Nurses' Unions, Climate Change and Health: A Global Agenda for Action

July 2019

GNU
Global Nurses United
Unidad Global de Enfermeros/as
Unidade Global de Enfermeiros/as
Union syndicale des infirmiers(ères) du monde
국제 간호사 연대

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This report was written for Global Nurses United (GNU) by Sean Sweeney, Irene Shen and John Treat of Trade Unions for Energy Democracy (TUED). The opinions expressed herein may not reflect the policies and positions of unions participating in GNU or TUED.

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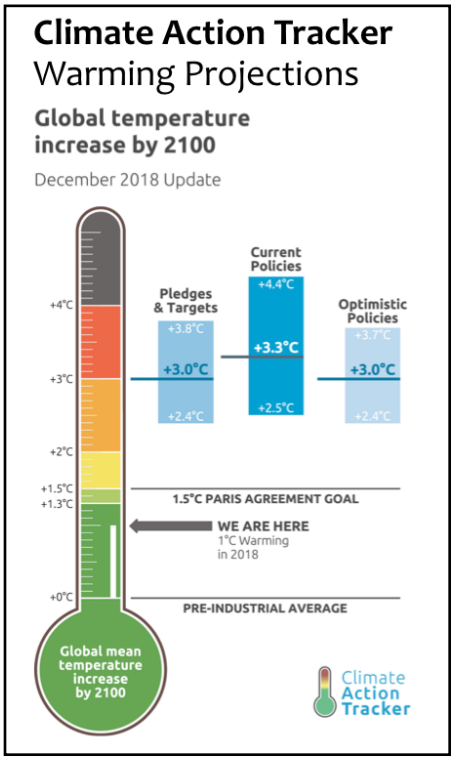
1. Introduction: Why Nurses Are Leading The Fight for Climate Justice



The planet is warming and the climate is changing. With increasing regularity, headlines report record-breaking heat waves, catastrophic storms, floods and fires, and rising numbers of people displaced due to famines, droughts and violence. The world seems to be rapidly becoming a more dangerous and more frightening place.

These changes have profound significance for human health. Indeed, the health impacts of global warming and climate change are already being felt by vast numbers of people around the world. At the same time, although certain health risks may actually diminish with increased warming for some people—for instance, risk from exposure to cold in some regions—health risks overall are set to increase significantly. In the medium term, this is especially true for risks related to exposure to floods, droughts and extreme heat; food security issues; and infectious diseases.[1] Longer-term, health risks associated with displacement and conflict are likely to become much more serious.

This paper aims to provide information to nurses and their unions regarding climate-related health risks. It summarizes what is happening now, and what health-related climate science suggests could happen if current trends continue.

Nurses and their unions have been at the forefront of many key struggles to minimize the negative health impacts of current and rising fossil fuel use, and for strong policy responses to the unfolding climate crisis. But it is today clear that addressing climate change will require a radical change at the level of politics and policy. The current policies—which are directed towards ensuring investment opportunities for big business—have been a massive failure. Emissions continue to rise, and health outcomes and indicators continue to worsen.

"A World That Is No Longer Recognizable"

Since pre-industrial times, the planet has warmed by an average of nearly 1 degree Celsius (roughly 1.8 degrees Fahrenheit). That level of warming is already having significant impacts on human health and wellbeing. On current trends, the world is expected to warm by 3 degrees Celsius or more by the end of this century. Warming at such levels poses a threat not merely to human health, but increasingly to health systems themselves, and the very possibility of responding to the health impacts that will follow from a continuation of our current course. This is not a future nurses will accept. Nurses and their unions and allies must urgently formulate a strategy to intervene and prevent such possibilities from becoming real.

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[1] IPCC, *AR4 Climate Change 2007: Impacts, Adaptation, and Vulnerability*; Chapter 19: "Assessing Key Vulnerabilities and the Risk from Climate Change," https://www.ipcc.ch/report/ar4/wg2/.

In late 2018, the UN's Intergovernmental Panel on Climate Change (IPCC) released its *Special Report on 1.5 Degrees Celsius* (commonly referenced as "SR15").[2] SR15 aimed to inform global leaders of the impacts of 1.5 degrees and 2 degrees above pre-industrial temperatures. The report authors offered three scenarios leading to the year 2100. The first scenario assumes an aggressive global effort to move away from carbon-based fuels ("decarbonization") — an effort that is consistent with the demands of science and that succeeds in limiting overall average warming to 1.5 degrees Celsius (1.5C). This amount of warming by 2100 is expected to produce a range of serious impacts beyond those we are already seeing, but the report's authors conclude that human wellbeing "remains overall similar to that in 2020."

In the second scenario, the authors assume total average warming of 2 degrees Celsius (2C) by 2050. After a slow start, governments take aggressive action, beginning around 2025, in order to "catch up." Warming is projected to reach 2C by 2050, but is subsequently brought back to 1.5C through widespread deployment of "carbon capture" technologies (which, it should be noted, are currently unavailable or at the experimental level). Because action was delayed, however, the authors project that the health and wellbeing of people generally declines after 2020, while "levels of poverty and disadvantage increase considerably."

The third scenario is based on very limited and / or delayed action on climate. On this scenario, international support for the Paris Agreement begins to wane after 2020. In the years that follow, CO2 emissions "are reduced at the local and national level," but are "limited and not always successful." As a result, by 2100, the world is projected to be a full 3 degrees Celsius warmer. The picture presented is sobering:

> The world as it was in 2020 is no longer recognizable, with decreasing life expectancy, reduced outdoor labour productivity, and lower quality of life in many regions because of too frequent heatwaves and other climate extremes.
>
> Droughts and stress on water resources renders agriculture economically unviable in some regions and contributes to increases in poverty. Major conflicts take place. Almost all ecosystems experience irreversible impacts, species extinction rates are high in all regions, forest fires escalate, and biodiversity strongly decreases, resulting in extensive losses to ecosystem services. These losses exacerbate poverty and reduce quality of life.

On current trends and without a radical change in the direction of policy, this third scenario is by far the most likely to unfold: a world that is "no longer recognizable." From a human health perspective—and from a moral perspective—this can only be described as catastrophic. It cannot be allowed to occur. Preventing it means that radical change is necessary. It also means that interventions to bring about such change will need to be decisive, and will need to be implemented as soon as possible.

Nurses' unions are uniquely placed to make a major contribution to the political effort and movement building that is needed to effect such decisive change. Our hope is that this paper can help further equip them to wage that struggle with a clearer understanding of the challenges that must be faced in order to achieve it.

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[2] Intergovernmental Panel on Climate Change (IPCC), *Special Report on Global Warming of 1.5ºC (SR15),* 8 October 2018, https://www.ipcc.ch/sr15/

2. Global Warming, Climate Change & Health

Since pre-industrial times, the planet has warmed by an average of nearly 1 degree Celsius (roughly 1.8 degrees Fahrenheit). This warming is caused by the accumulation of carbon dioxide (CO2), methane (CH4) and other heat-trapping "greenhouse gases" (GHGs) in the atmosphere—largely due to the release of these gases from the burning of fossil fuels: coal for electricity and industrial processes; gasoline and diesel for cars, trucks, airplanes and other vehicles; oil and natural gas for heat; and so on. Energy-related emissions constitute the majority of global emissions —roughly 60 percent. The generation of electricity is the single largest contributor to this, responsible globally for a quarter of energy-related emissions.

The rise in average temperatures caused by these accumulated emissions generates a range of climate and weather impacts: more frequent and more severe heatwaves; changes in precipitation leading to more frequent and more severe storms and flooding in some regions, and droughts in others; faster melting of sea ice and glaciers, which translates into rising sea levels; and more. These changes pose a variety of dangers to human health and wellbeing—many of which are likely to become more severe in the coming decades if emissions are not addressed.

Global Warming vs. Climate Change: What's in a Name?

These terms are often used interchangeably but have distinct meanings.

Global warming refers to the gradual warming of the planet—mostly since the early 20th century, and especially since the late 1970s—due largely to rising fossil fuel emissions, which add heat-trapping gases to Earth's atmosphere. Since 1880, the average surface temperature of the earth has risen by about 1°C (about 2°F), compared to the mid-20th-century baseline. This is on top of roughly 0.15°C of warming between 1750 and 1880.

Climate change refers to a broad range of phenomena caused by the overall average warming of the planet. These include not only rising temperature trends, but also encompass changes such as sea level rise; ice mass loss in Greenland, Antarctica, the Arctic and mountain glaciers worldwide; shifts in flower/plant blooming; and extreme weather events.

Most immediately, these impacts are mainly due to exposure to higher temperatures—which poses a special danger to many working people due to hotter working conditions in factories or fields—as well as to the physical hazards associated with droughts, heatwaves, fires, storms, floods and other "extreme weather events" (EWEs). Further impacts may result from disruptions of the ecosystems on which life depends, leading to malnutrition, increased exposure to infectious diseases, and other risks. Additional impacts can follow from rising displacement and injury due to social unrest and even violent conflict.

These impacts are likely to alter the lives and livelihoods of enormous numbers of people around the world. They are also expected to disproportionately effect people who are poor, elderly, or otherwise especially vulnerable.

The impacts of climate change on human health are often discussed as *primary*, *secondary* or *tertiary*, depending on the causal pathway through which that impact occurs.[3] **Primary effects** are those due to direct exposure to excessive heat or the physical hazards of extreme weather. **Secondary effects** are those resulting

[3] CD Butler, D. Harley, "Primary, secondary and tertiary effects of the eco-climate crisis: the medical response," Postgraduate Medical Journal, 86: 230–4, 2010.

from disruptions of surrounding ecosystems affecting food, disease, etc. **Tertiary effects** are those resulting from the disruption of social, political, and economic systems, producing dislocation or even violence.

