# BIODIVERSITY

## ESTIMATES GLOBAL CLIMATE IMPACT

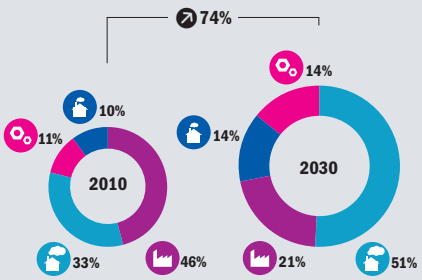
### 2010 EFFECT TODAY

USD **LOSS** PER YEAR **80 BILLION**

### 2030 EFFECT TOMORROW

USD **LOSS** PER YEAR **400 BILLION**

### ECONOMIC IMPACT




### CONFIDENCE INDICATIVE

SEVERITY

AFFECTED

INJUSTICE

PRIORITY

MDG EFFECT

- Richness of life in the world's ecosystems is currently in full decline as human activities from toxic pollution to deforestation and destruction of natural habitats for agricultural land persist
- Climate change forces biological zones to face weather conditions that are unsuitable for their plant, animal, insect, and other species, hastening decline and extinction
- Biodiversity loss has significant market value and on a large scale will slow the world's economic growth
- Limiting non-climate dangers to biodiversity, such as deforestation, will be the basis of an effective response to the impact of climate change

### RELATIVE IMPACT

$$$$$$$ 2010
57 4

$$$$$$$$$ 2030
75 7

### HOTSPOTS

2010 $ 2030

25,000 **USA** 45,000

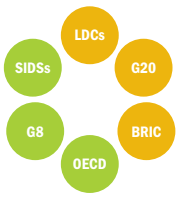
4,250 **CHINA** 45,000

3,500 **BRAZIL** 30,000

3,250 **IRAN** 25,000

3,250 **RUSSIA** 25,000

### GEOPOLITICAL VULNERABILITY




$ Economic Cost (2010 PPP non-discounted)

Developing Country Low Emitters

Developing Country High Emitters

Developed

Other Industrialized

$ = Losses per 10,000 USD of GDP

Change in relation to overall global population and/or GDP

$ = Millions of USD (2010 PPP non-discounted)

The international definition of biodiversity is "variability among living organisms" (CBD, 1992). Biodiversity has both market and non-market value—such as aesthetic and other non-traded values—principally through the integral role of biodiversity in sustaining ecosystems (Boyd and Banzhaf, 2007). The agricultural sector is particularly dependent on ecosystem services, such as water, pollination, and pest control. If removed, they will incur predictable market-based costs, since compensating measures must be taken at market cost. Experts have estimated that a 30% species loss can generate some 10% of lost plant production affecting agricultural outputs (Hooper et al., 2012). Global biodiversity loss has become not only a conservation issue, but a large-scale and serious macroeconomic problem. UNEP estimates current global environmental damages at over 6 trillion dollars (Garfunkel ed., 2010). As one of the costliest impacts of climate change assessed here, losses can only worsen unless comprehensive solutions are found (IPCC, 2007; Bellard et al., 2012).

## CLIMATE MECHANISM

The world's main biological zones, or biomes, from tropical woodlands, to grass steppes, and temperate deciduous forests, have taken thousands of years to establish rich habitats for an unimaginable variety of natural species. These zones are distinguished one from another by precise climate and geographical characteristics (Sala et al., 2000). The planet is warming at rates faster than in much of the Earth's recent past and the growing human presence in the environment limits the scope for biomes and their inhabitants to shift to new areas or adapt to changing climates (IPCC, 2007; Pereira et al., 2010). Some species will become invasive, establishing themselves in new areas where others are in decline (Vilà et al. in Canadell et al. (eds.), 2007; Hellmann et al., 2008). As climates become unsuitable, endemic species of all kinds which have evolved to thrive in a specific habitat will be locked into declining biological zones with reduced geographic range. As that area shrinks, species decline at a predictable rate, reducing biodiversity (Thomas et al., 2004). Climate change could conceivably also bring some biodiversity benefits in isolated cases, but on a global scale the impacts are clearly understood by experts to be negative (Bellard et al., 2012). Valuing the market worth of ecosystems and their so-called "services" is difficult, not least since it involves putting a price tag on ecological life (Farber et al., 2002). But in a surrogate market—in which consumers would be charged for the benefits many now enjoy without cost—around half of the losses estimated here might be considered to have value (Sutton and Constanza, 2002; Curtis, 2004).

