| Sri Lanka | 27.23 | 27.27 | 0.03 | 27.23 | 27.29 | 0.06 | 0.02 |
| Tunisia | 20.46 | 20.69 | 0.22 | 20.48 | 20.73 | 0.25 | 0.03 |
| Vietnam | 24.57 | 24.55 | -0.02 | 24.59 | 24.60 | 0.01 | 0.03 |

Source: World Bank; HSBC

## Table ii: Water risk indicators

| Country | Water resource per capita (m³ /person/ yr.) 2014 | 2016 | % Difference between 2014 & 2016 | Water resource pc. Change (% change) (Δ1) Change over 2004-2014 | (Δ2) Change over 2006-2016 | Momentum (Δ2-Δ1) Difference in the decade change |
|---|---|---|---|---|---|---|
| *Weights in exposure scores* | *25%* | | | | *25%* | |
| **Developed Market (DM)** | | | | | | |
| Australia | 20,971 | 20,392 | -2.8 | -14.2 | -14.2 | 0.0 |
| Austria | 9,097 | 8,883 | -2.4 | -4.3 | -5.5 | -1.1 |
| Belgium | 1,633 | 1,613 | -1.2 | -7.0 | -7.1 | 0.0 |
| Canada | 81,644 | 79,975 | -2.0 | -10.0 | -10.2 | -0.3 |
| Denmark | 1,063 | 1,047 | -1.5 | -4.2 | -5.1 | -0.9 |
| Finland | 20,141 | 20,018 | -0.6 | -4.3 | -4.2 | 0.1 |
| France | 3,181 | 3,154 | -0.8 | -5.5 | -4.9 | 0.6 |
| Germany | 1,902 | 1,863 | -2.0 | 1.9 | -0.4 | -2.2 |
| Ireland | 11,262 | 10,894 | -3.3 | -11.8 | -10.5 | 1.4 |
| Israel | 217 | 208 | -3.9 | -17.1 | -17.5 | -0.4 |
| Italy | 3,147 | 3,157 | 0.3 | -5.1 | -4.1 | 1.1 |
| Japan | 3,378 | 3,386 | 0.2 | 0.4 | 0.7 | 0.3 |
| Netherlands | 5,396 | 5,347 | -0.9 | -3.5 | -4.0 | -0.5 |
| New Zealand | 72,510 | 69,683 | -3.9 | -9.4 | -10.8 | -1.5 |
| Norway | 76,500 | 75,101 | -1.8 | -10.6 | -10.9 | -0.3 |
| Portugal | 7,442 | 7,497 | 0.7 | 0.8 | 1.9 | 1.1 |
| Singapore | 110 | 107 | -2.5 | -23.8 | -21.5 | 2.3 |
| Spain | 2,399 | 2,401 | 0.1 | -7.7 | -4.4 | 3.3 |
| Sweden | 17,945 | 17,570 | -2.1 | -7.2 | -8.3 | -1.1 |
| Switzerland | 6,533 | 6,390 | -2.2 | -9.8 | -10.6 | -0.9 |
| UK | 2,275 | 2,240 | -1.6 | -7.2 | -7.3 | -0.1 |
| USA | 9,634 | 9,498 | -1.4 | -8.1 | -7.7 | 0.4 |
| **Emerging Market (EM)** | | | | | | |
| Brazil | 42,343 | 41,642 | -1.7 | -9.5 | -9.0 | 0.6 |
| Chile | 52,408 | 51,542 | -1.7 | -9.3 | -8.9 | 0.4 |
| China | 2,082 | 2,060 | -1.0 | -5.0 | -4.9 | 0.1 |
| Colombia | 49,381 | 48,506 | -1.8 | -10.6 | -9.9 | 0.7 |
| Czech Republic | 1,249 | 1,245 | -0.3 | -3.1 | -3.1 | 0.1 |
| Egypt | 635 | 609 | -4.1 | -17.9 | -18.3 | -0.4 |
| Greece | 6,280 | 6,365 | 1.4 | 0.6 | 2.5 | 2.0 |
| Hungary | 10,541 | 10,593 | 0.5 | 2.4 | 2.6 | 0.1 |
| India | 1,477 | 1,443 | -2.3 | -13.0 | -12.2 | 0.7 |
| Indonesia | 7,914 | 7,732 | -2.3 | -12.4 | -12.0 | 0.4 |
| S Korea | 1,373 | 1,360 | -1.0 | -5.2 | -5.5 | -0.2 |
| Malaysia | 19,187 | 18,597 | -3.1 | -16.7 | -16.2 | 0.5 |