While primary and secondary effects have received considerable attention in the scientific literature, tertiary impacts—those resulting from social disruption, dislocation and conflict—have remained, in the words of one expert, "relatively underexplored and scarcely recognized." This is despite the fact that such effects "will likely have the greatest long-term impact on human health."[4]

As the IPCC has affirmed, the health impacts of global warming are already apparent. At the same time, although certain health risks may diminish with increased warming for some people—for instance, risk from exposure to cold in some regions—overall health risks are set to increase significantly. In the medium term, this is especially true for health risks due to floods, droughts and extreme heat, food security issues, and infectious diseases.[5] Longer-term, health risks associated with displacement and conflict are likely to become much more serious.

We will consider these impacts in more detail below. It is important that nurses and others concerned about the health impacts of climate change have some familiarity with the major categories of impacts, their likely trends, and where they can find more information when needed.

As noted above, however, on current trends these impacts are projected to get significantly worse in the coming years and decades. For this reason, it is important that we recognize, understand and tackle the underlying causes of the crisis, rather than merely treating its symptoms. We therefore need to consider the political context, and to examine the record of the policies that have been relied on to address the crisis for the past decade.

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[4] Bowles, D. C., C. D. Butler, and S. Friel (2013), Climate change and health in Earth's future, Earth's Future, 2, 60–67, doi: 10.1002/2013EF000177.

[5] IPCC, *AR4 Climate Change 2007: Impacts, Adaptation, and Vulnerability*; Chapter 19: "Assessing Key Vulnerabilities and the Risk from Climate Change," https://www.ipcc.ch/report/ar4/wg2/.

3. Climate Policy and Politics: Paris and After

In late 2015, governments around the world agreed on the text of the **Paris Climate Agreement**.[6] Its adoption was hailed as a "turning point for humanity." The agreement affirmed that governments understood the need for emissions to peak "as soon as possible," and to achieve "rapid reductions thereafter in accordance with best available science." It also established clear targets: first, to limit global temperature rise to well below 2 degrees Celsius above pre-industrial levels, and, second, to pursue efforts to minimize warming to no more than 1.5 degrees. The agreement came into effect in November 2016. By mid 2019, 185 countries had ratified the Agreement.

The Agreement was welcomed by global health organizations for acknowledging that governments "should, when taking action to address climate change, respect, promote and consider their respective obligations on the right to health." According to the WHO, the Paris Agreement is a "global safeguard for human health."[7] Its objective is to "strengthen the global response to climate change, in the context of sustainable development." Therefore, "Climate action is development action; as social resilience and economic productivity depend on the good health of populations, health must be central to climate change policy."

The Gap Between Ambition and Action

At the heart of the Paris Agreement are emissions pledges that were submitted to the UNFCCC Secretariat by national governments in 2015, prior to the negotiations. These pledges are today known as "Nationally Determined Contributions" (or "NDCs").

Even at the time the NDCs were submitted, it was widely acknowledged that they were not adequate to achieve even the less-ambitious target of limiting warming to "well below 2 degrees Celsius," and not remotely adequate to reach the more ambitious target of limiting it to 1.5C. Even if they were fully implemented, the proposed NDCs would mean a continuing *rise* in emissions until 2030, and would likely produce an overall average temperature increase of 3C or more by 2100. As the International Energy Agency (IEA) starkly put it, "There is no peak in sight for world energy-related CO2 emissions in the [NDC] Scenario: they are projected to be 8% higher than 2013 levels in 2030."[8] UNFCCC Executive Secretary Christiana Figueres urged national governments to go beyond their initial commitments, and called for a "ratcheting up of ambition in a structured, transparent and timely way" during the Agreement's implementation period (2020-2030).[9]

Despite Figueres' urging, governments are failing to do anything of the sort. In late 2018 the UN's Environment Program (UNEP) reported that most of the G20 countries—collectively responsible for 75% of annual global emissions—"are not yet on a path that will lead them to fulfilling their NDCs for 2030." On current policies and

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[6] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[7] https://www.who.int/news-room/detail/05-12-2018-health-benefits-far-outweigh-the-costs-of-meeting-climate-change-goals

[8] IEA, *Energy and Climate Change: World Energy Outlook Special Report, 2015,* https://webstore.iea.org/weo-2015-special-report-energy-and-climate-change

[9] UNFCCC, *INDC Synthesis Report Press Release*, 31 Oct, 2015, https://unfccc.int/news/indc-synthesis-report-press-release

commitments, the report noted, "global emissions are not estimated to peak by 2030, let alone by 2020."[10] Rather, the level of ambition agreed in Paris must be *tripled* to limit warming to 2°C, and increased *nearly fivefold* for 1.5°C.

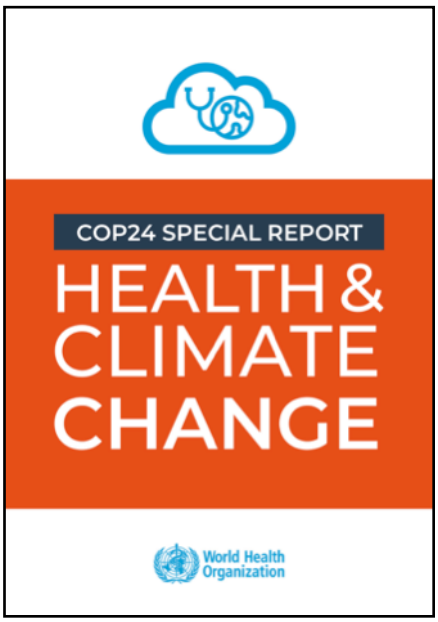
Meanwhile, the *Special Report on Global Warming of 1.5 degrees Celsius* (SR15), released in October 2018 just ahead of the COP24 talks in Katowice, Poland, concluded that, in order to limit warming to 1.5C, human-caused CO2 would need to fall by about 45 percent from 2010 levels by 2030, reaching "net zero" around 2050.

Although CO2 emissions leveled off globally from 2013 to 2016, they rose in 2017, and then again in 2018. The brief pause turned out to have been due mainly to the economic slowdown in China. The IEA had earlier reported that in order to have any chance of meeting existing NDC commitments by 2030, emissions would need to peak soon after 2020. But in March 2019, it confirmed preliminary estimates that emissions had risen by 1.7% in 2018, driven by a 2.7% annual increase in overall energy consumption.

The disconnect between what is happening and what is required could hardly be more alarming—but the response to that disconnect is also very striking. If most of the major countries are not even on track to meet the inadequate levels of ambition to which they have already committed, then calls for "more ambition" seem misplaced. The problem lies not in the levels of ambition, but in the policies and programs through which that ambition is being expressed.

Beyond Ambition: The Need for a Different Climate Politics

The IPCC's SR15 stated that limiting overall warming to 1.5C is still technically possible, but that meeting this goal "would require rapid, far-reaching and unprecedented changes in all aspects of society," including "transitions in land, energy, industry, buildings, transport, and cities."



Meanwhile, it is important to know what is happening with the world's energy systems and emissions. From a health perspective, it matters not only whether renewable sources are displacing fossils from the global energy mix—which, as we will see, they are not—but also how quickly. Unfortunately, the leading global health organizations have tended to follow the mainstream policy line regarding how policymakers should understand and respond to the key energy and emissions trends.

The World Health Organization's (WHO) *Special Report on Health and Climate Change* (SRHCC), released in late 2018, affirms the need for a "healthy energy transition" that can "ensure access to affordable, reliable, sustainable and modern energy, with zero emissions of GHGs and health-damaging air pollutants."[11] But there is no questioning of the dominant narrative. For example, it echoes the need for a "price on carbon," without asking why an effective carbon price has not yet emerged, despite being a top policy priority for more than two decades. It also states that

[10] UNEP, *Emissions Gap Report 2018*, https://www.unenvironment.org/resources/emissions-gap-report-2018

[11] WHO, *COP24 Special Report: Health & Climate Change*, https://www.who.int/globalchange/publications/COP24-report-health-climate-change/en/

investment and deployment in renewable energy are "growing rapidly" when, if anything, investment is falling and deployment has stalled.[12]

The same is true of the approach to policy seen in the Lancet's *Countdown on Health and Climate Change* series of reports. One of the stated goals of the *Countdown* reports has been to focus on the "financial and economic enablers of a transition to a low-carbon economy." The conclusions follow a pattern that is by now familiar:

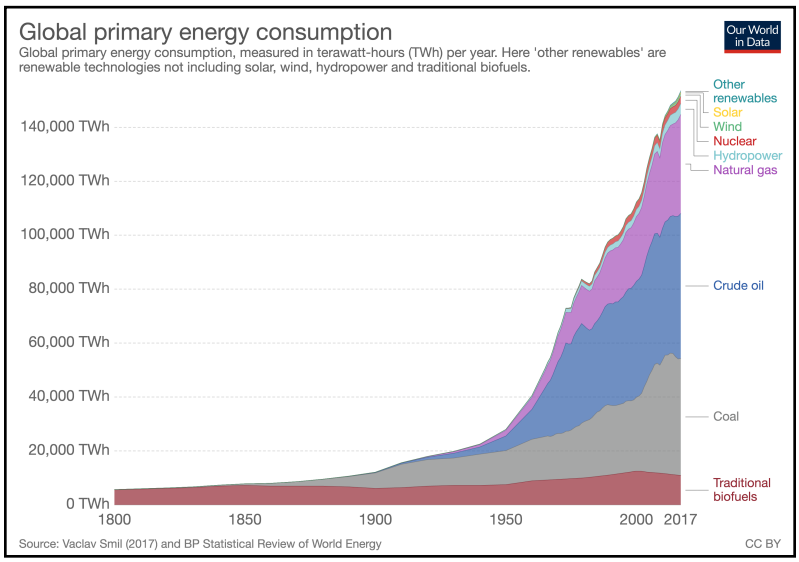
> The results of these [policy] indicators suggest that the beginning of an economic transition towards a low-carbon economy is underway…. These trends can be interpreted as early signs of a broader transformation, with important health benefits to follow, as a result of growing investment in low-carbon technology and employment, a transition away from fossil fuels, and strengthened and expanded pricing of greenhouse-gas emissions.

