

Scoring climate change risk

G20 vulnerability increases



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- ▶ **On our analysis India, China, Indonesia, South Africa and Brazil are the most vulnerable G20 countries in terms of climate change risks**
- ▶ **Since 2011 vulnerability indicators are marginally worse with water stress the main driver**
- ▶ **In the ten years from 2002 to 2012 the international disaster database shows that damage costs from extreme events were USD260bn in the G20**

Exposure to climate factors is rising

Two years have passed since our last assessment of the vulnerability of G20 countries to climate change risks (*Scoring Climate Risk: Which countries are most vulnerable?*, 9 August 2011). Then, our analysis looked at G20 country **exposure, sensitivity, adaptive capacity and adaptive potential**. Now, we maintain our methodology and update the data. Exposure looks at temperatures, water availability and extreme events. Sensitivity identifies the number of people affected by extreme events and the damage costs. Adaptive capacity and potential compares income, debt, rule of law, corruption and education indicators across countries. In this update we have assessed the change to data points on an absolute basis, and created a relative ranking of vulnerability between G20 countries. The main takeaways from our analysis are:

- ▶ Temperatures have increased, but at a slower rate than in the previous analysis. Australia has posted the highest temperature increase since our previous results.
- ▶ Water stress is increasing in almost all cases, with Saudi Arabia and Australia posting the largest deterioration in water availability.
- ▶ On a relative ranking basis, China's position has worsened to second most vulnerable G20 country to climate change risk from third in 2011. Turkey and South Korea are most improved relative to G20 peers.

We believe that assessing the climate change vulnerability between countries is a means to incorporate the climate factor into investment frameworks.

Summary

- ▶ We update our analysis in 2011 of the vulnerability of G20 countries to climate change risks and conclude that, overall, G20 countries have become marginally more vulnerable to climate change since 2011
- ▶ Increasing water stress is the biggest risk factor because of the implications for economic activity and societal tensions
- ▶ Canada, South Korea and the USA are the G20 countries least vulnerable to climate change risk

Climate change vulnerability

Climate change exacerbates resource stress in global energy, food and water systems. In our view, assessing country vulnerability to these stresses enables superior investment decision making. To do this, we capture four factors: exposure, impact sensitivity, adaptive potential and adaptive capacity.

Exposure captures the likelihood of vulnerability to climate change effects, based on metrics around temperature and water. Sensitivity demonstrates the magnitude of disruption from these impacts, as assessed by human impact and costs. Adaptive potential measures the economic resources available to a country to reduce vulnerability, and adaptive capacity assesses the key socio-economic factors that drive adaptation.

Table 1: Summary of results: 2011 vs. 2013 (1 = most vulnerable)

Relative basis	Score		Ranking		Rank Change	
	2011	2013	2011	2013		
India	8.5	8.3	1	1		
China	6.9	7.0	3	2	▲	1
Indonesia	7.3	6.8	2	3	▼	1
South Africa	6.4	6.6	6	4	▲	2
Brazil	6.6	6.5	4	5	▼	1
Saudi Arabia	6.4	6.2	5	6	▼	1
Mexico	5.5	5.8	10	7	▲	3
Russia	5.8	5.8	7	8	▼	1
Italy	5.6	5.5	9	9		
Argentina	5.4	5.5	11	10	▲	1
Turkey	5.6	5.3	8	11	▼	3
France	4.9	4.6	12	12		
Australia	4.1	4.3	14	13	▲	1
UK	3.7	4.1	16	14	▲	2
Germany	4.7	4.0	13	15	▼	2
Japan	3.5	3.7	17	16	▲	1
US	2.7	3.6	18	17	▲	1
South Korea	3.8	3.6	15	18	▼	3
Canada	2.5	2.8	19	19		

Source: HSBC

We conclude that **India, China, Indonesia, South Africa** and **Brazil** are the five most vulnerable G20 countries. The main changes from the 2011 results are in the exposure category, where temperature rises and water availability are trending in the direction consistent with further disruption relating to extreme events. Saudi Arabia, India and South Africa are the most vulnerable countries in this category.

Among the sensitivity indicators, which are based on data supplied by the International Disaster Database, damage costs reached USD260bn in the decade to 2012, up from USD237bn in our previous report. In GDP terms China spends the most at 0.30%, followed by Australia at 0.24%. The adaptive potential and capacity categories are broadly unchanged.

Ranking the G20

- ▶ On our analysis, India, China, Indonesia, South Africa and Brazil are the most vulnerable to climate change
- ▶ No country is immune from climate factors because of the interconnection of global economic activity
- ▶ Evaluating climate and resource risk enables superior understanding of potential investment risk in key market

Country vulnerability remains

The effects of climate change are ever more present. Since our last assessment of country vulnerability to climate change risk in 2011, key scientific indicators have moved in line with a warming planet (see [Have temperatures peaked?](#), 25 April 2013), and weather extremes have prevailed, with more scientific focus on attribution analysis assessing the degree to which individual weather events are linked to climate change (see [Weather on steroids in 2012](#), 19 July 2012).

Monitoring individual country vulnerability to climate change factors remains important for several reasons, including:

- ▶ **Inflation:** Climate effects could impact food or energy output, driving up prices (see [Less bread for your dough](#), 20 August 2012)
- ▶ **Attractiveness of 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 USD260bn in the decade to 2012, up from USD237.9bn in the decade before
- ▶ **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
- ▶ **Asset-stranding:** Drivers relating to climate change (disruption to resources, regulatory changes) potentially change the value that can be generated from assets. In extreme cases this might lead to 'asset stranding', at which point the realised value of a particular project would be zero. We looked at asset stranding concepts in [Coal and carbon](#), 21 June 2012 and [Oil and carbon revisited](#), 25 January 2013

Scoring methodology

In our report [Scoring Climate Change Risk](#), 9 August 2011, we set out the following methodology for assessing how, on a relative basis, the vulnerability of G20 countries to climate change stacks up.