| Country | Water resource per capita (m³ /person/ yr.) 2014 | 2016 | % Difference between 2014 & 2016 | Water resource pc. Change (% change) (Δ1) Change over 2004-2014 | (Δ2) Change over 2006-2016 | Momentum (Δ2-Δ1) Difference in the decade change |
|---|---|---|---|---|---|---|
| | | *25%* | | | *25%* | |
| **Emerging Market (EM) – cont.** | | | | | | |
| Mexico | 3,718 | 3,622 | -2.6 | -13.9 | -13.7 | 0.2 |
| Pakistan | 1,330 | 1,277 | -4.0 | -18.7 | -18.7 | 0.0 |
| Peru | 60,697 | 59,168 | -2.5 | -11.9 | -12.0 | -0.1 |
| Philippines | 4,785 | 4,636 | -3.1 | -15.4 | -15.0 | 0.4 |
| Poland | 1,592 | 1,594 | 0.2 | 0.4 | 0.5 | 0.1 |
| Qatar | 24 | 23 | -7.6 | -68.0 | -60.7 | 7.4 |
| Russia | 31,463 | 31,349 | -0.4 | 0.2 | -0.9 | -1.1 |
| S Arabia | 78 | 74 | -4.6 | -24.5 | -23.8 | 0.7 |
| S Africa | 948 | 918 | -3.2 | -13.2 | -13.7 | -0.5 |
| Thailand | 6,411 | 6,369 | -0.6 | -5.0 | -4.4 | 0.6 |
| Turkey | 2,747 | 2,661 | -3.1 | -13.0 | -13.5 | -0.5 |
| UAE | 17 | 16 | -2.1 | -54.9 | -43.4 | 11.5 |
| **Frontier Market (FM)** | | | | | | |
| Argentina | 20,386 | 19,983 | -2.0 | -9.9 | -9.8 | 0.1 |
| Bahrain | 87 | 81 | -6.2 | -37.9 | -32.8 | 5.2 |
| Bangladesh | 7,697 | 7,530 | -2.2 | -11.4 | -10.8 | 0.6 |
| Croatia | 24,892 | 25,296 | 1.6 | 4.7 | 6.5 | 1.7 |
| Estonia | 9,745 | 9,730 | -0.1 | 3.7 | 2.3 | -1.3 |
| Jordan | 106 | 99 | -6.8 | -37.2 | -37.2 | -0.1 |
| Kazakhstan | 6,270 | 6,091 | -2.9 | -13.2 | -14.0 | -0.8 |
| Kenya | 667 | 633 | -5.0 | -23.8 | -23.5 | 0.2 |
| Kuwait | 5 | 5 | -6.7 | -41.6 | -41.3 | 0.3 |
| Lebanon | 804 | 750 | -6.7 | -31.1 | -32.5 | -1.4 |
| Lithuania | 8,355 | 8,530 | 2.1 | 15.2 | 13.8 | -1.3 |
| Mauritius | 2,182 | 2,177 | -0.2 | -3.2 | -2.3 | 0.8 |
| Morocco | 845 | 822 | -2.7 | -12.1 | -12.5 | -0.4 |
| Nigeria | 1,622 | 1,539 | -5.1 | -23.3 | -23.3 | 0.0 |
| Oman | 353 | 316 | -10.5 | -38.3 | -41.6 | -3.3 |
| Romania | 10,648 | 10,759 | 1.0 | 7.7 | 7.6 | -0.2 |
| Serbia | 22,747 | 22,983 | 1.0 | 4.7 | 5.0 | 0.4 |
| Slovenia | 15,456 | 15,435 | -0.1 | -3.2 | -2.8 | 0.3 |
| Sri Lanka | 2,542 | 2,490 | -2.0 | -7.4 | -7.9 | -0.5 |
| Tunisia | 414 | 405 | -2.3 | -10.1 | -10.6 | -0.5 |
| Vietnam | 9,744 | 9,537 | -2.1 | -10.2 | -10.1 | 0.1 |