## IMPACTS

The scale of the estimated impact on biodiversity from climate change are substantial: around 80 billion dollars a year at present. By 2030, that estimate will nearly double as a share of global GDP, approaching 400 billion dollars a year in losses.

Although the impact is estimated to affect developing countries more severely, biodiversity loss will occur in virtually every region, since the world's entire climate is in rapid shift. However, lower-income countries are more dependent on ecosystem services, increasing the damage potential for populations lower on the socio-economic scale.

Large countries incur the most damages, especially the US, China, Brazil, Iran, and Russia. The US is estimated to incur one quarter of all losses today, at over 20 billion US dollars a year. Impacts are most severe as a share of GDP for countries in Africa and Central Asia, many of which could experience losses equivalent to more than 1% of GDP by 2030.

## THE BROADER CONTEXT

The long-term decline of biodiversity is well established and continues as a clear trend. For example, since the 1970s, the fall in the abundance of vertebrate species has been almost one third. The World Conservation Union's (IUCN) "Red List" of endangered species reveals some 20,000 species of animals and plants at high risk for extinction. Decline of natural habitats due to human activities is also a continuing trend around the world, although destruction of tropical forests and mangroves has shown signs of slowing in some areas (SCBD, 2010). Deforestation is still a major global concern and threatens biodiversity (Busch et al., 2011). High demand for food and biofuels, driven by population and economic growth is an important driver of land change and degradation

BIGGER PICTURE

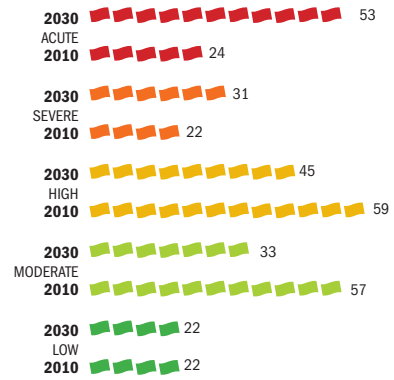
N/A

SURGE

OCCURRENCE

N/A

VULNERABILITY SHIFT




PEAK IMPACT

N/A

GENDER BIAS

INDICATOR INFORMATION

MODEL: Baumgartner et al., 2012; Thomas et al., 2004

EMISSION SCENARIO: SRES A1B (IPCC, 2000)

BASE DATA: Costanza et al., 1997; Mace et al., 2003; US Forest Service (2010)

= 5 countries (rounded)

Acute Severe High Moderate Low

and deforestation (Gisladottir and Stocking, 2005).

## VULNERABILITIES AND WIDER OUTCOMES

Assessments of the IUCN Red List show that the destruction of habitat by converting wild areas and forests into agricultural land are among the most significant contributors to biodiversity loss (Stuart et al., 2004; Brook et al., 2008). Unsustainable extraction of water resources further affects inland water-based ecosystems, especially those designed to meet the growing demand for water in the agricultural sector (Brinson and Malvarez, 2002). Agricultural and industrial pollutants are a further important source of stress (SCBD, 2010). The biomes most at risk due to climate change include scrubland, temperate deciduous forest, warm mixed forest, temperate mixed forest, and savannah (Thomas et al., 2004). Countries with high concentrations of these biomes have high vulnerability to biodiversity loss from climate change, even if current environmental conservation is sound. Lower-income countries, and those whose indigenous populations depend more heavily on ecosystems and wild areas, such as native forest, for their livelihood, are also highly vulnerable (Munasinghe, 1993; Salick and Byg, 2007). Countries like Brazil that are already suffering large-scale biodiversity losses from forest destruction will increasingly experience double pressures from climate change (Miles et al., 2004). Biodiversity loss from climate change will slow the progress of human development in the worst-affected developing countries and will cause tangible economic losses worldwide by reducing ecosystem services (Roe and Elliot, 2004).