Here we have updated our analysis based on the most recently available data. We have kept the methodology consistent, so that where we previously took a ten year average from 2001-2010 to iron out annual variation, we now take a ten year average from 2003-2012 to capture an extra two years of data. Hence, we look at whether countries have become more or less vulnerable to climate change factors in absolute terms – a simple comparison of the data between 2011 and 2013 – and, where relevant, look at whether the rate of change between the two decades is increasing or decreasing for the various factors.

There are four factors for consideration on the vulnerability of countries to climate change risk: exposure, impact sensitivity, adaptive potential and adaptive capacity.

Exposure captures the likelihood of vulnerability to climate change impacts, based on current metrics. **Impact sensitivity** demonstrates the magnitude of disruption from these impacts. **Adaptive potential** measures the economic resources available to a country to reduce vulnerability. And **adaptive capacity** assesses the key socio-economic factors that could modulate this economic potential.

Our ranking analysis provides an insight for long-term strategic decision making for corporates and policy makers in the context of potential climate change risk.

Table 2: Summary of vulnerability indicators

Indicator	Weight	Value	Summary rationale
Exposure	25%		
1) Avg. temperature		Average °C 2001-10	A higher starting average temperature indicates a greater vulnerability
2) Temp. changes		% change 1991-2000 to 2000-10	A higher rate of increase in average temperature suggests a higher vulnerability to changing weather factors
3) Water availability		m3 renewable / per capita / yr	A lower water availability per capita value indicates a greater vulnerability to climate change factors
4) Water availability		% from 1997-2008	A higher negative percentage change of renewable water per capita indicates a greater vulnerability
5) Extreme events		Land adjusted number of events	A high level of extreme events indicates a higher exposure
6) Chg in extreme events		% change 1991-00 to 2000-10	A higher rate of change of event indicates an increasing magnitude of climate risk
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	More people affected reflects a higher vulnerability
3) Damage costs		USD as a proportion of GDP	Higher damage costs as a proportion of the economy reflect a higher vulnerability to climate change driven weather events
Adaptive potential	25%		
1) Wealth		Income per capita (USDm)	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
Adaptive capacity	25%		
1) Rule of law		Index to denote perception of confidence in rule of law	Higher rule of law indicates better governance which demonstrates an ability to implement change
2) Corruption		Index to denote perception of control of governance	Better control of corruption indicates a greater likelihood of proper allocation of funds for adaptation
3) Education		Ratio of total enrolment to the population officially corresponding to tertiary education age	Higher education indicates a higher skills base to change

Source: HSBC, World Bank, Thomson Reuters Datastream

Country exposure to temperatures, water and extremes

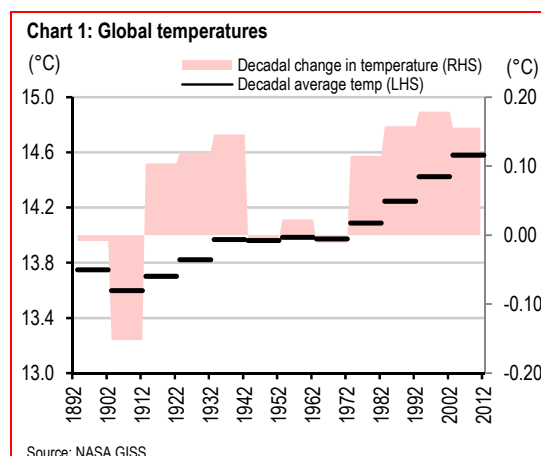
Overall since 2011, we find that country exposure to climate change factors has broadly worsened: temperatures continue to rise (albeit at a slower rate than previously), water stress is worsening at an accelerating rate. The number of extreme events has remained largely unchanged in the last two years. Saudi Arabia, India and South Africa are the most vulnerable G20 countries in our exposure category.

By climate exposure, we mean measuring the character, magnitude, rate of climate change and variation to which a system is exposed¹. These factors could be both positive and negative. For example, northern latitude territories may benefit from a longer growing season as a result of higher temperatures. However, our analysis aims to address country risk factors in relation to climate change, so our commentary around indicators – temperature, water availability and extreme events – focuses on the negative.

Temperature: warming, but at a slower rate

Temperatures are the most direct observation of whether the planet is warming. In our analysis we consider two metrics: decade-average temperatures by country and the change in degrees Celsius between the last two decades on a rolling basis.

At a global level temperatures have been increasing at a slowing rate as shown by the bars in chart 1 below. The change in the decade from 2002-2012 was 0.16°C, having been 0.18°C in the decade before. A simple average across the G20 is a 0.19°C rise for 2002-2012.



Our updated analysis looks at three issues:

- ▶ Average temperatures in the decade 2001-2010 (the data published in 2011 Scoring Climate Change Risk) compared with average temperatures in the decade 2003-2012
- ▶ The change in average temperatures between the decades of 1991-2000 and 2001-2010, (published in Scoring 2011) and the change in average temperatures between 1993-2002 and 2003-2012
- ▶ A comparison of the change recorded in 2011 and 2013 from above in order to identify whether the momentum in temperatures is improving or deteriorating in a climate context

The table overleaf shows the data. A footnote to this analysis is that since our previous analysis, NASA changed the methodology it uses to collect and homogenise observations. However, on comparing the results between original and revised 2011 data the conclusions are consistent so that in the discussion that follows we compare 2013 data (under the new NASA methodology) with the original 2011 data previously published.

¹ This is in line with the definition from the Intergovernmental Panel on Climate Change (IPCC).