Source: Aqua Stat, FAO; World Bank; HSBC

HSBC

## Table iii: Exposure and sensitivity to extreme events

| | Exposure | | | Sensitivity | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. of disasters (per 10,000 sq. km) | | | Disaster damages (per 1000 GDP) | | | Deaths (per million pop.) | | | People affected (per 1000 pop.) | | |
| Country | 1997-2006 | 2007-2016 | Change (%) | 1997-2006 | 2007-2016 | Change (%) | 1997-2006 | 2007-2016 | Change (%) | 1997-2006 | 2007-2016 | Change (%) |
| *Weights in:* | *Exposure* | *15%* | | *: Sensitivity* | *40%* | | | *30%* | | | *30%* | |
| **Developed markets** | | | | | | | | | | | | |
| Australia | 0.08 | 0.06 | -27.87 | 0.83 | 2.13 | 155.77 | 0.36 | 3.41 | 839.51 | 3.25 | 15.25 | 369.04 |
| Austria | 1.33 | 1.21 | -9.03 | 1.05 | 0.65 | -38.66 | 4.54 | 0.25 | -94.53 | 7.63 | 0.02 | -99.69 |
| Belgium | 4.95 | 4.95 | 0.00 | 0.02 | 0.19 | >1,000 | 20.59 | 3.87 | -81.18 | 0.35 | 0.07 | -80.43 |
| Canada | 0.04 | 0.03 | -31.43 | 0.22 | 0.91 | 318.22 | 0.25 | 0.09 | -64.78 | 2.10 | 6.42 | 206.01 |
| Denmark | 0.71 | 0.95 | 34.73 | 1.30 | 0.03 | -97.68 | 0.22 | 0.04 | -84.00 | 0.00 | 0.00 | |
| Finland | 0.03 | 0.00 | -100.00 | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.08 | 0.00 | -100.00 |
| France | 0.82 | 0.58 | -28.89 | 0.84 | 0.51 | -39.28 | 34.30 | 5.28 | -84.62 | 57.98 | 7.83 | -86.49 |
| Germany | 0.72 | 0.66 | -8.03 | 0.62 | 0.83 | 32.95 | 11.56 | 0.11 | -99.08 | 5.31 | 0.08 | -98.50 |
| Ireland | 0.87 | 0.58 | -33.33 | 0.11 | 0.13 | 14.58 | 0.28 | 0.09 | -68.85 | 0.13 | 0.13 | 2.80 |
| Israel | 2.31 | 2.31 | 0.00 | 0.07 | 0.32 | 371.35 | 0.28 | 0.64 | 129.06 | 0.22 | 265.47 | >1,000 |
| Italy | 0.71 | 0.99 | 38.10 | 0.72 | 0.30 | -58.83 | 35.24 | 0.31 | -99.11 | 1.01 | 0.34 | -66.33 |
| Japan | 1.34 | 1.65 | 22.43 | 0.74 | 0.26 | -65.36 | 0.54 | 1.03 | 91.36 | 11.93 | 4.49 | -62.38 |
| Netherlands | 2.67 | 2.37 | -10.93 | 0.13 | 0.17 | 33.47 | 12.29 | 0.06 | -99.51 | 0.13 | 0.00 | -100.00 |
| New Zealand | 0.53 | 0.27 | -50.00 | 0.50 | 0.74 | 48.53 | 0.23 | 0.09 | -60.20 | 2.08 | 0.35 | -83.08 |
| Norway | 0.08 | 0.05 | -33.33 | 0.03 | 0.00 | -100.00 | 0.00 | 0.08 | | 0.46 | 0.12 | -74.02 |
| Portugal | 1.64 | 1.31 | -20.12 | 2.15 | 0.77 | -64.36 | 31.59 | 0.60 | -98.10 | 14.58 | 0.56 | -96.13 |
| Singapore | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. |
| Spain | 0.46 | 0.34 | -26.26 | 0.60 | 0.22 | -63.55 | 36.61 | 0.13 | -99.63 | 0.10 | 0.18 | 75.46 |
| Sweden | 0.10 | 0.02 | -74.81 | 0.73 | 0.00 | -100.00 | 0.12 | 0.07 | -40.18 | 0.00 | 0.00 | |
| Switzerland | 3.04 | 3.04 | 0.01 | 0.87 | 0.29 | -67.18 | 14.61 | 0.18 | -98.80 | 0.76 | 0.02 | -96.88 |
| UK | 1.20 | 1.07 | -10.34 | 0.50 | 0.70 | 39.52 | 0.69 | 1.31 | 90.32 | 4.72 | 7.38 | 56.28 |
| USA | 0.28 | 0.25 | -12.31 | 2.33 | 2.22 | -4.49 | 1.53 | 0.96 | -37.19 | 35.79 | 320.19 | 794.59 |
| **Emerging markets** | | | | | | | | | | | | |
| Brazil | 0.05 | 0.06 | 18.60 | 0.16 | 0.51 | 224.97 | 0.36 | 0.98 | 169.92 | 65.74 | 194.90 | 196.49 |
| Chile | 0.32 | 0.24 | -25.00 | 0.51 | 1.30 | 155.86 | 0.95 | 1.35 | 41.32 | 41.18 | 24.41 | -40.73 |
| China | 0.21 | 0.23 | 13.99 | 3.91 | 2.97 | -24.17 | 1.15 | 0.66 | -42.78 | 931.07 | 627.92 | -32.56 |
| Colombia | 0.24 | 0.23 | -3.70 | 0.01 | 1.10 | >1,000 | 1.82 | 2.64 | 44.91 | 45.59 | 180.35 | 295.61 |
| Czech Rep. | 1.55 | 1.42 | -8.29 | 2.72 | 0.72 | -73.68 | 4.83 | 0.87 | -82.03 | 29.93 | 125.61 | 319.73 |
| Egypt | 0.06 | 0.07 | 16.67 | 0.00 | 0.06 | >1,000 | 0.08 | 0.26 | 231.89 | 0.01 | 0.42 | >1,000 |
| Greece | 1.78 | 1.01 | -43.48 | 0.66 | 0.65 | -1.58 | 0.74 | 0.91 | 23.49 | 1.26 | 0.74 | -41.59 |
| Hungary | 1.90 | 0.88 | -53.42 | 0.48 | 0.32 | -32.84 | 1.91 | 5.37 | 181.67 | 17.65 | 7.43 | -57.93 |
