



## Backgrounder:

# Comparing climate impacts at 1.5°C, 2°C, 3°C and 4°C

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### 1. The multiple benefits of the 1.5 degree climate target

As well as limiting climate change, cutting greenhouse gas emissions will provide multiple other benefits which can be unlocked by limiting climate change to 1.5 degrees celsius.

Some of the [most important](#)<sup>1</sup> other benefits (or 'co-benefits') of ambitious climate goals include better health for many people around the world, more secure access to food, protected fisheries, better energy security, and more economic growth. Addressing climate change could also bring other knock-on benefits, like better mobility. By delivering other public goods, these multiple benefits can [reduce](#)<sup>2</sup> the overall cost of mitigating climate change.

### 2. Healthier people

Climate change [threatens human health](#)<sup>3</sup> directly - by changing the weather, altering the distribution of vector-borne and other infectious diseases, and worsening air pollution - and indirectly - by causing undernutrition, harder working conditions, and mental stress.

By limiting warming to 1.5°C:

- About [3.3 million](#) cases of dengue fever annually in Latin America and the Caribbean could be avoided compared with a no-policy scenario with warming of 3.7°C. (That's [0.5 million a year](#) less cases compared with 2°C of warming.<sup>4</sup>)
- By limiting warming to less than 2°C, the number of people at risk of malaria could be [150 million](#) lower, compared with warming of 2-3°C. Malaria is estimated to cost [\\$12 billion](#) annually in Africa alone in health care costs, work and school cover, and loss of investment and tourism.
- Limiting warming to 1.5°C will generally bring bigger benefits for human health than 2°C, particularly for individuals in [developing countries](#).
- People in poor regions could be [less vulnerable](#) to undernutrition resulting from diminished food production, compared to higher levels of warming.
- Global food intake per capita is expected to be higher. The number of people undernourished in the world could be [25 million less](#) by the end of the century than under warming of 2°C .
- Compared to now, the incidence of heat stress in megacities such as Lagos in Nigeria, and Shanghai in China could be more than halved, with more than [350 million less](#) people exposed to deadly heat. ([More than the combined population](#) of Mexico and Brazil.)

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<sup>1</sup> Multiple benefits from climate change mitigation: Assessing the evidence (2017), Grantham Research Institute, p.1.

<sup>2</sup> Ibid, p.4.

<sup>3</sup> IPCC, AR5, WGII, Chapter 11, p.716.

<sup>4</sup> Limiting global-mean temperature increase to 1.5–2 °C could reduce the incidence and spatial spread of dengue fever in Latin America (2017), PNAS.

### 3. Less deaths from air pollution

Air pollution kills about [seven million](#) people a year. [95% of the global population](#)<sup>5</sup> live in areas that fail the World Health Organization's (WHO) recommended baseline for healthy air. Climate change will [worsen ozone pollution](#) that causes asthma attacks and other ailments, and may [weaken weather systems](#) that clear polluted air from densely populated areas.

By limiting warming to 1.5°C:

- There will be less [local and regional air pollution](#)<sup>6</sup> as greenhouse gas emissions are cut, providing the biggest single health co-benefit from limiting climate change. This is such a huge benefit that in economic terms it may even be [larger](#)<sup>7</sup> than the entire cost of reducing carbon emissions in most major emitting countries.
- Limiting temperature rise to 1.5°C compared to 2°C could prevent about [153 million premature deaths](#) from air pollution worldwide by 2100 - about 40% of those over the next 40 years.
- Under a moderate emissions scenario ([RCP4.5](#)) where temperatures rise 2-3°C by the end of the century, an average of 16,000 deaths caused by PM2.5, and an average of 8,000 ozone-related deaths could be avoided in the United States alone in 2050.<sup>8</sup>

### 4. Less hunger

Rising temperatures, drought, and extreme weather will damage food production. Without adaptation, every degree of global temperature rise could [reduce](#) global yields of wheat by 6.0%, rice by 3.2% and maize by 7.4%, and climate change could [lower](#) nutrient levels in crops. Drying in many regions could [threaten food security](#).<sup>9</sup> Even 2°C of global warming could [place 84 million](#)<sup>10</sup> more people at risk of hunger by 2050.