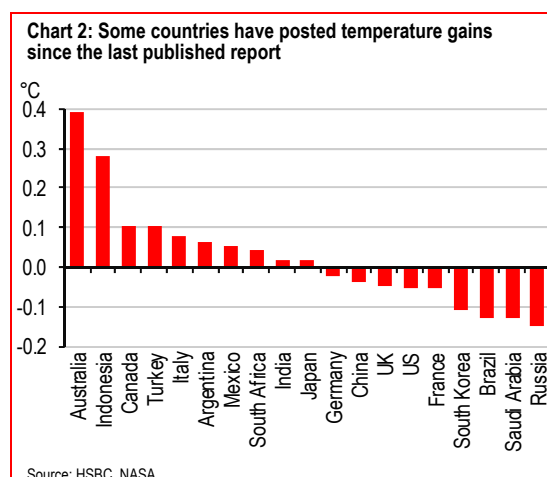
Table 3: Temperature Analysis (All data is in °C)

	Average temperatures °C			Temperature change °C		Momentum
	2011 Decade average 2001-2010 °C	2013 Decade average 2003-2012 °C	Difference between 2011 to 2013 results °C	2011 Change from 1991-2000 average to 2001-2010 average temperatures °C	2013 Change from 1993- 2002 average to 2003-2012 average temperatures °C	
Saudi Arabia	27.3	27.2	-0.13	0.8	0.8	-0.03
India	24.6	24.6	0.02	0.3	0.1	-0.18
South Africa	17.7	17.7	0.04	0.3	0.7	0.40
Turkey	12.7	12.8	0.10	0.9	0.2	-0.72
Australia	18.5	18.9	0.39	0.5	0.3	-0.23
Indonesia	27.3	27.6	0.28	-0.1	-0.1	-0.03
Italy	17.3	17.4	0.08	0.9	0.1	-0.75
China	13.3	13.3	-0.04	0.2	0.2	-0.04
Mexico	18.4	18.5	0.05	-0.3	-0.1	0.15
South Korea	12.8	12.7	-0.11	0.1	0.0	-0.13
Germany	10.1	10.1	-0.02	0.1	0.3	0.16
UK	10.8	10.8	-0.05	0.3	0.1	-0.17
Brazil	20.5	20.4	-0.13	0.5	0.1	-0.38
Argentina	15.3	15.4	0.06	-0.2	0.2	0.40
France	11.7	11.6	-0.05	0.5	0.1	-0.39
Japan	16.6	16.6	0.02	0.2	0.0	-0.25
US	12.2	12.1	-0.05	0.2	0.1	-0.05
Canada	11.2	11.3	0.11	-0.1	0.0	0.07
Russia	6.3	6.2	-0.15	0.7	0.6	-0.06

Source: HSBC, NASA.

1) Absolute temperature levels

The table shows that a comparison of the results between our two reports for average temperatures reveals that the split between temperature rises and falls is broadly 50:50. The most significant differences between the results are in Australia and Indonesia, as shown in chart 2.

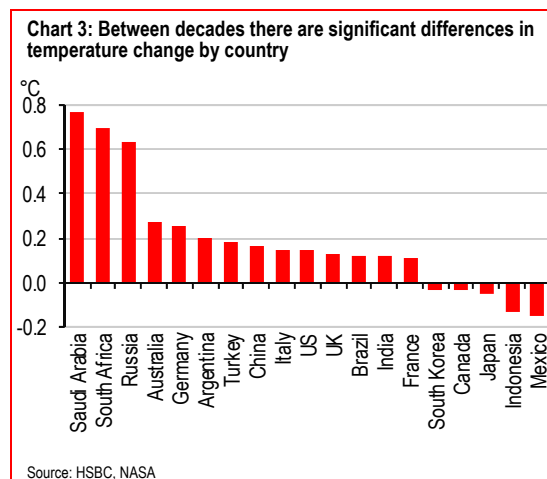


Our findings for Australia coincide with the findings from the Australian Bureau of Statistics, which noted that the current decade is Australia's warmest decade since 1910, with a mean temperature anomaly of 0.48°C above the long term average. Temperature change is one of the key drivers behind Australia's worsening in the overall vulnerability ranking from 10th most vulnerable to 5th most vulnerable relative to G20 peers, on our analysis.

2) Temperature change between decades

Chart 1 on page 5 showed that the global decadal temperature average has resumed a warming trend since the seventies. In addition this has occurred at a slowing rate. Among the countries above, the change in the decade temperature averages from 1993-2002 to 2003-2012 are mainly trending in an upward direction. The largest upward moves

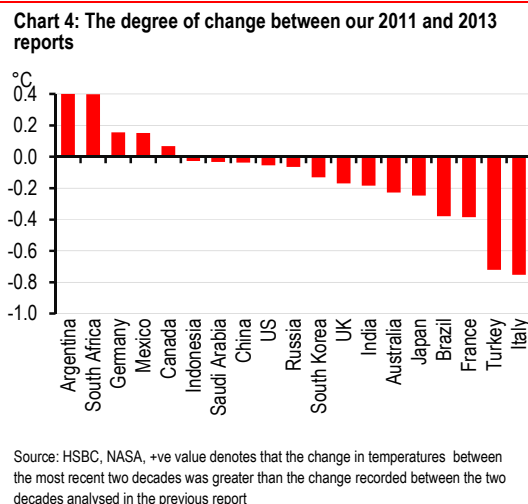
between decades were for Saudi Arabia, South Africa and Russia as shown in chart 3 below.



3) Momentum

The momentum indicator shows the degree to which the rate of change between decadal average temperatures has sped up or slowed down. A negative sign in the last column in table 3 above denotes that the change in temperatures between decades, as recorded in 2011 and 2013 (the previous two columns) is less now than the recording in 2011 or to put it another way, the rate of change has decelerated.