| India | 0.42 | 0.47 | 11.20 | 2.24 | 2.33 | 4.34 | 3.28 | 1.69 | -48.68 | 598.17 | 364.65 | -39.04 |
| Indonesia | 0.26 | 0.45 | 72.34 | 2.01 | 0.76 | -62.08 | 1.41 | 0.61 | -56.84 | 16.46 | 12.44 | -24.41 |
| S Korea | 3.61 | 1.44 | -60.26 | 1.63 | 0.10 | -93.61 | 2.48 | 0.37 | -85.03 | 14.28 | 1.54 | -89.24 |
| Malaysia | 0.85 | 0.46 | -46.43 | 0.19 | 0.49 | 154.96 | 0.30 | 0.24 | -19.60 | 11.77 | 94.96 | 706.70 |
| Mexico | 0.31 | 0.29 | -8.20 | 1.25 | 1.81 | 44.69 | 2.51 | 0.59 | -76.36 | 52.12 | 69.72 | 33.75 |
| Pakistan | 0.58 | 0.54 | -6.67 | 0.42 | 10.57 | >1,000 | 2.78 | 3.85 | 38.57 | 90.83 | 218.51 | 140.57 |
| Peru | 0.16 | 0.20 | 19.05 | 0.01 | 0.06 | 362.33 | 4.40 | 6.69 | 52.04 | 201.56 | 117.84 | -41.54 |
| Philippines | 3.05 | 5.47 | 79.12 | 0.78 | 8.64 | >1,000 | 7.71 | 15.56 | 101.89 | 464.90 | 1,021.95 | 119.82 |
| Poland | 0.59 | 0.72 | 22.28 | 1.24 | 0.66 | -46.54 | 2.87 | 2.99 | 4.04 | 6.40 | 2.72 | -57.48 |
| Qatar | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. |
| Russia | 0.05 | 0.02 | -62.33 | 0.31 | 0.41 | 31.15 | 1.40 | 39.29 | >1,000 | 20.12 | 1.48 | -92.64 |
| S Arabia | 0.03 | 0.06 | 100.00 | 0.00 | 0.21 | | 0.45 | 1.05 | 130.74 | 0.62 | 0.42 | -31.97 |
| S Africa | 0.26 | 0.18 | -29.03 | 0.21 | 0.38 | 76.82 | 0.66 | 0.55 | -15.60 | 333.31 | 59.81 | -82.05 |
| Thailand | 0.88 | 0.69 | -22.22 | 0.47 | 12.54 | >1,000 | 1.76 | 2.18 | 23.32 | 353.69 | 832.76 | 135.45 |
| Turkey | 0.35 | 0.14 | -59.26 | 0.25 | 0.06 | -75.36 | 0.53 | 0.14 | -72.93 | 21.14 | 0.61 | -97.12 |
| UAE | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. |
| **Frontier markets** | | | | | | | | | | | | |
| Argentina | 0.12 | 0.08 | -28.13 | 1.08 | 0.57 | -47.74 | 0.43 | 0.44 | 1.63 | 22.93 | 20.58 | -10.23 |
| Bahrain | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. |
| Bangladesh | 6.30 | 3.46 | -45.12 | 9.94 | 2.87 | -71.15 | 4.18 | 4.50 | 7.85 | 478.47 | 310.77 | -35.05 |
| Croatia | 2.14 | 1.97 | -8.33 | 1.19 | 0.13 | -88.83 | 18.70 | 0.51 | -97.27 | 0.50 | 3.00 | 496.47 |
| Estonia | 0.47 | 0.24 | -50.00 | 0.81 | 0.00 | -100.00 | 0.22 | 0.08 | -65.37 | 0.07 | 0.00 | -100.00 |
| Jordan | 0.68 | 0.00 | -100.00 | 0.01 | 0.00 | -100.00 | 0.30 | 0.00 | -100.00 | 62.38 | 0.00 | -100.00 |
| Kazakhstan | 0.02 | 0.03 | 33.33 | 0.01 | 0.15 | >1,000 | 0.02 | 0.32 | >1,000 | 42.52 | 5.28 | -87.58 |
| Kenya | 0.39 | 0.54 | 40.91 | 0.04 | 0.31 | 600.71 | 2.25 | 1.72 | -23.53 | 984.95 | 409.17 | -58.46 |
| Kuwait | 0.56 | 0.00 | -100.00 | 0.00 | 0.00 | | 0.10 | 0.00 | -100.00 | 0.10 | 0.00 | -100.00 |
| Lebanon | 1.96 | 3.91 | 100.00 | 0.00 | 0.00 | | 0.00 | 0.12 | | 4.99 | 204.60 | >1,000 |
| Lithuania | 0.96 | 0.64 | -33.30 | 0.91 | 0.00 | -100.00 | 1.57 | 1.28 | -18.09 | 0.00 | 0.00 | |
| Mauritius | 14.78 | 9.85 | -33.33 | 3.28 | 0.02 | -99.42 | 0.25 | 1.04 | 313.73 | 1.71 | 0.07 | -96.18 |
| Morocco | 0.27 | 0.25 | -8.33 | 1.73 | 0.33 | -80.85 | 0.73 | 0.51 | -29.70 | 10.34 | 29.58 | 186.17 |
| Nigeria | 0.32 | 0.20 | -37.93 | 0.01 | 0.14 | >1,000 | 0.53 | 0.52 | -2.56 | 4.53 | 54.11 | >1,000 |
| Oman | 0.06 | 0.16 | 150.00 | 0.12 | 8.28 | >1,000 | 1.57 | 3.14 | 100.38 | 0.04 | 7.63 | >1,000 |
| Romania | 1.87 | 0.96 | -48.86 | 1.90 | 0.63 | -66.77 | 2.43 | 1.71 | -29.92 | 15.75 | 2.13 | -86.50 |
| Serbia | 0.00 | 2.40 | | 0.00 | 5.38 | | 0.00 | 1.22 | | 0.00 | 25.40 | |
| Slovenia | 0.99 | 2.48 | 150.00 | 0.22 | 1.35 | 520.09 | 14.50 | 0.44 | -96.97 | 0.00 | 32.02 | |
| Sri Lanka | 2.23 | 4.78 | 114.29 | 0.10 | 3.01 | >1,000 | 1.60 | 3.40 | 111.97 | 232.57 | 507.50 | 118.21 |
| Tunisia | 0.13 | 0.19 | 50.00 | 0.00 | 0.00 | | 0.12 | 0.30 | 148.96 | 2.75 | 0.60 | -78.18 |
| Vietnam | 2.10 | 2.00 | -4.62 | 5.31 | 10.46 | 97.14 | 9.04 | 2.23 | -75.33 | 361.91 | 200.92 | -44.48 |