## RESPONSES

Biodiversity loss due to climate change can be offset through measures that reduce other major biodiversity threats. Where those threats are already minimized, boosting conservation efforts, creating nature preserves, and reversing the fragmentation of habitats through the establishment of biodiversity corridors may help stem losses (Tabarelli et al., 2010). The principal response areas include promoting protection and sustainable management of forests, rationalizing and enhancing efficiencies in water usage, and managing toxic pollutants from industrial waste, agricultural fertilizers, and pesticides (Tilman et al., 2002). Interventions aimed at controlling invasive species, which can accelerate local biodiversity losses among endemic species, have shown to be effective and can complement other efforts (Veitch and Clout (eds.), 2004).
For many of the worst-affected communities in lower-income countries, capacity to implement such measures will be a major hurdle and international support will be vital. As with other systemic challenges, mainstreaming biodiversity considerations into decision making at different levels will be crucial to more effective solutions (Cowling et al., 2008). Social support should also be foreseen for indigenous groups and other communities which are heavily reliant on the fastest declining ecosystems (Salick and Byg, 2007).
Promising trends are visible in the global fight against biodiversity loss: protected and sustainable forest areas continue to grow incrementally and biodiversity aid has increased significantly in the past five years (SCBD, 2010). But the need is far greater than the response to date and most forms of biodiversity loss are irreversible (IPCC, 2002; Thomas et al., 2004). As climate change accelerates the decline, the urgency to respond effectively has never been greater.

## THE INDICATOR

**The indicator measures the proportion of species doomed to future extinction in different biomes around the world on account of the contraction of geographical climate-determined range size and future biome distribution due to climate change (Thomas et al., 2004). The exact time lag between threatened extinctions and their full realization varies and is not fully understood, although estimates exist (Brooks et al., 1999). Since the process of biodiversity loss due to climate change is continuous, in reality only a proportion of the estimated losses would be incurred at a date later than indicated. The indicator pairs biodiversity loss information and vegetation change with estimations of the lost economic value to determine a scale of economic losses in affected economies and the world (Mace et al. in Hassan et al. (eds.), 2005; US Forest Service, 2010; Costanza et al., 1997).**