So, for example, in the case of Saudi Arabia, table 3 shows that ten-year average temperatures in the 2011 Scoring report were 27.3°C, but by 2013 the ten year average temperature level had decreased to 27.2°C, a change of 0.13°C. In terms of how temperatures have moved between decades, Saudi Arabia posted a 0.8°C increase between average temperatures in the last two decades so that between the 2011 and 2013 scoring analysis, the difference amounts to -0.03°C, i.e. a marginal deceleration in the rate of change.



In some cases the rate of change has accelerated, as shown in chart 4 above, ranked in order of change. Argentina, South Africa, Germany, Mexico and Canada posted an accelerating rate of change in temperatures between the two decades.

In our view overall temperature moves reflect a marginal worsening of the vulnerability to climate change factors in the G20.

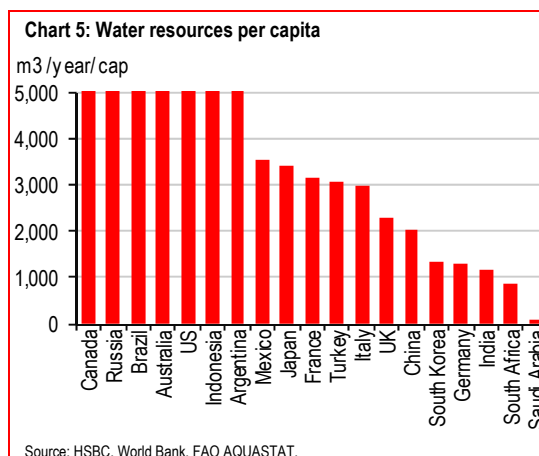
Water: less water, depleting faster

In our 2011 report we ascribed a higher weight to water than for temperature or events on the basis that it is fundamental for economic stability and growth and also because climate change is expressed most keenly through water. Here, we maintain this view. In the water category we have examined three factors. Table 4 summarises our results.

- 1) A comparison of water resource per capita between the 2011 and 2013 scoring analysis.
- 2) An assessment of the change in water resources between the last two decades
- 3) A comparison of the rate of change of water availability between the two reports. It is negative for a country if water per capita decreases and if it is decreasing at a faster rate (i.e. more negative) than in our previous analysis.

1) Water availability per capita

On average water resources have declined at a faster rate than in our 2011 analysis across the G20, as shown in table 5. Among the G20, Saudi Arabia is the most water-stressed.



2) Change to water availability per capita

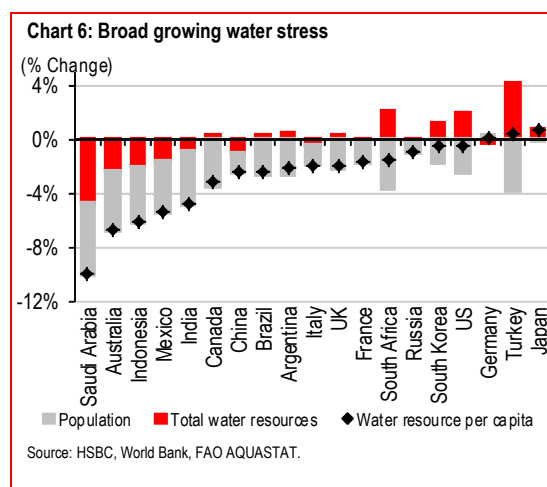
Saudi Arabia also has the worst track record in terms of declining water availability between the last two decades. Water resource is not only the scarcest in per capita terms but is also depleting

Table 4. Water Analysis (Table is ordered by country rank in the exposure category – most exposed countries at the top)

	Water resource per capita m3 /year/ cap			Water resource change % change		Momentum
	2011 Latest data (2008)	2013 Latest data (2011)	% Difference between 2011 to 2013 results	2011 Change from 1999-2008	2013 Change from 2002-2011	
Saudi Arabia	95	85	-10.0	-23.8	-26.8	-3.0
India	1,224	1,165	-4.8	-16.3	-15.8	0.5
South Africa	902	888	-1.6	-13.7	-12.2	1.5
Turkey	3,071	3,083	0.4	-14.3	-14.2	0.1
Australia	23,346	21,764	-6.8	-12.1	-14.7	-2.6
Indonesia	8,881	8,332	-6.2	-13.3	-12.5	0.8
Italy	3,062	3,002	-2.0	-4.2	-5.2	-1.0
China	2,092	2,041	-2.4	-7.7	-6.6	1.1
Mexico	3,768	3,563	-5.4	-12.5	-13.7	-1.2
South Korea	1,347	1,340	-0.5	-5.7	-5.3	0.4
Germany	1,301	1,302	0.1	-0.4	0.1	0.5
UK	2,359	2,314	-1.9	-4.7	-5.3	-0.6
Brazil	28,223	27,551	-2.4	-13.2	-12.3	0.9
Argentina	6,920	6,771	-2.2	-10.6	-10.0	0.6
France	3,224	3,168	-1.7	-5.9	-6.2	-0.3
Japan	3,378	3,399	0.6	-1.0	-0.9	0.1
US	9,042	9,001	-0.5	-10.9	-10.5	0.4
Canada	85,691	82,969	-3.2	-10.2	-10.6	-0.4
Russia	30,503	30,195	-1.0	4.7	3.0	-1.7

Source: HSBC, World Bank, FAO AQUASTAT

more rapidly than other countries – water per capita has dropped by 10% in three years, as shown in chart 6. Chart 6 also shows the decomposition of water availability and population change for the contribution to overall change in water per capita between the 2011 and 2013 results.