Source: EMDAT, World Bank; Note: Values are total over the decade and changes are between the two decades, figures are rounded to two decimal

## Table iv: Transition risk exposure

| | Fossil rents (% GDP) | | Fossil in export (%) | | Fossil in energy (%) | |
|---|---|---|---|---|---|---|
| Country | 2015 | Chg. (2015-05) | 2016 | Chg. (2016-06) | 2016 | Chg. (2016-06) |
| *Weights* | *22%* | *11%* | *22%* | *11%* | *22%* | *11%* |
| **Developed markets** | | | | | | |
| Australia | 0.8 | -1.2 | 25.6 | 1.6 | 93.4 | -0.9 |
| Austria | 0.1 | 0.0 | 1.0 | -0.4 | 66.0 | -8.9 |
| Belgium | 0.0 | 0.0 | 6.9 | -0.9 | 75.8 | 1.9 |
| Canada | 0.3 | -4.2 | 15.4 | -4.0 | 73.6 | -1.0 |
| Denmark | 0.5 | -1.3 | 3.3 | -5.9 | 65.7 | -20.9 |
| Finland | 0.0 | 0.0 | 7.5 | 2.5 | 39.7 | -12.1 |
| France | 0.0 | 0.0 | 1.9 | -1.6 | 46.6 | -5.3 |
| Germany | 0.0 | -0.1 | 1.4 | -0.7 | 79.8 | -1.5 |
| Ireland | 0.0 | 0.0 | 0.5 | -0.1 | 85.4 | -5.6 |
| Israel | 0.2 | 0.1 | 1.4 | 1.3 | 96.3 | -0.6 |
| Italy | 0.1 | 0.0 | 2.5 | -1.1 | 79.2 | -10.0 |
| Japan | 0.0 | 0.0 | 1.5 | 0.5 | 93.7 | 12.2 |
| Netherlands | 0.5 | -0.1 | 10.9 | -0.5 | 91.4 | -1.4 |
| New Zealand | 0.2 | -0.1 | 1.4 | -1.3 | 59.4 | -8.3 |
| Norway | 5.4 | -5.9 | 52.2 | -15.1 | 58.5 | 1.8 |
| Portugal | 0.0 | 0.0 | 5.7 | 0.8 | 76.9 | -3.9 |
| Singapore | 0.0 | 0.0 | 11.4 | -1.8 | 97.5 | -0.8 |
| Spain | 0.0 | 0.0 | 3.8 | -0.7 | 72.9 | -9.6 |
| Sweden | 0.0 | 0.0 | 5.0 | -0.1 | 26.8 | -6.6 |
| Switzerland | 0.0 | 0.0 | 0.2 | -0.2 | 50.1 | -3.8 |
| UK | 0.3 | -0.6 | 6.2 | -3.3 | 80.7 | -7.8 |
| USA | 0.2 | -1.1 | 6.5 | 3.2 | 82.8 | -2.9 |
| **Emerging markets** | | | | | | |
| Brazil | 0.9 | -1.5 | 6.2 | -1.4 | 59.1 | 5.7 |
| Chile | 0.0 | 0.0 | 0.7 | -1.7 | 73.3 | -0.7 |
| China | 0.6 | -3.5 | 1.2 | -0.5 | 87.5 | 0.7 |
| Colombia | 2.8 | -2.5 | 47.5 | 9.6 | 76.7 | 1.4 |
| Czech Rep. | 0.1 | -0.5 | 1.2 | -0.6 | 76.0 | -7.0 |
| Egypt | 0.0 | 0.0 | 17.9 | -29.3 | 96.0 | 0.0 |
| Greece | 0.0 | -0.1 | 27.1 | 14.2 | 85.1 | -7.8 |
| Hungary | 0.2 | -0.2 | 1.2 | -0.7 | 69.3 | -10.7 |
| India | 1.2 | -1.3 | 10.6 | -4.2 | 73.5 | 6.7 |
| Indonesia | 1.3 | -5.4 | 19.3 | -8.1 | 65.6 | 0.4 |
| S Korea | 0.0 | 0.0 | 5.5 | -0.9 | 82.0 | 1.5 |
| Malaysia | 2.1 | -5.8 | 14.0 | 0.3 | 96.6 | -0.1 |