According to the report, the pace and scale of both government action and private sector engagement needs to increase in order to meet the Paris commitments. But it fails to consider whether the approach itself is adequate to the task, or even whether an effective carbon price is likely to emerge soon *in any part of the world*. The facts suggest otherwise: only a small share of global emissions—just over 13%— are covered by any price at all, and only a tiny fraction by a price which advocates of carbon pricing consider likely to have any appreciable effect.

So the mainstream reports remain captive to a narrative that assumes progress is being made and current policies are working, even if "more ambition" is needed. This could not be further from the truth.

Energy Transition, or Energy Expansion?

Consumption of coal, oil and gas has grown dramatically in recent decades, with little sign of slowing, let alone reversing. Despite "record setting" growth in renewables, overall growth in demand for energy is larger still, so that fossil fuel use continues to rise alongside renewables.

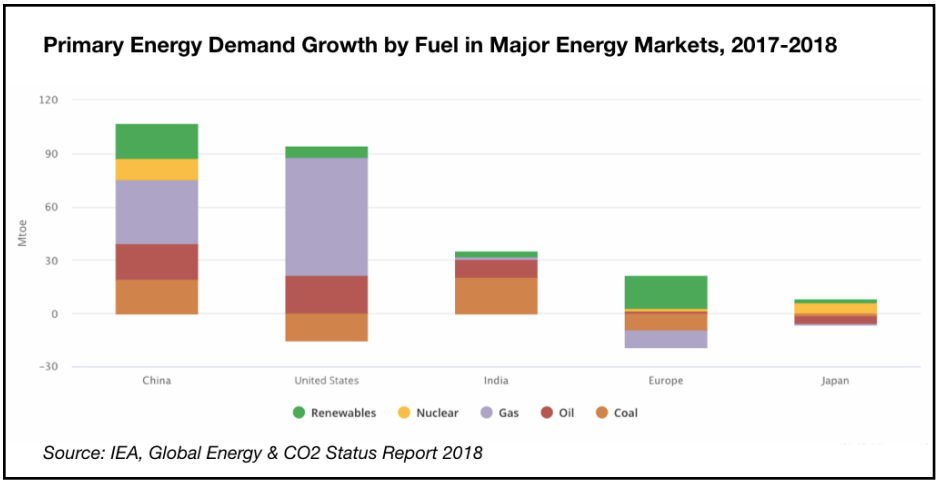


In March 2019, the International Energy Agency (IEA) reported that global energy demand grew by 2.3% in 2018 – the sharpest rise, and nearly twice the average rate, this decade.[13] The surge was attributed to strong overall economic growth, as well as to record temperatures in many parts of the world, which raise demand for heating and cooling.

Even with the closure of many coal plants around the world, coal remains the dominant

[12] John Treat and Sean Sweeney, "Growth in Renewables has Stalled. Investment is Falling. But Why?" Trade Unions for Energy Democracy, 17 May 2019, http://unionsforenergydemocracy.org/growth-in-renewables-has-stalled-investment-is-falling-but-why/

[13] IEA, *Global Energy & CO2 Status Report*, https://www.iea.org/geco/



fuel for generating electricity. Coal consumption is growing dramatically in several large countries, mainly in Southeast Asia, and on current trends is projected to remain at roughly current levels in the global energy mix for many years to come.[14]

Where coal generation capacity *has* been replaced in the energy mix, it has mostly been replaced by natural gas (which is mainly composed of methane) rather than renewable sources. This is especially true for the world's two largest emitters, the US and China. Just in the US, an additional 14.5 GW of gas-fired power generation capacity was added in 2018—the equivalent of roughly two-dozen coal-fired power plants. And although natural gas produces lower CO2 emissions than coal when it is burned, fracking releases uncombusted methane into the atmosphere, which is roughly 86 times more powerful as a greenhouse gas than CO2. In the OECD countries, natural gas production rose 7.4% in 2018 over 2017 levels, to reach a record of more than 130 billion cubic meters in December 2018.[15]

There has also been a dramatic growth in oil use. In August 2016, the IEA reported that oil demand had risen to a little over 97 million barrels per day, up from roughly 76 million in early 2002.[16] As with coal, this is an astonishing level of increase in such a short period of time. The IEA anticipates that global demand for oil will continue growing at around 1.4 million barrels per day for the foreseeable future.

Much of the increase in oil use is due to the demand for road transport (although the growth in aviation and shipping are also significant). Globally, more than 86 million cars and light commercial vehicles were sold in 2018.[17] Currently, global annual vehicle sales are roughly four times the levels of 1965. Of the 86 million vehicles sold in 2018, 1.26 million were battery powered—a large increase over the year before, but still just 1.4% of total sales. This surge was substantially due to a large increase of sales in China.[18]

In terms of health indicators, burning coal continues to be a major contributor to illness and premature death. The recent slow down in coal burning has meant that this indicator is, from a health perspective, perhaps going in the right direction. But the health impacts of burning oil products (mainly petrol, diesel, kerosene, etc) fuels for transport are becoming increasingly severe.

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[14] Global Coal Exit Database, https://coalexit.org/database

[15] IEA, *Global Energy & CO2 Status Report*, https://www.iea.org/geco/

[16] IEA, *Oil Market Report*, https://www.iea.org/oilmarketreport/reports/2019/0419/

[17] carsalesbase.com, *Global Car Sales Analysis 2018*, March 1, 2019, http://carsalesbase.com/global-car-sales-2018/

[18] carsalesbase.com, *Global Electric Car Sales Analysis 2018*, March 2, 2019, http://carsalesbase.com/global-electric-car-sales-analysis-2018/

Meanwhile, renewable energy use is increasing, but not fast enough to seriously slow the growth in fossil fuel use in the short to medium term, let alone to drive coal, oil and gas from the world's energy systems. Modern renewable energy (primarily wind and solar power) has gained a foothold in the electricity sector, but emissions from the generation of electricity have nevertheless increased by more than 45 percent globally since the year 2000, while electricity demand has increased by more than 50 percent.[19]

Currently, global emissions stand at almost twice the annual emissions levels of the mid-1990s. Global emissions from fossil fuel and industry rose 60% between 1990-2014. As noted above, annual CO2 emissions levels are rising. As a result of these energy-related trends, CO2 emissions are expected to rise 45% by 2035 (based on 2010 levels).

What these trends indicate is that we are not seeing a "transition to renewables," but rather an *energy expansion*. Overall energy consumption and emissions continue to rise, and there is no sign that current policies will drive fossil fuels from the energy mix—certainly not in the time available to avoid very grave climate impacts.

In its SR15, released in October 2018, the IPCC noted: "Any increase in global warming, even an increase by half a degree, could affect human health. Warming of 1.5°C is not considered 'safe' for most nations, communities, ecosystems and sectors and poses significant risks to natural and human systems."

On current trends, warming will far exceed not only the 1.5C threshold, but even the 2C threshold. Even if all countries meet their Paris commitments, the world will still be on course for around 3 degrees Celsius of warming—and *most G20 countries are not on track to meet their own targets*.

[19] See Trade Unions for Energy Democracy, *Resist, Reclaim, Restructure: Unions and the Struggle for Energy Democracy*, December 2012, and Trade Unions for Energy Democracy, *Power to the People: Towards Democratic Control of Electricity Generation*, May 2015; http://unionsforenergydemocracy.org/resources/tued-publications/.

4. Health Impacts of Climate Change

An extensive body of knowledge has been developed by researchers focused specifically on links between health and climate. As we consider these in more detail, it is crucial to keep in mind that the continuing rise of greenhouse gas (GHG) emissions means that the dangers to human health posed by climate change are not only *already serious*, but are *increasing*.

As noted earlier, health impacts due to climate change are typically discussed on the basis of their causal pathways:

1) **Primary effects** are those involving direct exposure to excessive heat, or to the physical hazards of extreme weather events. These would include such things as heat stress from exposure to higher ambient temperatures, as well as physical injury from exposure during storms, flooding or other "extreme weather events."

2) **Secondary effects** are those resulting from disruptions to ecosystems or relationships between species. These would include such things as malnutrition caused by falling harvest yields or poor livestock health, as well as exposure to infectious diseases due to changes in disease vectors.

3) **Tertiary effects** are those resulting from the disruption of social, political, and economic systems. These can thus include a range of physical and mental effects due to insecurity from job losses or changes, physical dislocation, or exposure to conflict (which is often due to scarcity of food, water, land, etc.).

There are additional health impacts that are not necessarily the result of climate change, but that are closely associated with the physical and chemical processes of our fossil fuel-driven economy. These include greater health risks from higher air pollution levels (from burning of fossil fuels in many cases) as well as increased exposure to UV radiation as a result of depletion of the ozone layer.

Economic Status and Climate Vulnerability

As with many other health risks, economic status affects vulnerability to climate impacts; poorer populations and poorer countries are precisely those most likely to experience the most disruptive effects of climate change.[20] Countries like Madagascar, Mozambique, Philippines, Haiti, Zimbabwe, Myanmar, Ethiopia, Cambodia, Vietnam, Thailand, and Malawi have some of the lowest *per capita* emissions levels in the world but, according to the IPCC, will also feel the most severe impacts from a changing climate. In other words, the effects of the warming caused by the emissions of the rich countries—and increasingly by the major

[20] IPCC, *Fifth Assessment Review* (AR5), 2014,"Summary for Policy Makers," https://www.ipcc.ch/report/ar5/syr/

developing countries like China, India and Brazil—are actually being felt in countries that are among the poorest on the planet. The resulting health impacts are also often being felt most acutely in these countries.