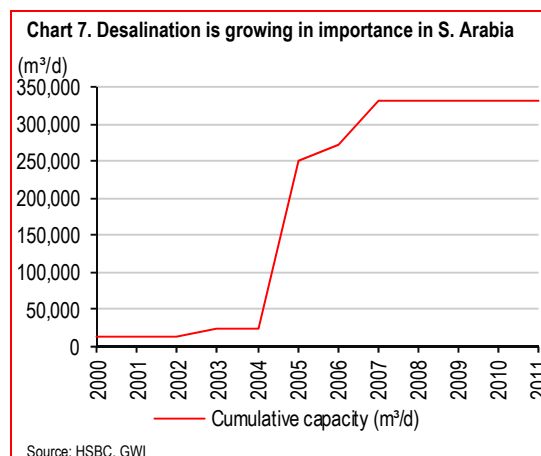


For instance in Saudi Arabia, the country with the largest change in per capita water availability with a 10% reduction per capita, half of the change is because of population growth, with the other half a result of absolute decrease in total water resources. In contrast, in a country such as the US, the total increase in water resources is only marginally outrun by an increase in population, to leave the balance a 0.5% drop from the previous decade. In this instance population growth is a drag on water per capita in all cases, as demonstrated by the negative grey bars.

One major reason behind the rapid water depletion in Saudi Arabia is the water intensity of oil production that it takes 30 barrels of water (4.7m^3) to produce 1 barrel of oil (see [Water is more important than oil](#), 22 January 2013).

However, Saudi Arabia's has been stepping up its desalination capacity, which now amounts to

$4.3\text{m}^3/\text{yr}/\text{cap}^2$, since 2004 and representing a crucial water source for the country as shown in chart 7. In addition, for further water conversation Saudi Arabia is also shifting towards using solar (rather than oil) to desalinate water.



Equally important as national level water statistics for investors, is the distribution of water resources around a country, and crucially whether water is located in the regions with high water demand. We set water supply and demand dynamics in [Water Stress](#), 19 September 2012.

Extreme events are stable

A consequence of climate change is the increasing probability of extreme weather related events. For instance, the IPCC SREX³ report published in 2011 highlighted that as global warming intensifies, a 1-in-20-year event would likely become a 1-in-5-year event. ([Extreme climate; expect more droughts and floods](#), 22 November 2011).

For our analysis we observed the number of extreme events over a ten-year period, defined as droughts, floods, extreme temperatures and wildfires⁴, normalised by adjusting for land mass.

² This is the total capacity of all large-scale desalination plants built in Saudi Arabia from 1990-2011. Source: GWI.

³ Intergovernmental Panel on Climate Change, (IPCC) Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX).

⁴ Sourced from the International Disaster Database from the Centre for Research on the Epidemiology of disasters.

When normalised in this way the new numbers compared with published data in 2011 appear minimal. However, a paper from the American Meteorological Society assesses the likelihood of climate change issues factoring into the weather extremes of 2012. Table 5 summarises the findings.

Table 5: Attributing 2012 extreme events to climate change

Extreme event	Location	Probability increase with climate change
Cold February Drought	West Europe	No established relationship
Drought, heat wave	Kenya, Somalia	Unclear
Winter drought	Central US	Four times more frequent than pre-industrial years
Flood	Iberian Peninsula	More likely
Heavy rainfall	North China	Unclear
Heavy rainfall	South-west Japan	No established relationship
Heavy rainfall	East Australia	5-15% higher likelihood
Heavy rainfall	New Zealand	1-5% higher likelihood
Summer heavy rainfall	UK	More likely
Hurricane (Sandy)	Mid-Atlantic US	Doubled likelihood of the scale of impact due to higher sea levels as compared with 1950
September sea ice extent	Arctic	Higher likelihood of depletion; largely absent by mid-century

Source: Explaining extreme events of 2012 from a climate perspective, Bulletin of the American Meteorological Society, NOAA

Exposure conclusions

At the aggregate level on an absolute basis, the combination of the three categories – temperature, water and extreme events – show that overall exposure to climate change has increased marginally since 2011. Temperatures are rising, albeit at a diminishing rate for most countries, but water stress is increasing at an accelerating rate.

The absolute results and overall score for countries are summarised in table 6.

On a relative basis our analysis shows there have been some interesting moves between countries, as shown in table 7 below. The top three most exposed countries from 2011 remain the same i.e. Saudi Arabia, India and South Africa. Australia, Mexico and Germany have become relatively more exposed to climate change factors, while Brazil and France are relatively less vulnerable.

Table 6: Exposure (ranked by highest exposure)

	Temp change °C change	Ave temp °C	Water resource m3 /year/ cap	Water resource % change	Extreme events Events/ 10,000k m ²	Overall Score
Weight	15%	20%	25%	25%	15%	100%
S Arabia	0.8	27.2	85	-26.8	0.05	8.7
India	0.1	24.6	1,165	-15.8	0.39	8.1
S Africa	0.7	17.7	888	-12.2	0.12	7.4
Turkey	0.2	12.8	3,083	-14.2	0.25	6.3
Australia	0.3	18.9	21,764	-14.7	0.04	5.8
Indonesia	-0.1	27.6	8,332	-12.5	0.38	5.8
Italy	0.1	17.4	3,002	-5.2	0.71	5.7
China	0.2	13.3	2,041	-6.6	0.12	5.5
Mexico	-0.1	18.5	3,563	-13.7	0.14	5.4
S Korea	0.0	12.7	1,340	-5.3	1.03	5.3
Germany	0.3	10.1	1,302	0.1	0.46	5.0
UK	0.1	10.8	2,314	-5.3	0.70	4.9
Brazil	0.1	20.4	27,551	-12.3	0.05	4.8
Argentina	0.2	15.4	6,771	-10.0	0.06	4.7
France	0.1	11.6	3,168	-6.2	0.33	4.2
Japan	0.0	16.6	3,399	-0.9	0.38	4.1
US	0.1	12.1	9,001	-10.5	0.09	3.9
Canada	0.0	11.3	82,969	-10.6	0.03	2.5
Russia	0.6	6.2	30,195	3.0	0.02	1.9

Source: HSBC, World Bank, Thomson Reuters Datastream

In the next section we look at country sensitivity to climate change risks.