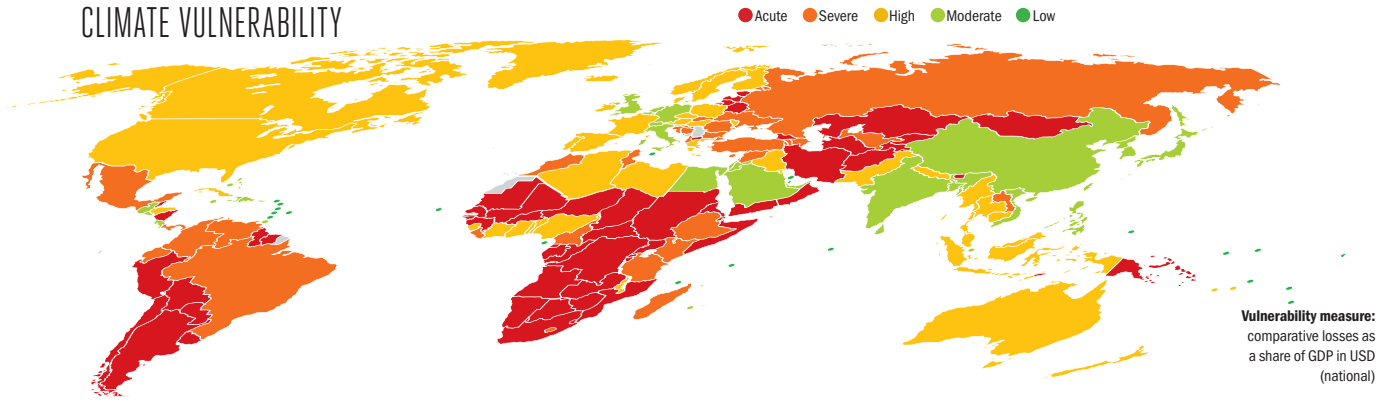
ESTIMATES COUNTRY-LEVEL IMPACT

| COUNTRY | $ 2010 | $ 2030 | 🌳 2010 | 🌳 2030 |
|---|---|---|---|---|
| **ACUTE** | | | | |
| Afghanistan | 80 | 650 | -10,000 | -20,000 |
| Angola | 400 | 2,500 | -60,000 | -100,000 |
| Argentina | 3,000 | 20,000 | -35,000 | -70,000 |
| Belarus | 700 | 4,250 | -550 | -1,250 |
| Belize | 15 | 100 | -450 | -850 |
| Bhutan | 45 | 350 | -250 | -450 |
| Bolivia | 500 | 4,000 | -35,000 | -65,000 |
| Botswana | 150 | 750 | -1,500 | -3,000 |
| Burkina Faso | 60 | 400 | -4,500 | -9,250 |
| Central African Republic | 35 | 200 | -5,500 | -10,000 |
| Chad | 200 | 1,250 | -20,000 | -40,000 |
| Chile | 800 | 6,250 | -15,000 | -30,000 |
| Congo | 80 | 500 | -400 | -750 |
| Djibouti | 10 | 75 | -550 | -1,250 |
| DR Congo | 55 | 350 | -20,000 | -45,000 |
| Equatorial Guinea | 60 | 400 | -400 | -850 |
| Eritrea | 20 | 100 | -2,750 | -5,750 |
| Estonia | 85 | 400 | -150 | -300 |
| Gabon | 100 | 650 | -4,000 | -8,000 |
| Georgia | 55 | 350 | -2,750 | -5,500 |
| Guinea | 30 | 200 | -4,250 | -8,500 |
| Guinea-Bissau | 5 | 40 | -600 | -1,250 |
| Guyana | 65 | 300 | -3,500 | -7,250 |
| Iran | 3,250 | 25,000 | -10,000 | -20,000 |
| Kazakhstan | 950 | 5,000 | -5,750 | -10,000 |
| Kyrgyzstan | 90 | 600 | -1,250 | -2,500 |
| Latvia | 150 | 700 | -600 | -1,250 |
| Lithuania | 200 | 1,250 | -200 | -400 |
| Macedonia | 65 | 450 | -2,000 | -4,000 |
| Mali | 100 | 750 | -20,000 | -40,000 |
| Mauritania | 70 | 450 | -15,000 | -35,000 |
| Mongolia | 150 | 1,500 | -3,000 | -6,250 |
| Mozambique | 80 | 550 | -35,000 | -70,000 |
| Namibia | 100 | 600 | -2,250 | -4,250 |
| Nicaragua | 40 | 300 | -1,500 | -2,750 |
| Niger | 55 | 350 | -20,000 | -40,000 |
| Oman | 200 | 1,750 | -2,000 | -3,750 |
| Papua New Guinea | 65 | 500 | -1,250 | -2,500 |
| Paraguay | 100 | 900 | -10,000 | -25,000 |
| Peru | 800 | 6,250 | -4,000 | -8,250 |
| Senegal | 75 | 500 | -3,250 | -6,500 |
| Solomon Islands | 10 | 80 | -75 | -150 |
| Somalia | 85 | 550 | -15,000 | -30,000 |
| South Africa | 1,750 | 10,000 | -5,250 | -10,000 |
| Sudan/South Sudan | 300 | 2,000 | -45,000 | -90,000 |
| Suriname | 30 | 150 | -2,750 | -5,500 |
| Tajikistan | 45 | 300 | -450 | -850 |
| Timor-Leste | 10 | 85 | -1,500 | -3,250 |
| Turkmenistan | 350 | 2,000 | -8,000 | -15,000 |
| Uruguay | 200 | 1,250 | -400 | -800 |
| Yemen | 150 | 1,250 | -3,250 | -6,500 |
| Zambia | 65 | 400 | -85,000 | -150,000 |
| Zimbabwe | 75 | 500 | -9,500 | -20,000 |
| **SEVERE** | | | | |
| Albania | 40 | 250 | -50 | -100 |
| Armenia | 35 | 250 | -700 | -1,500 |
| Azerbaijan | 200 | 1,250 | -2,000 | -4,000 |
| Bosnia and Herzegovina | 70 | 500 | -1,500 | -3,000 |
| Brazil | 3,500 | 30,000 | -200,000 | -450,000 |
| Bulgaria | 250 | 1,500 | -5,250 | -10,000 |
| Cameroon | 85 | 550 | -2,250 | -4,250 |
| Colombia | 650 | 4,750 | -5,500 | -10,000 |
| Croatia | 150 | 1,250 | -1 | -5 |
| Cyprus | 35 | 100 | -55 | -100 |
| Ecuador | 150 | 1,250 | -2,750 | -5,250 |
| Ethiopia | 150 | 1,000 | -25,000 | -55,000 |
| Kenya | 100 | 700 | -950 | -2,000 |
| Laos | 30 | 300 | -1,250 | -2,500 |
| Lesotho | 5 | 40 | -25 | -50 |
| Liberia | 1 | 20 | -1,750 | -3,750 |
| Madagascar | 40 | 250 | -1,000 | -2,250 |
| Mexico | 2,500 | 20,000 | -50,000 | -100,000 |
| Morocco | 300 | 2,000 | -10,000 | -20,000 |
| Panama | 75 | 550 | -1,750 | -3,500 |
| Romania | 350 | 2,500 | -200 | -350 |
| Russia | 3,250 | 25,000 | -70,000 | -150,000 |
| Slovakia | 200 | 1,250 | -450 | -900 |
| Swaziland | 10 | 55 | -45 | -90 |
| Syria | 200 | 1,500 | -1,250 | -2,250 |
| Tanzania | 150 | 850 | -10,000 | -20,000 |
| Tunisia | 150 | 1,250 | -4,000 | -7,750 |
| Turkey | 1,500 | 4,750 | -4,750 | -9,750 |
| Ukraine | 700 | 4,750 | -800 | -1,500 |
| Uzbekistan | 100 | 850 | -7,250 | -15,000 |
| Venezuela | 550 | 4,000 | -25,000 | -55,000 |
| **HIGH** | | | | |
| Algeria | 150 | 1,000 | -55,000 | -100,000 |
| Australia | 1,250 | 2,250 | -50,000 | -100,000 |
| Austria | 300 | 800 | -1,000 | -2,000 |
| Benin | 20 | 100 | -6,000 | -10,000 |
| Brunei | 20 | 150 | -100 | -250 |
| Cambodia | 40 | 450 | -1,500 | -3,000 |
| Canada | 2,250 | 4,000 | -60,000 | -100,000 |
| Costa Rica | 35 | 300 | -700 | -1,500 |
| Cote d ,Ivoire | 40 | 250 | -3,500 | -6,750 |