A clear example of the intersections of climate change and social disadvantage on health is in the rise in death rates among poor people in countries experiencing heat waves over the past several years. In 2015, 1,100 people died in the southern states of Andhra Pradesh and Telangana in India during the summer heat wave in which some sections of road in New Delhi melted.[21] Needless to say, people who could afford air conditioning fared much better than those who could not. In many countries, race and ethnicity are also powerful markers of social status, exacerbating the health vulnerabilities associated with many forms of inequality, exclusion and oppression.

Age is also likely to be a factor in determining climate-related health impacts, but research in this area is just beginning. Worldwide, the proportion of people aged over 60 is projected to increase from about 10% currently to about 32% by the end of the century.[22] How an older population will deal with climate-related illnesses on top of other age-related conditions remains unclear at this point in time. A 2011 study in the journal of the American Society on Aging showed that older people are more vulnerable to extreme weather events, and that the use of pesticides that act as neurotoxins in humans may accelerate neurological issues associated with aging, include Alzheimer's and other forms of dementia. All of the vulnerabilities that elderly people face as a result of climate change are expected to be exacerbated by other vulnerabilities, such as those of economic class or lack of access to education.[23]

Other consequences of warming are linked with changes in the local resources on which people depend. Indigenous people who rely heavily on local resources, for example, and live in parts of the world where climates are changing quickly, are generally at greater risk of economic losses, and therefore at greater risk of poor health. Studies among Inuit people, for example, show that rapid warming of the Canadian Arctic is jeopardizing hunting and many other day-to-day activities, with implications for livelihoods and wellbeing. The fact that warming leads to changes in the environment that may impact livelihoods applies to numerous other communities as well, including, but not limited to, people dependent on fishing, agriculture, and tourism for their survival.

Access to high-quality health care and essential public health services is also a significant determinant of susceptibility to negative climate impacts. According to the IPCC, the imposition of austerity in many European countries since 2008 has led to cutbacks in health services in some countries, followed by a resurgence of climate-sensitive infectious diseases including malaria. Similarly, the World Bank notes that not only are poorer people more vulnerable to climate related illnesses, but that disease, and poor health more generally, increases poverty for several reasons, and that "[h]ealth expenditures can absorb a large share of a

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[21] Susanna Kim, ABC News, "India's Deadly Heatwave Melting Roads," May 27, 2015. http://abcnews.go.com/International/indias-deadly-heatwave-melting-roads/story?id=31341298

[22] IPCC, AR5, 2014. K. R. Smith, et. al., Chapter 11, "Human Health: Impacts, Adaptation, Co-Benefits." Section 11.3.5. – Public Health and Other Infrastructure, https://www.ipcc.ch/report/ar5/syr/

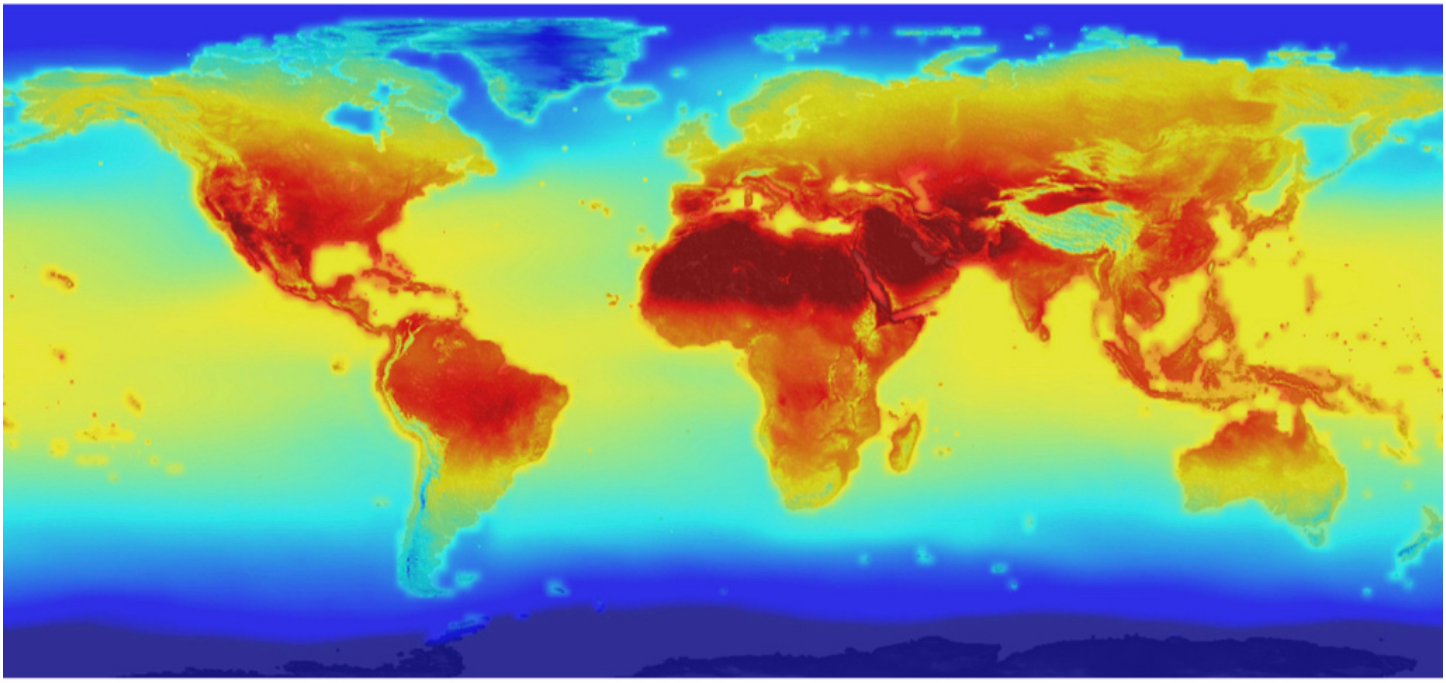
[23] Filberto, et. al. "Older People and Climate Change: Vulnerability and Health Effects." *Generations: Journal of the American Society on Aging,* June 10, 2011, http://www.asaging.org/blog/older-people-and-climate-change-vulnerability-and-health-effects

household's income."[24] In this context, climate change becomes part of a cycle of inequality and impoverishment that is both caused by and exacerbates poverty.

Primary Health Impacts

Heat Stress

The IPCC's SR15 report drew attention to the possible impacts on urban dwellers, particularly in the global South. At 1.5C of warming, twice as many megacities are expected to become heat stressed as at present, potentially exposing at least an additional 350 million people to deadly heat stress by 2050 in cities like Lagos and Shanghai. Populations at highest risk include older adults, children, women, those with chronic diseases, and people taking certain medications. According to The Centre for Research on the Epidemiology of Disasters, "Slum dwellers are more affected by heatwaves... because of the lack of trees and vegetation to mitigate extreme temperatures. The same trend is also found in developed countries where the presence of green urban spaces is strongly correlated with the wealth of a neighborhood."[25] In some regions, cold-related mortality is projected to decrease with increasing temperatures, although increases in heat-related mortality generally are projected to outweigh any reductions in cold-related mortality with warmer winters.[26]



NASA has used historical measurements with data from climate simulations using the best available computer models to provide forecasts of how global temperatures might change up to 2100. Credit: NASA.

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[24] World Bank, *Shock Waves: Managing the Impacts of Climate Change on Poverty*, 2016, p. 112; https://openknowledge.worldbank.org/bitstream/handle/10986/22787/9781464806735.pdf

[25] Howell, J. and Elliott, J. (2018). Damages Done: The Longitudinal Impacts of Natural Hazards on Wealth Inequality in the United States. *Social Problems*. https://academic.oup.com/socpro/advance-article/doi/10.1093/socpro/spy016/5074453

[26] IPCC, *SR15*, Section 3.4.7.1,

It bears emphasizing that although the IPCC's SR15 also considers what might happen if the world reached 2 degrees Celsius—in order to understand what may differ if warming can be limited to 1.5 degrees—the world is currently on course to see even more warming than that: 3 degrees Celsius or more by 2100. Warming of that magnitude is likely to result in heat stress that could affect billions of people.

Heat Stress and Occupational Health

In recent years the IPCC, the United Nations Development Program (UNDP), the ILO and others have drawn special attention to the effects of climate change on people at work. One of the major concerns is the impact of rising temperatures on the health (and also economic wellbeing) of workers performing both indoor and outdoor work. Exposure to excessive heat while working—generally meaning at temperatures above 35C—reduces both work capacity and labor productivity, which has health-related and economic implications. Maintaining a core body temperature near 37C is essential for health and human performance, and large amounts of sweating as a result of high heat exposure while working creates a risk of dehydration. This can lead to heat exhaustion, heat stroke, and increased risk of accidental injuries.

According to the UNDP, "More than one billion workers already grapple with dozens of additional extremely hot days in a year due to climate change alone. While every decade brings a similar amount of additional hot days for exposed regions with warming set to continue for decades no matter what degree of emissions control is realized." The WMO reports that the number of very hot days per year have doubled since the 1960s in regions like West Africa.

According to Lancet's *Countdown,* excessive exposure to heat led to the loss of 153 billion hours of labor in 2017—62 billion hours more than in the year 2000. Approximately 80% of these losses were in the agricultural sector. The areas most affected by these changes are concentrated in already vulnerable areas in India, Southeast Asia, sub-Saharan Africa, and South America.

Heat stress is also an issue for those working indoors in environments that are not temperature controlled, and even for some workers in high-income countries. Heat has an impact on labor productivity as well. As workers take longer rests to prevent heat stress, or are unable to work due to heat stress, hourly productivity goes down.