| | Fossil rents (% GDP) | | Fossil in export (%) | | Fossil in energy (%) | |
|---|---|---|---|---|---|---|
| Country | 2015 | Chg. (2015-05) | 2016 | Chg. (2016-06) | 2016 | Chg. (2016-06) |
| *Weights* | *22%* | *11%* | *22%* | *11%* | *22%* | *11%* |
| **Emerging markets** | | | | | | |
| Mexico | 1.5 | -3.9 | 4.8 | -10.6 | 90.4 | 1.3 |
| Pakistan | 0.9 | -1.6 | 0.0 | 0.0 | 59.7 | -2.0 |
| Peru | 0.6 | -1.0 | 6.4 | -1.6 | 79.6 | 10.6 |
| Philippines | 0.1 | -0.2 | 1.3 | -1.0 | 62.0 | 5.8 |
| Poland | 0.3 | -0.5 | 2.3 | -1.5 | 89.9 | -6.0 |
| Qatar | 11.3 | -21.2 | 80.3 | -8.7 | 100.0 | 0.0 |
| Russia | 9.1 | -8.9 | 47.0 | -15.7 | 90.2 | -0.4 |
| S Arabia | 23.3 | -28.5 | 70.3 | -14.0 | 100.0 | 0.0 |
| S Africa | 1.3 | -1.4 | 8.6 | -0.9 | 86.9 | -0.2 |
| Thailand | 0.7 | -1.0 | 3.0 | -2.0 | 79.8 | -1.8 |
| Turkey | 0.1 | -0.1 | 2.1 | -1.9 | 87.6 | -1.4 |
| UAE | 11.9 | -10.0 | 31.7 | -30.9 | 99.8 | -0.1 |
| **Frontier markets** | | | | | | |
| Argentina | 0.8 | -4.2 | 2.5 | -12.4 | 88.5 | -0.1 |
| Bahrain | 4.9 | -0.7 | 42.1 | 5.8 | 100.0 | 0.0 |
| Bangladesh | 0.7 | -0.2 | 0.2 | -0.2 | 73.8 | 8.4 |
| Croatia | 0.4 | -0.1 | 6.4 | -7.4 | 70.7 | -6.9 |
| Estonia | 0.1 | -0.1 | 6.7 | -8.5 | 12.3 | -19.1 |
| Jordan | 0.0 | 0.0 | 0.0 | -0.4 | 97.6 | -0.3 |
| Kazakhstan | 7.0 | -17.4 | 60.6 | -8.0 | 99.2 | 0.3 |
| Kenya | 0.0 | 0.0 | 2.6 | -5.6 | 17.2 | 0.6 |
| Kuwait | 39.1 | -15.6 | 85.2 | -6.7 | 100.0 | 0.0 |
| Lebanon | 0.0 | 0.0 | 2.7 | 2.1 | 97.6 | 4.2 |
| Lithuania | 0.0 | -0.2 | 13.5 | -9.7 | 68.0 | 6.8 |
| Mauritius | 0.0 | 0.0 | 1.5 | 1.4 | 84.5 | 5.0 |
| Morocco | 0.0 | 0.0 | 0.5 | 0.0 | 88.5 | 3.6 |
| Nigeria | 3.4 | -27.3 | 89.1 | -7.7 | 19.0 | -0.7 |
| Oman | 22.9 | -21.8 | 69.2 | -17.9 | 100.0 | 0.0 |
| Romania | 0.8 | -1.3 | 3.1 | -6.3 | 72.8 | -12.3 |
| Sri Lanka | 0.0 | 0.0 | 0.0 | 0.0 | 50.3 | 6.8 |
| Serbia | 0.3 | -1.0 | 1.7 | | 83.9 | -6.3 |
| Slovenia | 0.0 | 0.0 | 2.7 | 2.2 | 60.9 | -8.6 |
| Tunisia | 2.1 | -1.9 | 5.6 | -7.3 | 88.4 | 1.8 |
| Vietnam | 1.6 | -8.4 | 0.0 | 0.0 | 69.8 | 9.1 |