$ Additional economic costs due to climate change (million USD PPP) - yearly average

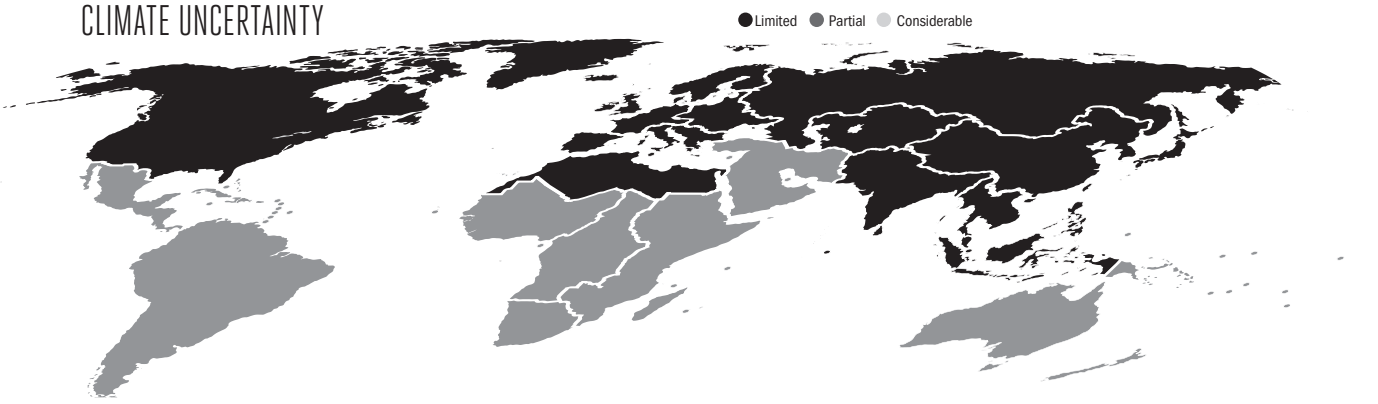
🌳 Contraction of biological zones due to climate change ($km^2$) - yearly average