- ***Agricultural Workers***

Because they work outdoors, the impacts of higher temperatures on agricultural workers can be particularly serious. In many parts of the world—and often those with the hottest climates—the agricultural sector still employs the largest share of workers. In developing countries, according to the ILO, just under 70 percent of workers were employed in agriculture [2017 figures], while this sector accounts for nearly 40 percent of workers in lower middle-income countries, just 16 percent in upper middle-income countries, and 3 percent in developed countries.[27] Because agricultural workers are often paid by output, such heat exposure can cause longer workdays and / or reduced daily income.[28]

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[27] ILO, *World Employment and Social Outlook: Trends 2018*, https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_615590/lang--en/index.htm

[28] UNDP, *Climate Change and Labour: Impacts of Heat in the Workplace*, 2016, https://www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/tackling-challenges-of-climate-change-and-workplace-heat-for-dev.html

The UNDP notes that factories in low and middle-income countries seldom have air conditioning or other effective cooling and ventilation systems. Heat stress and the same daily production targets in all parts of the year means that the workers have to work longer each day in the hot season than in cool seasons; but the salaries typically remain the same.[29]

- ***Informal Workers***

Many workers exposed to heat at work fall into the ILO's category of "informal" workers, and many of these are also in "vulnerable employment." The ILO reports that in 2017, "almost 1.4 billion workers are estimated to be in vulnerable forms of employment, and every year an additional 17 million join them."[30] Vulnerable employment will, in 2020, continue to affect roughly 72 percent of workers in Southern Asia, 46 percent in South-Eastern Asia and the Pacific, and 31 percent in Eastern Asia, and it continues to be more pervasive among women than men. This is especially the case in South-Eastern Asia and the Pacific, as well as in Southern Asia, where vulnerable employment rates among women are respectively more than 10 and 8 percentage points higher than those of men. According to the ILO, around 40% of informal sector workers are employed in agriculture or construction. These are precisely the kind of workers who are most exposed to excessive heat.

- ***Migrant Workers***

Climate change is also thought to be an important factor in the movement of people. This was recognized by the UNFCCC Paris Agreement with the formal inclusion of "migrants" in the Preamble and 2015 UNFCCC Paris decision on Loss and Damage. According to the Lancet's *Countdown 2018*, "In the absence of planning and interventions, several hundred million people could end up being vulnerable to forced migration, with climate change as the sole contributing factor."[31]

Climate change and climate change-related environmental degradation not only appears to be driving migration, but migrant workers are themselves often among the most harshly affected by climate-related risks. According to UNDP, "Migrant workers frequently find themselves–at origin, transit and destination–engaged in occupations that are highly exposed to rising heat, such as in the construction or agricultural sectors." Furthermore, "Migrants can be especially vulnerable to health risks as they may not have access to health care and occupational safety and health services in their destination country."[32]

Migration is also connected to water scarcity, which is itself associated with climate change. The IPCC's SR15 report states, "80% of the world's population already suffers from serious threats to its water security as measured by indicators including water availability, water demand, and pollution." At COP21 in Paris during December 2015, the head of the World Meteorological Society, Michel Jarraud, warned that, as water

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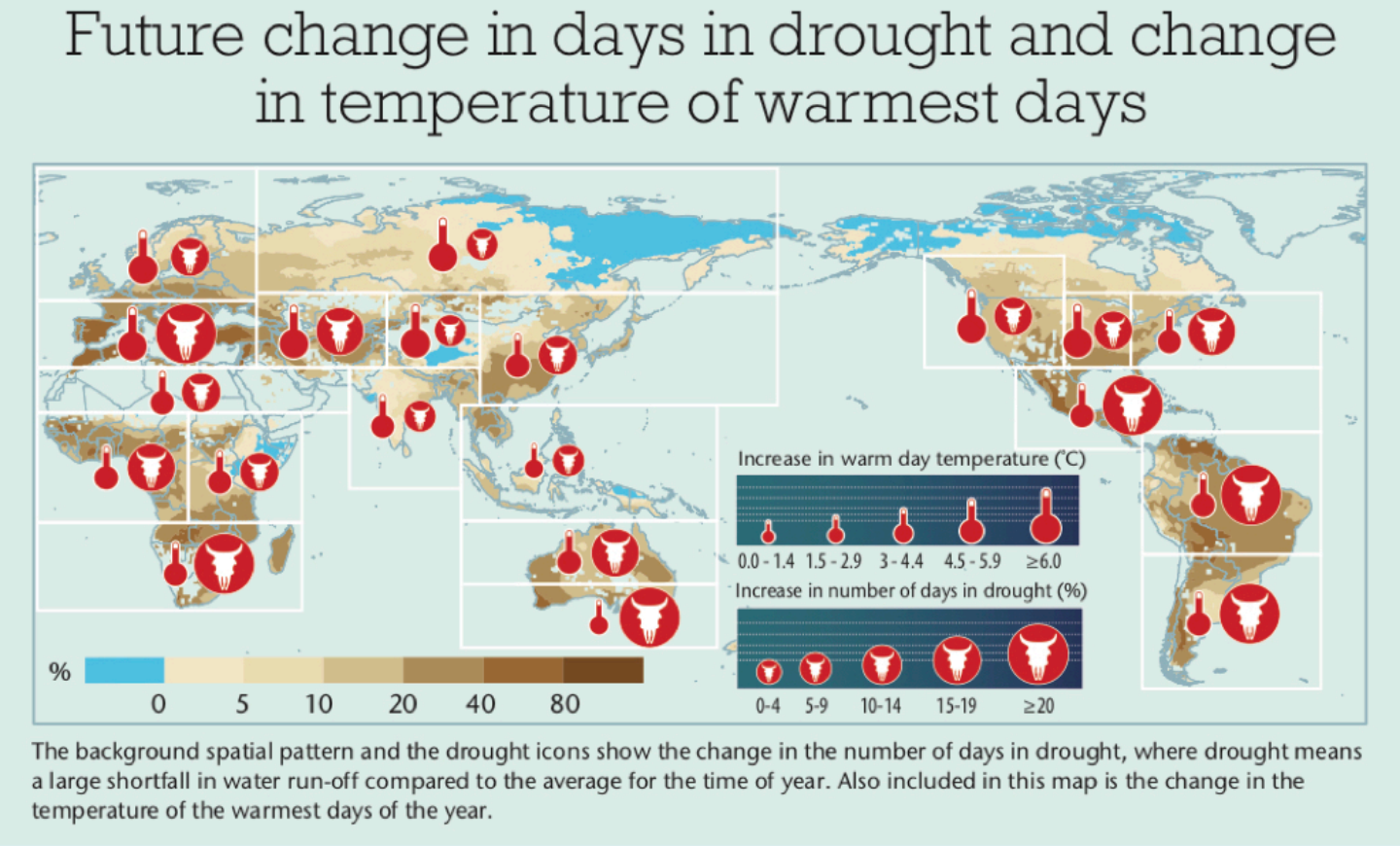
[29] UNDP, *Climate Change and Labour: Impacts of Heat in the Workplace*, 2016, https://www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/tackling-challenges-of-climate-change-and-workplace-heat-for-dev.html

[30] ILO, *World Employment and Social Outlook: Trends 2018*, https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_615590/lang--en/index.htm

[31] Lancet Countdown, "Briefing for US Policy Makers on Health and Climate Change"; November 28, 2018; available at http://www.lancetcountdown.org/the-report/

[32] UNDP, Climate Change and Labor: Impacts of Heat in the Workplace, 2016, https://www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/tackling-challenges-of-climate-change-and-workplace-heat-for-dev.html



Source: UK Met Office, Human Dynamics of Climate Change Project

becomes increasingly scarce, the number of "climate refugees" will rise. Approximately 1.6 billion people around the world live in areas that have been classified as suffering from water scarcity. That number is expected to grow to 2.8 billion by 2025, and to continue rising as temperatures continue to increase.[33] Experts predict the scarcity will unleash a major refugee crisis as the lack of water for drinking, for growing food and for manufacturing makes large, populated areas uninhabitable and hundreds of millions of people are forced to move. As Jarraud told the Carbon Brief website, "Often we think about climate change in terms of temperature but actually the most important parameter which will be affected is the water cycle. In a water-stressed area, there will be even more stress on the water resources."

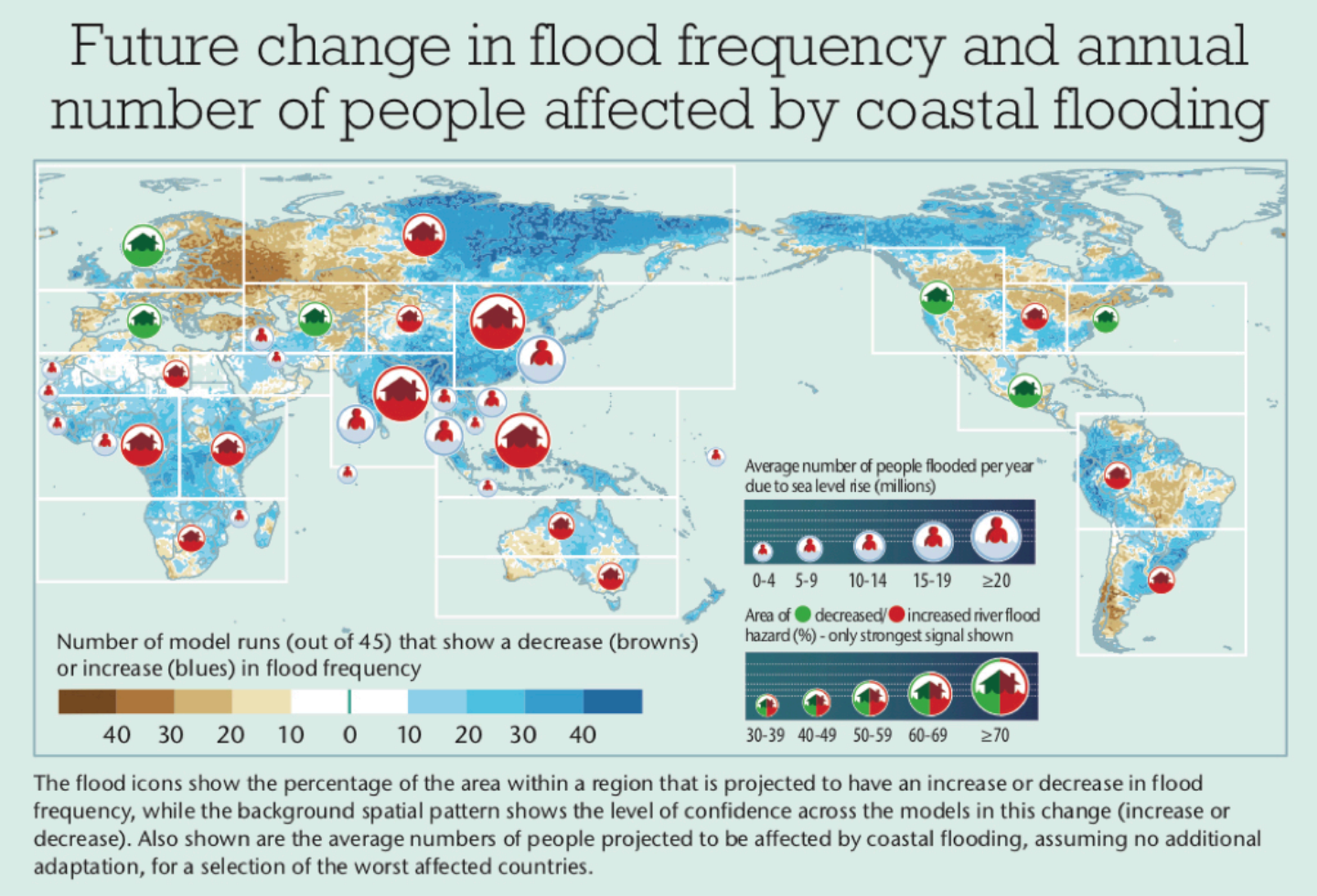
Exposure to "Extreme Weather Events"