Source: UNCTAD, World Bank; Note: weights are rounded off to the nearest whole number

## Table v: Capacity to respond to climate change

| | GDP PPP pc | Pub. debt | SWF pc | Eq. risk prem. | GINI | Governance | | Education |
|---|---|---|---|---|---|---|---|---|
| Country | | % GDP | USD | (%) | | Control of corrpt. | Rule of law | School enrol, tert. |
| | 2016 | 2015 | Latest | Jan '18 | | (-2.5 to 2.5) | (-2.5 to 2.5) | (%) |
| *Weights* | *12.5%* | *12.5%* | *12.5%* | *12.5%* | *12.5%* | *12.5%* | *12.5%* | *12.5%* |
| **Developed markets** | | | | | | | | |
| Australia | 46,790 | 37.6 | 4,381 | - | 34.7 | 1.8 | 1.8 | 90.3 |
| Austria | 50,644 | 86.2 | | 0.5 | 30.5 | 1.5 | 1.8 | 81.5 |
| Belgium | 46,541 | 106.1 | | 0.7 | 28.1 | 1.6 | 1.4 | 75.0 |
| Canada | 44,025 | 91.5 | 369 | - | 34.0 | 2.0 | 1.8 | N.A. |
| Denmark | 49,819 | 45.5 | | - | 28.5 | 2.2 | 1.9 | 82.8 |
| Finland | 43,365 | 62.5 | | 0.5 | 26.8 | 2.3 | 2.0 | 87.3 |
| France | 41,466 | 96.1 | | 0.6 | 32.3 | 1.4 | 1.4 | 64.4 |
| Germany | 48,885 | 71.0 | | - | 31.4 | 1.8 | 1.6 | 68.3 |
| Ireland | 71,405 | 78.7 | 1,781 | 1.0 | 31.9 | 1.6 | 1.5 | 83.8 |
| Israel | 37,783 | 64.1 | | 0.8 | 41.4 | 1.1 | 1.0 | 64.7 |
| Italy | 38,345 | 132.7 | | 2.2 | 34.7 | 0.0 | 0.3 | 62.5 |
| Japan | 41,476 | 248.0 | | 0.8 | 32.1 | 1.5 | 1.4 | 63.4 |
| Netherlands | 51,320 | 65.1 | | - | 28.6 | 2.0 | 1.9 | 78.5 |
| New Zealand | 39,049 | 30.0 | 6,073 | - | N.A. | 2.3 | 1.9 | 83.9 |
| Norway | 59,385 | 27.9 | 190,893 | - | 26.8 | 2.2 | 2.0 | 76.7 |
| Portugal | 30,665 | 129.0 | | 2.9 | 35.6 | 1.0 | 1.1 | 61.9 |
| Singapore | 88,003 | 104.7 | 99,157 | - | N.A. | 2.1 | 1.8 | N.A. |
| Spain | 36,462 | 99.3 | | 2.2 | 36.0 | 0.5 | 1.0 | 89.7 |
| Sweden | 49,508 | 43.4 | | - | 27.2 | 2.2 | 2.0 | 62.3 |
| Switzerland | 63,741 | 45.7 | | - | 32.5 | 2.1 | 1.9 | 57.7 |
| UK | 43,081 | 89.0 | | 0.6 | 34.1 | 1.9 | 1.6 | 56.5 |
| USA | 57,638 | 105.2 | 484 | - | 41.0 | 1.3 | 1.7 | 85.8 |
| **Emerging markets** | | | | | | | | |
| Brazil | 15,153 | 73.7 | | 3.5 | 51.3 | -0.4 | -0.1 | 50.6 |
| Chile | 23,960 | 17.5 | | 0.7 | 47.7 | 1.1 | 1.1 | 88.6 |
| China | 15,559 | 42.9 | 1,190 | 0.8 | 42.2 | -0.3 | -0.2 | 43.4 |
| Colombia | 14,181 | 50.6 | | 2.2 | 51.1 | -0.3 | -0.3 | 55.7 |
| Czech Rep. | 35,140 | 40.3 | | 0.8 | 25.9 | 0.5 | 1.1 | 65.0 |
| Egypt | 11,150 | 89.0 | | 7.5 | 31.8 | -0.6 | -0.4 | 36.2 |
| Greece | 26,526 | 176.9 | | 10.4 | 35.8 | -0.1 | 0.2 | 113.9 |
| Hungary | 26,997 | 75.3 | | 2.5 | 30.9 | 0.1 | 0.5 | 50.9 |
| India | 6,583 | 69.1 | | 2.2 | 35.2 | -0.3 | -0.1 | 26.9 |
| Indonesia | 11,632 | 27.3 | | 2.5 | 39.5 | -0.4 | -0.4 | 24.3 |
| S Korea | 35,751 | 37.9 | 2,387 | 0.6 | 31.6 | 0.4 | 1.1 | 93.2 |