By limiting warming to 1.5°C:

- [25 million fewer](#) people globally could be undernourished by the end of the century, compared to a 2°C future.<sup>11</sup>
- Key developing regions would be less vulnerable to a [10-15%](#)<sup>12</sup> fall in crop yields by mid-century, compared to a 2°C future.
- [43 million](#) fewer people in African countries could be at risk of hunger, compared to a 2°C future.<sup>13</sup>
- A small but [significant proportion](#) of the population of Asian river basins will have better water availability and greater food security, compared to higher levels of temperature rise.
- [Risks to food production](#) in the Pacific Islands would be significantly lower by the end of the century. Climate change impacts such as sea level rise, ocean acidification, and extreme weather events would be less frequent and less intense, resulting in more [stable food production processes](#).<sup>14</sup>

### 5. More economic growth

Climate change will damage the global economy. Even 2°C of warming will lower economic growth in many countries, especially poorer ones.

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<sup>5</sup> State of global air: A special report on global exposure to air pollution and its disease burden (2018), Health Effects Institute, p.3.

<sup>6</sup> Multiple benefits from climate change mitigation: Assessing the evidence (2017), Grantham Research Institute. p.1.

<sup>7</sup> Ibid, p.1.

<sup>8</sup> Co-benefits of global, domestic, and sectoral greenhouse gas mitigation for US air quality and human health in 2050 (2017), p.8.

<sup>9</sup> Climate change and food security: risks and responses (2016), Food and Agriculture Organization of the United Nations, p.7.

<sup>10</sup> Inclusive climate change mitigation and food security policy under 1.5°C climate goal (2018), Environmental Research Letters, p.1.

<sup>11</sup> Projected global undernourished population is 530-550 million at 1.5°C and 540-590 million at 2°C

<sup>12</sup> Pursuing the 1.5°C limit: Benefits and opportunities (2017), International Climate Initiative, p.vi.

<sup>13</sup> Clements, R. (2009). The Economic Cost of Climate Change in Africa, p.7

<sup>14</sup> Climate change and Pacific Island food systems (2018), CCAFS and CTA, p.15-18.

By limiting warming to 1.5°C:

- We will [minimise further economic damage](#) from climate change, with 1.5°C bringing [similar projected impacts](#) on economic growth as current conditions of around 1°C of temperature rise.
- Global [economic losses](#) from 1.5°C of warming are 0.14% smaller than for 2°C.
- There will be reduced combined economic damages resulting from the impacts of climate change and [global inequality](#).<sup>15</sup>
- By 2100, [90% of the world's population](#),<sup>16</sup> particularly poor countries in Africa, Asia, and Latin America, will be likely to experience reduced economic damages compared to 2°C.
- By 2100, the world could be [three per cent wealthier](#)<sup>17</sup> than in a 2°C warmer climate. National economies could save as much as US\$30trillion in cumulative benefits between now and the end of the century.
- The negative economic impacts of climate change will [fall disproportionately](#) on the world's poorest countries, but the economic burden will be less imbalanced if warming is limited to 1.5°C. Keeping warming to 1.5°C would more evenly spread the cost of climate change across developed and developing economies.
- Climate change forcing a poorly managed transition a low carbon economy could threaten the stability of the global economy. Planning the transition carefully and enacting it deliberately will give the [best conditions](#) for future economic prosperity.

## 6. More jobs

Fossil fuels provide fewer jobs than low-carbon technologies. Shifting to clean energy on the scale necessary to deliver a 1.5°C world could create significant employment opportunities.

By limiting warming to 1.5°C:

- In all futures with more renewable power, jobs in biomass energy, hydropower, and nuclear generate more employment [per energy unit](#) than fossil fuels<sup>18</sup> and will create jobs in green industries.
- By 2050, there could be [double the amount of jobs](#)<sup>19</sup> in the energy sector. Jobs in clean energy are also [higher quality](#),<sup>20</sup> and generally [safer and more skilled](#).<sup>21</sup>
- Policies to deliver a 1.5°C world could see [68% more green jobs](#) (in maintenance, manufacturing, construction, and installation of clean energy) by 2030.
- A global green economy will mean less jobs in carbon intensive industries, but more jobs overall. Limiting climate change could see [6 million jobs](#)<sup>22</sup> lost from carbon intensive industries by 2030, but 24 million added in new industries, a net increase of [18 million jobs](#)<sup>23</sup> in sectors including clean energy, electric vehicles, and sustainable building.