In 2007 the World Meteorological Organization reported that global warming is leading to more "extreme weather events" (EWEs) worldwide. More recent data increasingly confirms a direct correlation between warming and the increasing incidence of EWEs.

According to a 2018 report published by the United Nations Office for Disaster Risk Reduction (UNDRR) and the Centre for Research on the Epidemiology of Disasters (CRED), between 1998 and 2017, climate-related and geophysical disasters "killed 1.3 million people and left a further 4.4 billion injured, homeless, displaced or in

[33] Tom Bawden, *The Independent,* "Climate change: World 'faces food shortages and mass migration' caused by global warming," December 23, 2015, https://www.independent.co.uk/environment/climate-change-world-faces-food-shortages-and-mass-migration-caused-by-global-warming-a6784911.html

need of emergency assistance."[34] Although most of those fatalities were caused by geophysical events such as earthquakes and tsunamis, 91% of the disasters recorded during the period were caused by storms, droughts, heatwaves and other extreme weather events. According to the report, the rise in climate-related events pushed the average number of disasters per year to 329 between 1998-2017, more than double the average of 165 events per annum in 1978-1997. The report attributes some of the increase to better reporting of disaster data, noting that, within that total, "floods were the most frequent type of disaster, 43% of all recorded events. Floods also affected the largest number of people, at more than two billion, followed by drought, which affected a further 1.5 billion people in 1998-2017." The frequency of storms is not increasing as much as that of floods, but storms are the second most frequent driver of climate-related disasters. In 2018, the WHO also reported, "A changing, more variable climate is now recognized as the most likely, highest-impact global risk to society as a whole and which presents a clear and present danger to health security.[35]



Source: UK Met Office, Human Dynamics of Climate Change Project

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[34] United Nations Office for Disaster Risk Reduction (UNDRR) and the Centre for Research on the Epidemiology of Disasters (CRED), *Economic Losses, Poverty and Disasters 1998-2017*, https://www.unisdr.org/we/inform/publications/61119

[35] WHO, *COP24 Special Report: Health & Climate Change*, https://www.who.int/globalchange/publications/COP24-report-health-climate-change/en/

Several IPCC reports have confirmed that increased storm surges, coastal flooding, and sea level rise due to global warming is projected to exacerbate the risk of death, injury, ill-health, and the disruption of livelihoods in low-lying coastal zones and small island developing states and other small islands. Coastal communities especially (home to hundreds of millions of people) will suffer from reduced health, reduced income, livelihoods, cultural identity and reduced coastal protection.

Similarly, the 2018 *Countdown* report warned that, "if left unmitigated, climate change is expected to result in an additional 1.4 billion drought-exposure events per year and 2 billion flood-exposure events per year by the end of the century." According to *Countdown* both floods and drought events show clear regional trends, with South America and Southeast Asia among the regions most exposed. In 2017, a total of 712 extreme weather events occurred globally, and resulted in $326 billion in economic losses, almost triple the total losses of 2016.

Related Mortality

The number of vulnerable people exposed to heatwaves increased by 125 million between 2000 and 2016.
According to the IPCC's SR15, "Climate change has contributed to increased heat-related mortality. There is robust evidence that climate change is affecting the frequency, intensity, and duration of heatwaves and that exposure to high ambient temperatures is associated with excess morbidity and mortality." The magnitude of projected heat-related mortality and hazardous heat conditions at 2C is greater than at 1.5C, and each additional unit of warming is projected to increase heat related mortality. Even if climate change is held below 2°C, taking into consideration urban heat island effects, there could be a substantial increase in the occurrence of deadly heatwaves in cities, with the projected risks similar at 1.5C and 2C, but substantially larger than under the present climate.

Flooding

The early months of 2019 brought a fresh round of horrifying images to screens around the world as extreme weather unleashed major flooding across regions of southern Africa. In March, Tropical Cyclone Idai unleashed torrential rains and devastating winds on Mozambique, focused in the Beira region. Emergency workers described the aftermath as the most destructive flooding in the region in 20 years.[36] Within a month, the death toll was reported to have passed 1,000 (although that number was expected to rise further), while 3 million people were estimated to have been displaced or otherwise affected; total recovery costs were

Zambezia Province, Mozambique. Photo: Zambezia Health Department

[36] https://www.mprnews.org/story/2019/03/19/cyclone-huge-floods-endanger-thousands-in-southern-africa

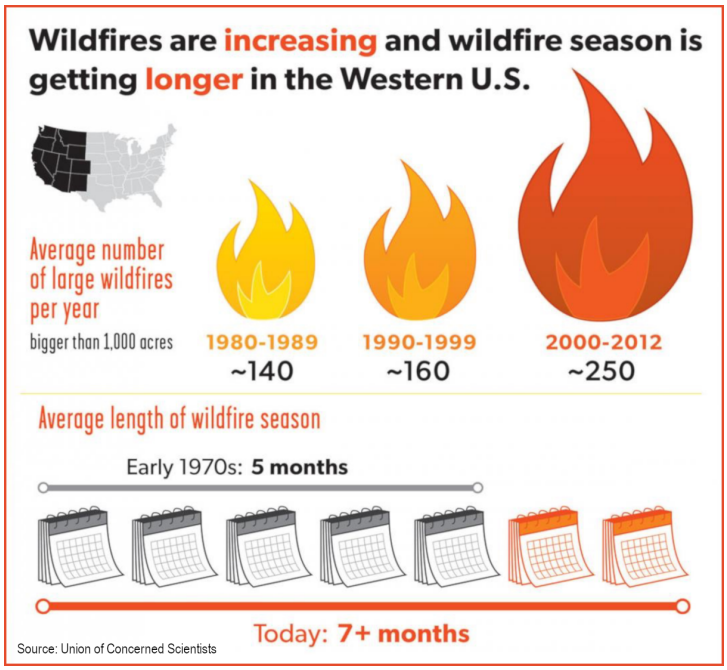
projected at $2 billion.[37] In the words of aid agency Direct Relief, although the storm was not the strongest ever to make landfall on the African continent, it "may well turn out to be the deadliest," with the greatest risks to health for people living in Mozambique and neighboring Zimbabwe still in the future—most critically through increased risk of exposure to cholera, but also HIV, tuberculosis, malaria and dengue fever, as well as compromised nutrition and maternal and child health.[38]

One month after Cyclone Idai, torrential rains in southeastern South Africa brought devastating flooding, killing at least 70 people in KwaZulu-Natal Province, and several more in neighboring Eastern Cape.[39] Wherever they occur, flooding events like these will exacerbate a range of nutrition- and disease-related vulnerabilities, particularly among the poorer communities affected.

Fires

In some regions, hotter and drier conditions are expected to increase the frequency and severity of fires. Forest and bush fires pose serious health risks to firefighters and other first responders, including the risk of burns, lung damage from smoke inhalation, other serious injuries and even death. Serious fires in Australia and the U.S. State of Arizona in recent years have led to significant numbers of deaths, underscoring the danger from increasing frequency of wildfires to human health. Most of the U.S. State of California is now prone to wildfires, with an annual fire season that has claimed more territory each year.[40] According to the National Institutes of Health:

> Most semiarid regions, including the Sahel, central Australia, central Asia, southern Africa, and the western U.S., show a high probability of increased wildfires, especially for 3°C, reflecting increased biomass growth. Increased fire risk is also apparent in the southeastern U.S. and at high elevations (notably the Tibetan plateau). More frequent wildfires are likely (60% for 3°C) in much of South America.[41]



Smoke from forest fires is linked with increased mortality and morbidity. Large fires are also accompanied by an increased number of patients seeking emergency services. Toxic gaseous and particulate air pollutants are released into the atmosphere, which can significantly contribute to acute and chronic illnesses of the respiratory system,

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[37] https://qz.com/africa/1596668/cyclone-idai-death-toll-passes-1000-with-damage-to-cost-billions/

[38] https://www.directrelief.org/2019/03/health-risks-rise-in-the-wake-of-cyclone-idai/

[39] https://www.cnn.com/2019/04/24/africa/51-dead-south-africa-flood-intl/index.html

[40] Tim McDonnell, "California's Devastating Fire Season Is the New Normal," *Mother Jones*, August 5, 2015. http://www.motherjones.com/environment/2015/08/california-deadly-tinderbox

[41] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1559762/

particularly in children, including pneumonia, upper respiratory diseases, asthma and chronic obstructive pulmonary diseases. Pollutants from forest fires can affect air quality for thousands of miles. Wildfires, which occur more commonly following heat waves and drought, release particulate matter and other toxic substances that may affect large numbers of people for days, or even for months.[42]

Although there are multiple factors contributing to the apparent increase in the frequency and deadliness of fires—growing cities, planning failures, higher concentrations of people living near forests and combustible landscapes—steadily rising temperatures due to climate change are accelerating these patterns. According to David Bowman, a professor of environmental change biology at the University of Tasmania in Australia, "We are seeing more severe, more intense and longer lasting wildfires causing more loss of life and property. Fires used to be seen as local, but we should see them as part of a global-scale phenomenon."[43]

Secondary Impacts

In addition to the primary risks to health associated with rising heat, fires, floods and other "extreme weather events," secondary effects are those caused by disruptions to ecosystems or relationships between species, and so include such things as malnutrition caused by falling harvest yields or poor livestock health, as well as exposure to infectious diseases due to changes in disease vectors. Despite being less direct or immediate, these are not necessarily less serious.