Table 7: Change in exposure – 2011 vs 2013 report

	Exposure Score		Exposure ranking		Rank Change
	2011	2013	2011	2013	
Saudi Arabia	8.5	8.7	1	1	
India	8.3	8.1	2	2	
South Africa	7.6	7.4	3	3	
Turkey	6.8	6.3	4	4	
Australia	6.2	5.8	10	5	▲ 5
Indonesia	6.0	5.8	6	6	
Italy	5.6	5.7	5	7	▼ 2
China	5.5	5.5	9	8	▲ 1
Mexico	5.2	5.4	12	9	▲ 3
South Korea	5.1	5.3	7	10	▼ 3
Germany	5.1	5.0	15	11	▲ 4
UK	5.0	4.9	13	12	▲ 1
Brazil	4.9	4.8	8	13	▼ 5
Argentina	4.3	4.7	16	14	▲ 2
France	4.2	4.2	11	15	▼ 4
Japan	3.9	4.1	14	16	▼ 2
US	3.9	3.9	17	17	
Canada	2.1	2.5	18	18	
Russia	1.8	1.9	19	19	

Source: HSBC, World Bank, Thomson Reuters Datastream. Countries in order of their 2013 Exposure rankings

Sensitivity to extreme events

By sensitivity, we mean the degree to which a country can be affected by an extreme weather event both in humanitarian and in economic terms. To do this we selected three indicators: the number of deaths from weather events; the cost of the event in terms of GDP; and finally the number of people affected (other than death) to certain levels (e.g. homelessness vs. physical injury). We normalised the data by adjusting for population. These factors represent different measures of the socioeconomic impact of extreme events.

Since climate change can lead to more frequent occurrences of extreme events, greater damage from extreme events indicates higher sensitivity to climate change in our view. There is little change in our results since 2011 among the G20 as shown in table 8.

Table 8: Change in sensitivity indicators – 2011 vs 2013 report

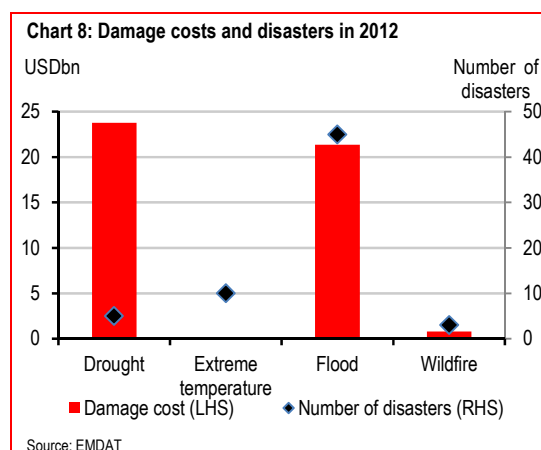
	Deaths		Damage costs		People affected	
	Average number, pa, per million of population		% of GDP		Average number, pa, per million of population	
	2001-2010	2003-2012	2001-2010	2003-2012	2001-2010	2003-2012
China	1	1	0.29	0.30	74,002	70,723
Australia	3	3	0.24	0.24	1,224	1,119
Russia	40	50	0.19	0.19	1,302	792
India	2	1	0.22	0.19	46,958	12,536
Brazil	1	1	0.05	0.08	3,458	3,486
South Africa	0	0	0.04	0.07	32,428	32,931
UK	1	1	0.06	0.08	622	577
Italy	35	39	0.06	0.07	30	5
France	35	42	0.08	0.06	91	58
Saudi Arabia	1	2	0.06	0.06	101	60
Mexico	0	0	0.05	0.05	2,749	5,289
Indonesia	1	1	0.06	0.04	1,364	1,018
US	0	0	0.03	0.05	3,907	3,925
Argentina	0	0	0.05	0.04	1,810	1,058
Germany	11	13	0.10	0.01	402	2
Turkey	0	0	0.03	0.02	223	149
Japan	0	0	0.00	0.01	93	123
South Korea	0	1	0.01	0.00	724	115
Canada	0	0	0.01	0.04	55	60
Average	7	8	0.09	0.09	9,028	7,054

Source: HSBC, EM-DAT, World Bank, Thomson Reuters Datastream. Countries ranked in order of their 2013 Sensitivity rankings

The data is measured on a ten-year rolling basis so that in the 2011 report we used averages for 2001-2010 and here we update this to 2003-2012. Thankfully, in the metric that assesses the number of mortalities as a result of extreme events there are few cases of increases.

We measure damage costs in relation to GDP to give context on the scale of spending by country, which hasn't changed much between our two reports. Chart 9 overleaf shows the cost by country on an annual basis, demonstrating significant variation by region and amount. We estimate that the cumulative damage costs from events relating to climate factors during the decade from 2002-2013 are USD260bn in total.