## 7. Protected oceans

Fisheries and aquaculture are already threatened by ocean warming and acidification. These impacts are expected to worsen as temperatures rise.

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<sup>15</sup> Large potential reduction in economic damages under UN mitigation targets (2018), Nature, p.549.

<sup>16</sup> Ibid, p.552.

<sup>17</sup> Ibid, p.550.

<sup>18</sup> Pursuing the 1.5°C limit: Benefits and opportunities (2017), International Climate Initiative, p.ix.

<sup>19</sup> Ibid, p.iii.

<sup>20</sup> Ibid, p.xii.

<sup>21</sup> Ibid, p.31.

<sup>22</sup> Greening with jobs: World employment social outlook (2018), International Labour Organization, p.37.

<sup>23</sup> Ibid, p.1.

By limiting warming to 1.5°C:

- Risks to hatcheries and other aquaculture infrastructure from rising sea levels [will decrease](#), and access to small-scale fisheries will be protected for millions of people living on tropical coastlines.
- There will be significant benefits to marine fisheries, including increased catch potential, especially in tropical regions. People that rely on fishing for their well-being will be [less vulnerable](#) to changes to their income, health, and environment. Less fish species will become extinct.<sup>24</sup>
- Fisheries in the Indo-Pacific region could [halve](#) the expected reduction in their catch due to climate change,<sup>25</sup> compared with warming that will occur under current policies.
- The world's tropical coral reefs could avoid severe degradation and [collapse](#). If temperatures rise to two degrees celsius, [virtually all](#) the world's tropical coral reefs are at risk. Coral reef habitats account for [10 to 12%](#)<sup>26</sup> of the fish caught in tropical countries, and 20 to 25% of the fish caught by developing nations.<sup>27</sup> They provide food, income and protection from storms for millions of people along [coastal areas](#).

## 8. Easier, cleaner travel

By limiting warming to 1.5°C:

- An extra [100 million](#)<sup>28</sup> EVs on the roads to meet climate targets would require a 50-fold increase on today's numbers. For every 82.5 million EVs deployed, [one million barrels](#)<sup>29</sup> of oil demand would be reduced every day. By the late 2020, EVs could cause [peak oil demand](#).<sup>30</sup>
- EVs could [significantly improve urban air quality](#). By 2050, urban areas will increase by another [2.5 billion people](#), with 90% of this increase to take place in Asia and Africa.
- EVs could also drive a [shift towards increased mobility](#),<sup>31</sup> growth in ride sharing, and perhaps even unlock low-carbon autonomous vehicles. If EVs become [increasingly affordable](#)<sup>32</sup> they could contribute to reducing transport costs and traffic congestion, and rejuvenating urban spaces.

## 9. A safer world

By limiting warming to 1.5°C:

- [Factors](#) that contribute to hunger, migration, and human conflict - including extreme weather events and less secure food and water supplies, will be limited.
- Links between climate change, human conflict, and forced migration [are complex](#). But even limiting the impact of warming on agriculture and food security could [help](#) create a safer world.
- Businesses would reduce their risk from the impacts of extreme weather events that cause [major damage](#) to buildings, machinery, data centres, transportation networks, and supply chains.

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<sup>24</sup> IPCC, AR5, WGII, Chapter 7, p.508.

<sup>25</sup> "Because the ocean": Achieving the Paris agreement 1.5°C temperature limit (2017), Climate Analytics, p.3.

<sup>26</sup> IPCC, AR5, WGII, CC boxes, p.99.

<sup>27</sup> IPCC, AR5, WGII, CC Boxes, p.99.

<sup>28</sup> Global EV outlook 2017: One million and counting (2017), International Energy Agency, p.23.

<sup>29</sup> Electric vehicles: The catalyst to further decarbonisation (2018), Carbon Tracker Initiative, p.1.

<sup>30</sup> Ibid, p.1.

<sup>31</sup> Electric Vehicles for Smarter Cities: The Future of Energy and Mobility (2018), World Economic Forum, p.5.

<sup>32</sup> Ibid, p.8.

*This paper was prepared by GSCC to support understanding of issues arising from the IPCC's Special Report on 1.5°C warming.*



**Why we are here**

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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