Nutrition and Food Security

The scientific literature has raised serious concerns with regard to the impact of climate change on food security and nutrition.

In its *SR.1.5* report, the IPCC restated what has been known for some time: "Climate change exacerbates the risk of food insecurity and the breakdown of food systems, particularly for poorer populations in both urban and rural settings. For example, the interaction of climate change with food security can exacerbate undernutrition, increasing the vulnerability of individuals to a range of diseases." And "Climate change-related changes in dietary and weight-related risk factors are projected to increase mortality due to global reductions in food availability."[44]

The Food and Agriculture Organization (FAO; a UN body) has been monitoring food and nutrition trends for decades, and its initiative *The State of Food Security and Nutrition in the World* launched in 2017 with other bodies (including the WHO) is an important source of information. In 2018, the FAO produced *Building climate resilience for food security and nutrition,* a comprehensive investigation of all of the aspects of undernourishment and food insecurity.[45]

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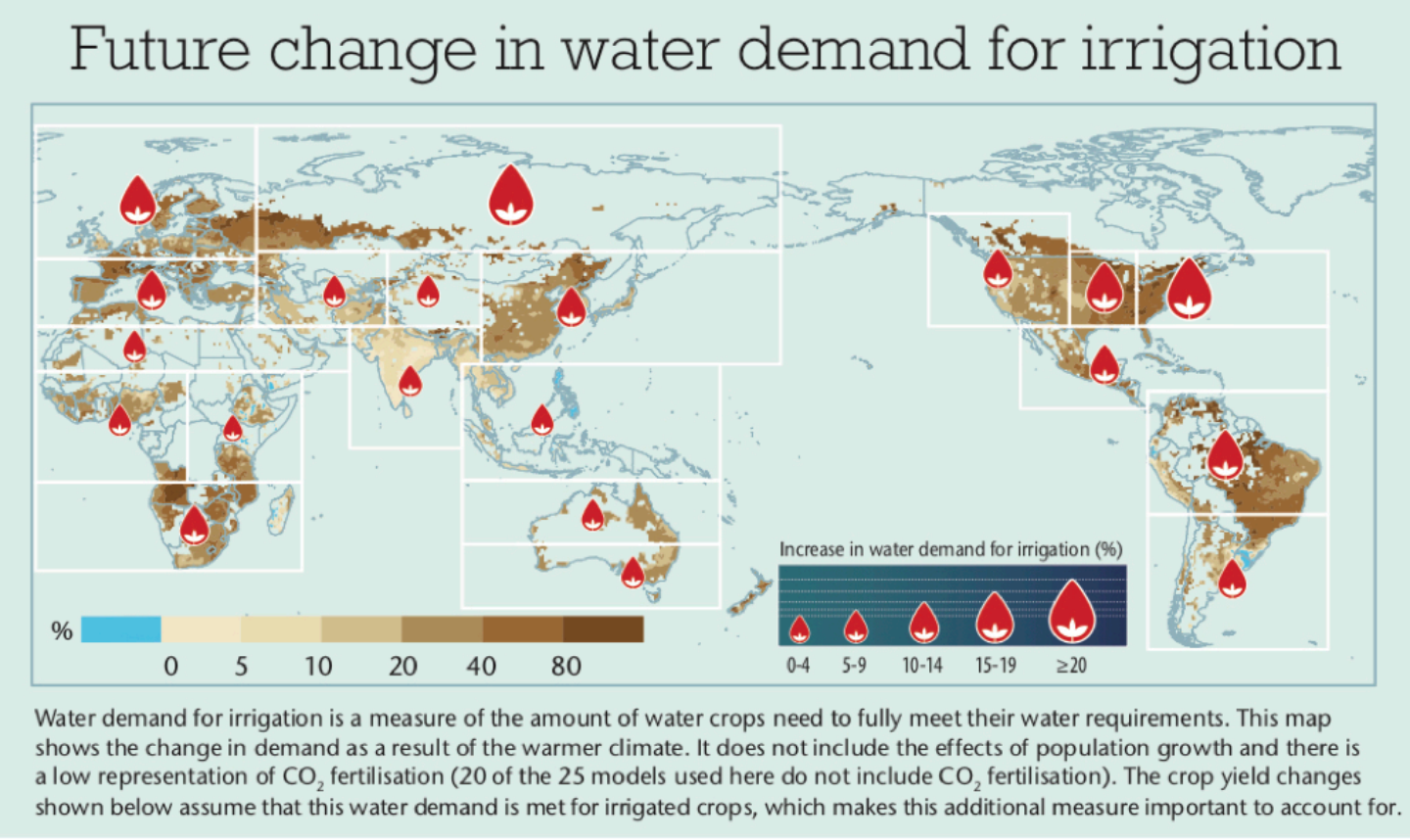
[42] IPCC, AR5, 2014, K. R. Smith, et. al., Chapter 11, "Human Health: Impacts, Adaptation, Co-Benefits." Section 11.5.3.2. – Acute Air Pollution Episodes

[43] https://www.huffpost.com/entry/fire-fire-everywhere-the-2018-global-wildfire-season-is-already-disastrous_n_5b5a1271e4b0de86f494ed28

[44] IPCC, SR15, 2018, Section 3.6 and Section 3.4.6.1

[45] FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. http://www.fao.org/3/i9553en/i9553en.pdf



Water demand for irrigation is a measure of the amount of water crops need to fully meet their water requirements. This map shows the change in demand as a result of the warmer climate. It does not include the effects of population growth and there is a low representation of CO_2 fertilisation (20 of the 25 models used here do not include CO_2 fertilisation). The crop yield changes shown below assume that this water demand is met for irrigated crops, which makes this additional measure important to account for.

Source: UK Met Office, Human Dynamics of Climate Change Project

Significantly, the 2018 report showed that the number of undernourished people has started to rise again in the past three years, after falling steadily for many years. In 2017 the number of undernourished people reached 821 million – around one person out of every nine in the world. Undernourishment and severe food insecurity appear to be increasing in almost all sub-regions of Africa, as well as in South America, whereas the undernourishment situation is stable in most regions of Asia. In 2017, nearly 151 million children under five were found to have stunted growth, while the lives of over 50 million children in the world continue to be threatened by wasting.

The FAO report also stated:

> In addition to conflict, climate variability and extremes are among the key drivers behind the recent uptick in global hunger and one of the leading causes of severe food crises. The cumulative effect of changes in climate is undermining all dimensions of food security – food availability, access, utilization and stability.[46]

In 2017, nearly 124 million people across 51 countries and territories faced "crisis" levels of acute food insecurity, or worse, requiring urgent humanitarian assistance to safeguard their lives and preserve their livelihoods. In 34 of these countries, more than 76 percent of the populations facing such levels of food insecurity – nearly 95 million people in total – were also affected by what the FAO refers to as "climate shocks and extremes."

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[46] FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. http://www.fao.org/3/i9553en/i9553en.pdf

Long droughts—lasting years or even decades—have already contributed to malnutrition, infectious diseases and respiratory diseases. In its *5th Assessment Review*, the IPCC reaffirmed its earlier conclusion that climate change will increase the likelihood of under-nutrition, and stressed the importance of adaptation measures: "Without accelerated investment in planned adaptations, climate change by 2050 would increase the number of undernourished children under the age of five by 20-25 million globally, or by 17-22 per cent."

Drought and the consequent loss of livelihoods is also a major trigger for population movements, particularly rural to urban migration. Population displacement can lead to increases in communicable diseases and poor nutritional status resulting from overcrowding, and a lack of safe water, food and shelter. Recently, rural to urban migration has been implicated as a driver of HIV transmission.

For the World Health Organization, "Malnutrition is anticipated to be one of the greatest threats to health resulting from climate change, and the young and the elderly will be particularly affected."[47] Rising temperatures, floods and droughts also affect food safety. For example, rising temps can increase the levels of pathogens in food sources (such as ciguatera in fish) and in food, and flooding increases the risk that pathogens will spread from livestock. The WHO also notes, "The effects on nutrition also include impaired nutrient quality of crops, the diversity of food produced and consumed, impacts on water and sanitation, patterns of risks and changes in maternal care, child care and breastfeeding." And the FAO reports, "Changes in climate are already undermining production of major crops (wheat, rice and maize) in tropical and temperate regions and, without adaptation, this is expected to worsen as temperatures increase and become more extreme."[48]

Mosquito-Borne Diseases

A solid foundation of research exists on the relationship between climate change and mosquito-borne illnesses such as malaria and dengue fever.