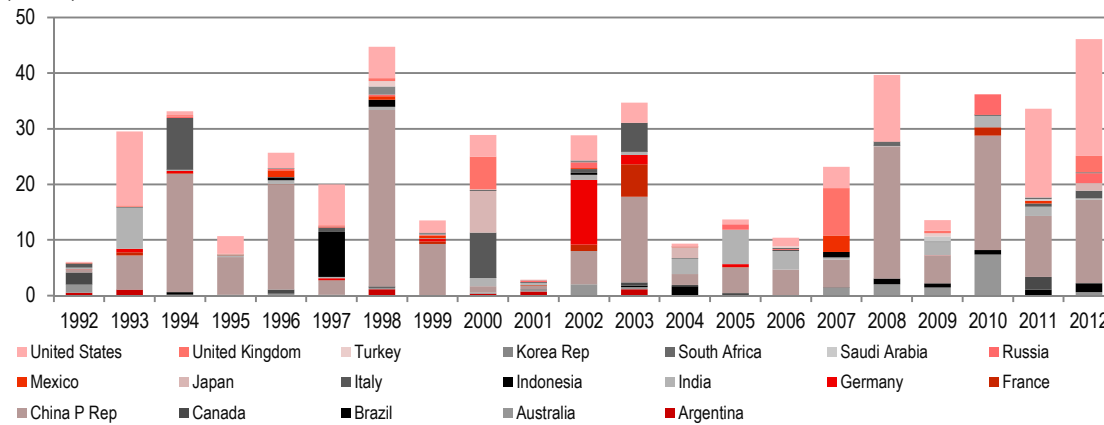
Of the USD260bn total damage, 41% was incurred in China, followed by the US (23.5%) and India (7.7%). In 2012, damage costs were USD46bn. Of this, USD23.8bn came from droughts and USD21.4bn from floods. Chart 8 shows that there were a total of 5 incidents of droughts, 45 incidents of floods, 10 incidences of extreme temperatures and 3 wildfires in 2012 across the G20 countries.



The number of people affected by extreme events overall has decreased slightly, with Germany and India posting the largest declines.

Chart 8. Damage costs across regions since 1992

(USDbn)



Sensitivity conclusions

In our 2011 report, the countries most sensitive to climate factors were India, China and Russia.

Now the three are China, Australia and Russia, as shown in table 9 below.

Table 9: Sensitivity Ranking

	Overall Score		Sensitivity Ranking		Rank Change
	2011	2013	2011	2013	
China	8.6	8.4	2	1	
Australia	7.9	8.2	4	2	▲ 2
Russia	8.3	8.2	3	3	
India	8.6	8.1	1	4	▼ 2
Brazil	6.3	7.1	7	5	▲ 2
South Africa	4.9	6.5	11	6	▲ 6
UK	4.6	6.2	13	7	▲ 6
Italy	5.2	5.7	10	8	▲ 2
France	6.2	5.4	8	9	▼ 1
Saudi Arabia	5.9	5.3	9	10	▼ 1
Mexico	4.9	4.9	12	11	
Indonesia	6.6	4.5	6	12	▼ 6
US	3.4	4.4	15	13	▲ 2
Argentina	4.5	4.2	14	14	
Germany	6.9	3.3	5	15	▼ 10
Turkey	3.1	2.7	16	16	
Japan	1.3	2.5	18	17	▲ 2
South Korea	1.5	2.4	17	18	▼ 1
Canada	1.3	2.1	19	19	▼ 1

Source: HSBC, EM-DAT, World Bank, Thomson Reuters Datastream. Countries in order of their 2013 Sensitivity rankings

The most interesting move in our view is that India has become less sensitive to climate factors since there were improvements across all categories (fewer mortalities and people affected by disaster and less spent as a percentage of GDP). Indonesia has also improved its climate sensitivity status relative to peers. Increasing damage costs in South Africa and the UK mean the countries are more vulnerable on a relative basis than previously.

More details on country vulnerability to climate change events will be published with the Intergovernmental report on climate change (IPCC) report on climate impacts, adaptation and vulnerability in March next year.

Having identified which countries are the most exposed and sensitive to climate change, the natural progression is to look at whether a country has the propensity to adapt ('climate-proof' itself). This can be determined from the economic conditions (adaptive potential) and the socio-economic factors of a country (adaptive capacity).

Adaptive potential and capacity

Adaptive potential

From a financial perspective, countries with higher income per capita and lower debt-to-GDP should be better positioned to take pre-emptive action and to react to disasters. Therefore for adaptive potential, we examine GDP per capita with the rationale that the less wealthy a country is, the less likely it will be able to channel available capital specifically towards adaptation. We also studied debt levels, on the basis that a lower debt-to-GDP ratio indicates greater potential to increase spending on 'climate-proofing'.

In terms of absolute adaptive potential, the picture across the G20 is mixed: average GDP per capita has increased but this is accompanied by an increase in average debt/GDP ratios so that while more resources are available owing to higher income, potentially a smaller slice of these resources would be available to address climate issues owing to the higher debt burdens.

Table 10: Adaptive potential (highest overall score most vulnerable)

	GDP per capita Constant 2000 US\$		Debt-GDP ratio Gross % GDP	
	2001-2010	2003-2012	2001-2010	2003-2012
India	536	588	72.5	74.4
Brazil	3,898	4,056	69.4	68.5
Indonesia	914	926	49.7	45.8
Argentina	8,093	7,634	72.1	71.4
Italy	19,130	19,434	111.0	112.1
Turkey	4,302	4,704	52.7	50.7
Russia	2,152	2,352	28.3	26.3
South Africa	3,266	3,376	34.7	36.6
China	1,287	1,542	15.7	19.2
Mexico	5,926	5,923	43.2	42.9
Saudi Arabia	9,399	9,347	50.8	42.5
Canada	23,922	24,667	81.9	80.1
France	22,081	22,369	65.4	69.6
Japan	37,755	38,588	168.2	184.1
Germany	23,378	23,931	65.5	68.8
South Korea	12,628	13,485	22.0	26.4
US	35,582	36,430	67.7	75.0
UK	26,033	27,152	49.4	55.2
Australia	22,596	23,464	17.6	17.6
Average	13,836	14,209	60	61

Source: HSBC, World Bank, Thomson Reuters Datastream. Countries in order of their 2013 Adaptive Potential rankings.

Adaptive capacity

Adaptive capacity measures the socio-economic dimensions that can influence underlying potential. Our methodology considers three indicators: the rule of law, corruption and education using data from the World Bank.

We assume that where governance on the rule of law is strong, and corruption tends to be lower, and a higher rate of further education is in place, the potential for making positive behavioural changes among the general population is higher.