## CLIMATE VULNERABILITY




**Vulnerability measure:** comparative losses as a share of GDP in USD (national)

## CLIMATE UNCERTAINTY




| COUNTRY | 2010 | 2030 | 2010 | 2030 |
|---|---|---|---|---|
| Cuba | 85 | 650 | -2,250 | -4,250 |
| Czech Republic | 250 | 1,750 | -750 | -1,500 |
| Denmark | 150 | 400 | -30 | -60 |
| Fiji | 5 | 35 | -50 | -95 |
| Finland | 150 | 400 | -2,750 | -5,250 |
| France | 1,750 | 5,000 | -15,000 | -25,000 |
| Gambia | 5 | 20 | -200 | -400 |
| Ghana | 55 | 350 | -3,000 | -6,000 |
| Greece | 400 | 1,250 | -3,750 | -7,250 |
| Honduras | 45 | 350 | -2,500 | -5,250 |
| Hungary | 150 | 950 | -750 | -1,500 |
| Iceland | 20 | 40 | -5 | -10 |
| Indonesia | 500 | 3,750 | -5,000 | -10,000 |
| Iraq | 85 | 650 | -2,750 | -5,500 |
| Ireland | 300 | 550 | -350 | -650 |
| Libya | 100 | 750 | -40,000 | -85,000 |
| Malawi | 10 | 60 | -600 | -1,250 |
| Malaysia | 350 | 2,750 | -7,000 | -15,000 |
| Moldova | 15 | 85 | -300 | -650 |
| Myanmar | 45 | 350 | -20,000 | -35,000 |
| Nepal | 25 | 200 | -200 | -400 |
| New Zealand | 250 | 400 | -50 | -100 |
| Nigeria | 200 | 1,250 | -5,250 | -10,000 |
| Norway | 250 | 500 | -500 | -950 |
| Pakistan | 300 | 2,250 | -2,000 | -4,000 |
| Poland | 700 | 4,750 | -2,500 | -5,000 |
| Portugal | 200 | 650 | -3,750 | -7,250 |
| Sierra Leone | 5 | 40 | -600 | -1,250 |
| Slovenia | 75 | 500 | -600 | -1,250 |
| Spain | 1,500 | 4,250 | -15,000 | -30,000 |
| Sweden | 400 | 950 | -3,250 | -6,500 |
| Thailand | 350 | 2,500 | -7,750 | -15,000 |
| Togo | 5 | 30 | -450 | -950 |
| Uganda | 25 | 200 | -250 | -500 |
| United States | 25,000 | 45,000 | -25,000 | -50,000 |
| Vanuatu | 1 | 5 | -30 | -65 |
| **MODERATE** | | | | |
| Bahamas | 5 | 35 | -500 | -950 |
| Bangladesh | 20 | 150 | -100 | -250 |
| Belgium | 100 | 350 | -350 | -750 |
| Burundi | 1 | 5 | -650 | -1,250 |
| China | 4,250 | 45,000 | -60,000 | -100,000 |
| Dominican Republic | 30 | 250 | -3,750 | -7,250 |
| Egypt | 10 | 60 | -25,000 | -50,000 |
| El Salvador | 15 | 100 | -450 | -950 |
| Germany | 1,000 | 3,000 | -1,250 | -2,500 |
| Guatemala | 30 | 250 | -1,250 | -2,750 |
| Haiti | 1 | 20 | -200 | -400 |
| India | 1,500 | 10,000 | -15,000 | -30,000 |
| Israel | 30 | 200 | -150 | -250 |
| Italy | 700 | 2,000 | -8,500 | -15,000 |
| Jamaica | 5 | 40 | -400 | -750 |
| Japan | 900 | 2,500 | -4,500 | -9,250 |
| Jordan | 5 | 35 | -550 | -1,000 |
| Lebanon | 15 | 100 | -65 | -150 |
| Luxembourg | 15 | 40 | -30 | -60 |
| Mauritius | 5 | 20 | -50 | -100 |
| Netherlands | 150 | 400 | -500 | -1,000 |
| North Korea | 15 | 150 | -1,750 | -3,500 |
| Philippines | 95 | 750 | -350 | -650 |
| Rwanda | 1 | 10 | -650 | -1,250 |
| Saudi Arabia | 150 | 1,250 | -15,000 | -25,000 |
| Singapore | 10 | 70 | -15 | -30 |
| South Korea | 500 | 4,000 | -550 | -1,000 |
| Sri Lanka | 30 | 250 | -1,250 | -2,750 |
| Switzerland | 70 | 200 | -300 | -600 |
| Trinidad and Tobago | 5 | 45 | -200 | -350 |
| United Arab Emirates | 20 | 150 | -500 | -1,000 |
| United Kingdom | 1,000 | 3,000 | -1,500 | -3,000 |
| Vietnam | 70 | 750 | -150 | -300 |
| **LOW** | | | | |
| Antigua and Barbuda | | | | |
| Bahrain | | | | |
| Barbados | | | | |
| Cape Verde | | | | |
| Comoros | | | | |
| Dominica | | | | |
| Grenada | | | | |
| Kiribati | | | | |
| Kuwait | | | | |
| Maldives | | | | |
| Malta | | | | |
| Marshall Islands | | | | |
| Micronesia | | | | |
| Palau | | | | |
| Qatar | | | | |
| Saint Lucia | | | | |
| Saint Vincent | | | | |
| Samoa | | | | |
| Sao Tome and Principe | | | | |
| Seychelles | | | | |
| Tonga | | | | |
| Tuvalu | | | | |