| Malaysia | 27,736 | 57.4 | 1,119 | 1.4 | 46.3 | 0.1 | 0.5 | 26.1 |
| Mexico | 17,877 | 54.0 | | 1.4 | 48.2 | -0.8 | -0.5 | 29.9 |
| Pakistan | 5,246 | 63.6 | | 7.5 | 30.7 | -0.9 | -0.8 | 9.9 |
| Peru | 13,044 | 24.0 | | 1.4 | 44.3 | -0.4 | -0.5 | 40.5 |
| Philippines | 7,819 | 34.8 | | 2.2 | 40.1 | -0.5 | -0.4 | 35.8 |
| Poland | 27,923 | 51.3 | | 1.0 | 32.1 | 0.7 | 0.7 | 68.1 |
| Qatar | 127,728 | 39.8 | 124,523 | 0.7 | N.A. | 0.9 | 0.9 | 14.5 |
| Russia | 23,163 | 16.4 | 702 | 2.9 | 37.7 | -0.9 | -0.8 | 80.4 |
| S Arabia | 54,522 | 5.0 | 22,243 | 0.8 | N.A. | 0.2 | 0.5 | 63.1 |
| S Africa | 13,248 | 49.8 | | 2.5 | 63.4 | 0.0 | 0.1 | 19.4 |
| Thailand | 16,946 | 42.7 | | 1.8 | 37.8 | -0.4 | 0.0 | 48.9 |
| Turkey | 24,412 | 32.9 | | 2.9 | 41.2 | -0.2 | -0.2 | 94.7 |
| UAE | 72,540 | 18.1 | 140,944 | 0.6 | N.A. | 1.3 | 0.9 | N.A. |
| **Frontier markets** | | | | | | | | |
| Argentina | 19,979 | 52.1 | | 6.3 | 42.7 | -0.3 | -0.3 | 82.9 |
| Bahrain | 46,867 | 61.9 | 7,438 | 5.2 | N.A. | -0.1 | 0.5 | 43.3 |
| Bangladesh | 3,587 | 31.7 | | 4.2 | 32.1 | -0.8 | -0.6 | 13.4 |
| Croatia | 23,732 | 86.7 | | 3.5 | 32.2 | 0.2 | 0.4 | 69.1 |
| Estonia | 29,620 | 9.7 | | 0.8 | 34.6 | 1.2 | 1.2 | 69.6 |
| Jordan | 9,065 | 93.4 | | 5.2 | 33.7 | 0.3 | 0.3 | 44.9 |
| Kazakhstan | 25,331 | 21.9 | 6,788 | 2.5 | 26.5 | -0.8 | -0.4 | 46.3 |
| Kenya | 3,161 | 51.3 | | 5.2 | N.A. | -0.9 | -0.5 | 4.1 |
| Kuwait | 74,408 | 11.2 | 129,300 | 0.6 | N.A. | -0.2 | 0.0 | 27.0 |
| Lebanon | 14,337 | 138.4 | | 7.5 | 31.8 | -1.0 | -0.9 | 38.5 |
| Lithuania | 29,966 | 42.8 | | 1.4 | 37.7 | 0.7 | 1.0 | 68.5 |
| Mauritius | 21,144 | 58.6 | | 1.8 | 35.8 | 0.3 | 0.8 | 36.7 |
| Morocco | 7,838 | 64.1 | | 2.9 | N.A. | -0.1 | -0.1 | 28.1 |
| Nigeria | 5,872 | 11.5 | 16 | 6.3 | 43.0 | -1.0 | -1.1 | 10.1 |
| Oman | 42,826 | 14.9 | 5,424 | 2.2 | 0.0 | 0.4 | 0.4 | 7.8 |
| Romania | 23,626 | 39.3 | | 2.5 | 27.5 | 0.0 | 0.3 | 53.2 |
| Serbia | 14,725 | 77.4 | | 4.2 | 29.1 | -0.3 | -0.1 | 58.3 |
| Slovenia | 33,421 | 83.2 | | 1.8 | 25.7 | 0.8 | 1.1 | 82.9 |
| Sri Lanka | 12,337 | 76.0 | | 5.2 | 39.2 | -0.3 | 0.0 | 19.8 |
| Tunisia | 11,618 | 55.7 | | 5.2 | 35.8 | -0.1 | 0.0 | 34.6 |
| Vietnam | 6,435 | 58.3 | 5 | 5.2 | 34.8 | -0.4 | 0.0 | 28.8 |

Source: World Bank, IMF, SWF Institute, Note: Equity risk premium is marked against matured market rate, School enrol.- tertiary value captures all the enrolment against the corresponding. age group (could be >100), N.A.= not available, GINI, governance and education data points are the latest available

# Disclosure appendix

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| | | |
|---|---|---|
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