Table 11: Adaptive capacity (highest overall score least able to adapt on socio economic metrics)

Weight	Rule of law	Corruption	Population in tertiary education	Overall Score
	Index	Index	% enrolled of those that have requisite qualification	
	2.5 = best -2.5 = worst	2.5 = best -2.5 = worst		
	35%	30%	35%	100%
Indonesia	-0.73	-0.81	23.1	9.3
China	-0.44	-0.54	26.8	8.2
India	0.07	-0.43	17.9	7.9
Mexico	-0.48	-0.27	28.0	7.7
Brazil	-0.30	-0.01	25.6	7.3
Russia	-0.90	-0.93	75.9	7.2
South Africa	0.09	0.31	15.0	6.9
Argentina	-0.63	-0.44	74.8	6.6
Turkey	0.06	-0.10	55.4	6.3
Saudi Arabia	0.12	-0.14	41.2	6.3
Italy	0.49	0.27	65.0	4.3
Japan	1.27	1.27	59.7	4.1
France	1.42	1.39	56.7	3.9
Germany	1.65	1.81	47.3	3.6
South Korea	0.92	0.43	103.1	2.9
UK	1.67	1.82	59.8	2.5
US	1.55	1.51	94.8	2.1
Canada	1.74	2.02	60.0	1.8
Australia	1.76	2.01	79.9	1.1

Source: HSBC, World Bank, Thomson Reuters Datastream.
Note: latest data year is 2011

Due to methodology changes since 2011 the data is not comparable. However on updated metrics our findings, that the three most vulnerable countries are Indonesia, China and India, remain the same.

Overall climate vulnerability

In terms of **absolute vulnerability**, our analysis shows that countries are becoming marginally more exposed to climate change: temperatures continue to rise, water resources are being depleted and extreme events are occurring. In our view, evaluating country vulnerabilities to the climate factor is a critical tool for risk management, informing both asset allocation and the understanding of pressures along global value chains.

On a relative basis the table below summarises the results across categories, demonstrating that **India, China and Indonesia** are the three countries most vulnerable to climate change risks. This is in line with our previous analysis of 2011.

Table 12: Country indicators ranked by most vulnerable countries

	Overall Score	Exposure					Sensitivity		Adaptive potential			Adaptive Capacity		
		Temp change °C	Av. Temp °C	Water resource m³/yr/cap	Water resource % change	Extreme events Events/10,000km²	Number of deaths Av p.a. per mn pop'n	Damage costs % of GDP	People affected Av p.a. per mn pop'n	GDP per capita Constant 2000 USD	Debt-GDP ratio Gross % GDP	Rule of law Index: 2.5 = 2.5 = best, -2.5 = worst	Corruption Index: 2.5 = 2.5 = best, -2.5 = worst	Education % pop'n in tertiary ed'n
Weight		15%	20%	25%	25%	15%	30%	40%	30%	60%	40%	35%	30%	35%
India	8.3	0.1	24.6	1,165	-19.4	0.4	1	0.19	12,536	588	74.4	0.07	-0.43	17.9
China	7.0	0.2	13.3	2,041	-8.1	0.1	1	0.30	70,723	1,542	19.2	-0.44	-0.54	26.8
Indonesia	6.8	-0.1	27.6	8,332	-15.4	0.4	1	0.04	1,018	926	45.8	-0.73	-0.81	23.1
South Africa	6.6	0.7	17.7	888	-15.0	0.1	0	0.07	32,931	3,376	36.6	0.09	0.31	15.0
Brazil	6.5	0.1	20.4	27,551	-15.1	0.1	1	0.08	3,486	4,056	68.5	-0.30	-0.01	25.6
Saudi Arabia	6.2	0.8	27.2	85	-32.3	0.0	2	0.06	60	9,347	42.5	0.12	-0.14	41.2
Mexico	5.8	-0.1	18.5	3,563	-16.8	0.1	0	0.05	5,289	5,923	42.9	-0.48	-0.27	28.0
Russia	5.8	0.6	6.2	30,195	3.7	0.0	50	0.19	792	2,352	26.3	-0.90	-0.93	75.9
Italy	5.5	0.1	17.4	3,002	-6.4	0.7	39	0.07	5	19,434	112.1	0.49	0.27	65.0
Argentina	5.5	0.2	15.4	6,771	-12.4	0.1	0	0.04	1,058	7,634	71.4	-0.63	-0.44	74.8
Turkey	5.3	0.2	12.8	3,083	-17.5	0.2	0	0.02	149	4,704	50.7	0.06	-0.10	55.4
France	4.6	0.1	11.6	3,168	-7.7	0.3	42	0.06	58	22,369	69.6	1.42	1.39	56.7
Australia	4.3	0.3	18.9	21,764	-18.1	0.0	3	0.24	1,119	23,464	17.6	1.76	2.01	79.9
UK	4.1	0.1	10.8	2,314	-6.6	0.7	1	0.08	577	27,152	55.2	1.67	1.82	59.8
Germany	4.0	0.3	10.1	1,302	0.2	0.5	13	0.01	2	23,931	68.8	1.65	1.81	47.3
Japan	3.7	0.0	16.6	3,399	-1.1	0.4	0	0.01	123	38,588	184.1	1.27	1.27	59.7
US	3.6	0.1	12.1	9,001	-12.9	0.1	0	0.05	3,925	36,430	75.0	1.55	1.51	94.8
South Korea	3.6	0.0	12.7	1,340	-6.6	1.0	1	0.00	115	13,485	26.4	0.92	0.43	103.1
Canada	2.8	0.0	11.3	82,969	-13.1	0.0	0	0.04	60	24,667	80.1	1.74	2.02	60.0

Source: HSBC, World Bank, Thomson Reuters Datastream

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