Projections suggest that rising temperatures lead to an expanding geographic range for certain species of the *Anopheles* genus of mosquitoes, which are responsible for the transmission of malaria to humans. According to Scientists Against Malaria, *Anopheles* mosquitoes have already affected the lives of more humans than any other insect.[49]

In its AR5, the IPCC reported that the number of global malaria deaths was estimated to be 1,238,000 in 2010. According to more recent estimates from the WHO's *World Malaria Report 2013*, there were an estimated 207 million cases of malaria in 2012, and an estimated 627 000 deaths.[50] Mortality from malaria fell by 42% globally from 2000 to 2012, so that any contribution from climate change to increased exposure and death from malaria may be obscured by falling mortality rates overall (due mainly to significantly scaling up of malaria intervention programs), although the contribution of climate change may increase the number of outbreaks, particularly in regions where malaria had previously been unrecorded.

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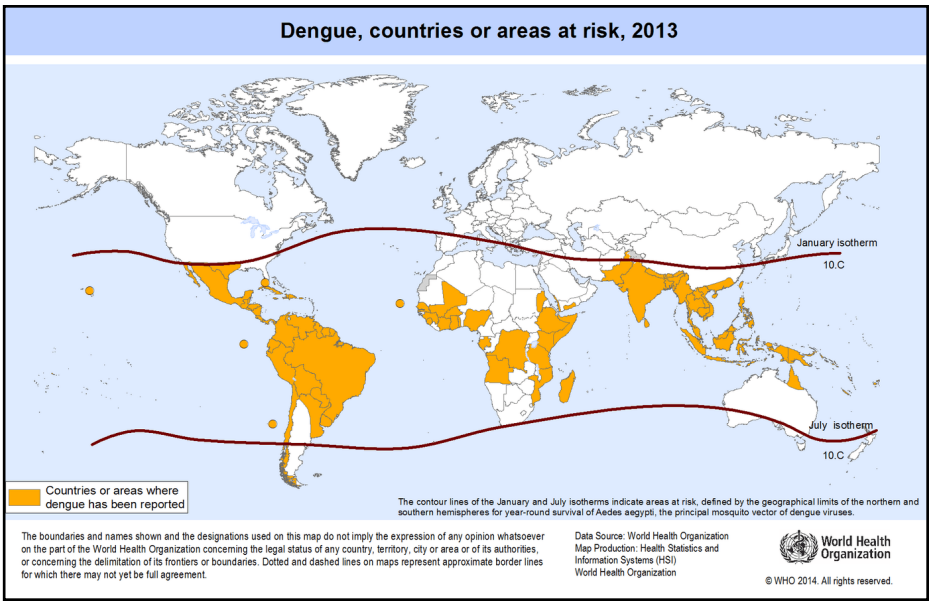
[47] WHO, *COP24 Special Report: Health & Climate Change*, https://www.who.int/globalchange/publications/COP24-report-health-climate-change/en/

[48] FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. http://www.fao.org/3/i9553en/i9553en.pdf

[49] https://scientistsagainstmalaria.net/vector/anopheles-vector

[50] https://www.who.int/malaria/media/world_malaria_report_2013/en/

Rising average temperatures are also projected to increase the numbers and geographical distribution of the *Aedes* mosquito, which is responsible for transmission to humans of dengue fever, chikungunya, yellow fever and the Zika virus. According to the IPCC's *SR15*, the prevalence of dengue fever could increase with 1.5 degrees Celsius of warming, and increase still more at 2 degrees Celsius.



Dengue fever and chikungunya have generally been on the rise in places where historically they have been common. Dengue is the most rapidly spreading mosquito-borne viral disease, showing a 30-fold increase in global incidence over the past 50 years. Heavy precipitation seems to favor the spread of dengue fever, but drought can also be a contributing factor if households store water in containers that provide suitable mosquito breeding sites. According to *The Lancet Countdown*, globally the vector potential for transmission of the dengue fever virus was the highest ever recorded.

Other diseases, such as West Nile Virus, have appeared in places where they have never been recorded before.[51] The incidence of some, like lyme disease, are likely to increase as temperatures rise.[52] According to the IPCC's SR 1.5, "Increased warming in North America and Europe could result in geographic expansions of regions (latitudinally and altitudinally) climatically suitable for West Nile virus transmission, and could expand the geographic range and seasonality of Lyme and other tick-borne diseases in parts of North America and Europe.

Mosquito- and water-borne diseases are linked to a host of other concerns for human health, not the least of which is the effects of warming on our food supply. The link between high ambient temperatures and increased incidence of salmonella food poisoning, for example, has been demonstrated in many places.

Tertiary Impacts

As noted previously, tertiary effects are those resulting from the disruption of social, political, and economic systems. These can thus include a range of physical and mental effects due to insecurity from job losses or changes, physical dislocation, or exposure to conflict (which is often due to scarcity of food, water, land, etc.).

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[51] Crystal Gammon, "Global Warming May Lead to More West Nile Virus," Scientific American, March 20, 2009. http://www.scientificamerican.com/article/west-nile-virus-global-warming/

[52] NH Ogden, et. al. "Climate change and the potential for range expansion of the Lyme disease vector Ixodes scapularis in Canada." International Journal for Parasitology. 36(1): 63-70, 2006.

Mental Health

Major studies note the effects of climate change on mental health. Lancet's *Countdown* notes, "Climate change aggravates risks to mental health and wellbeing when the frequency, duration, intensity, and unpredictability of weather-related hazards change." The resultant weather effects increase the number of people exposed or re-exposed to extreme events, and their consequent psychological problems, with suicide an extreme manifestation of trauma.

Because of their rapidly growing frequency, duration, and intensity, heatwaves are of particular concern, with strong evidence linking their occurrence to increases in population distress, hospital psychiatric admissions, and suicides.[53] In parts of rural Australia, prolonged drought resulted in loss of livelihood and industry, and studies of the area have shown an increased incidence of suicide among male farmers.[54]

Depression, anxiety and Post-Traumatic Stress Disorder (PTSD) following climate-related disasters such as floods, cyclones, tropical storms, and wild fires are increasingly being documented. In November 1998, Hurricane Mitch devastated much of Nicaragua and Honduras. A study conducted six months later found that rates of PTSD and depressive disorders were much higher in Nicaragua's worst affected communities than in those less severely affected.[55]

Violence and Conflict

A growing body of evidence is connecting climate change to political and military struggles over land and resources.[56] Soil degradation, freshwater scarcity, population pressures and other forces that are related to climate are all potential causes of conflict. It is difficult to separate out the influence of climate change on any given war or outbreak of violence, but factors associated with risk of violent conflict are sensitive to climate variability, and the connection of war and violence to a changing climate is clear.

Conflict and climate change are major drivers of displacement in Syria and elsewhere in the Arab region. UNHCR photo

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[53] Baba Umar, Al Jazeera. "India's shocking farmer suicide epidemic," May 18, 2015. http://www.aljazeera.com/indepth/features/2015/05/india-shocking-farmer-suicide-epidemic-150513121717412.html

[54] Stephanie Small, ABC News, "Fears Queensland's severe drought will lead to more farmer suicides," October 23, 2013. http://www.abc.net.au/news/2013-10-23/fears-queenslands-drought-will-lead-to-more-farmer-suicides/5041148

[55] AK Goenjian, et al., "Posttraumatic Stress and Depressive Reactions Among Nicaraguan Adolescents After Hurricane Mitch," American Journal of Psychiatry, 158: 788–94, 2001

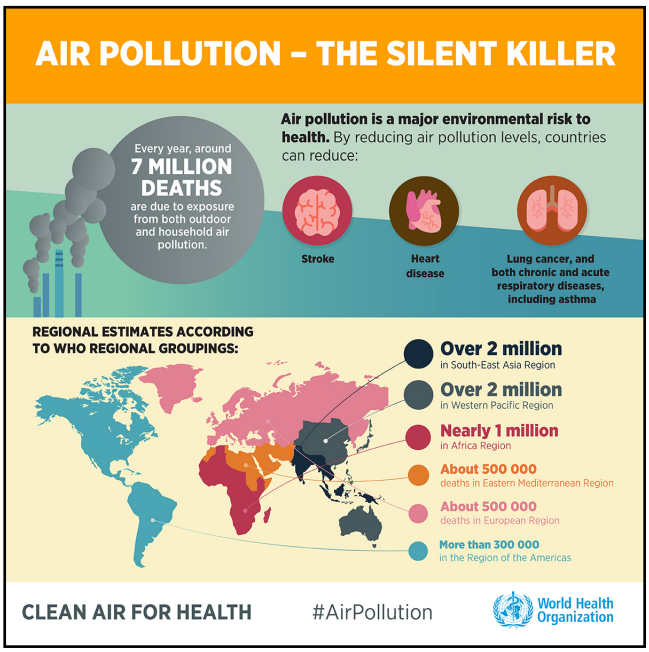
[56] Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Review, 2014. K. R. Smith, et. al., Chapter 11, "Human Health: Impacts, Adaptation, Co-Benefits." Section 11.6.4. - Violence and Conflict

A study published in the Proceedings of the National Academy of the Sciences in 2015 was unequivocal in stating that Syria's extreme drought, from 2006 until 2009, was anthropogenic in origin, and that it played a "catalytic effect" in fueling the conflict. The authors cited studies that showed that the extreme dryness, combined with other factors, including the misguided agricultural and water-use policies of the Syrian government, caused crop failures that led to the migration of as many as 1.5 million people from rural to urban areas. This in turn added to social stresses that eventually resulted in the uprising against President Bashar al-Assad in March 2011.[57]

A debate currently rages in the scientific community about whether climate change is related to the incidence of civil wars in the Congo, South Sudan, and Somalia. Drought, migration and limited access to water were all factors in the conflicts that are currently taking place in those places.

Associated Health Risks

In addition to those impacts on human health that are due to climate change, there are additional serious dangers to health that are closely associated with the use of fossil fuels. Burning coal, oil and gas causes significant air pollution that can have devastating impacts on health, despite having little relationship to climate change as such.



Air Pollution

Air pollution generated by fossil fuels is sometimes regarded as a 19th century problem associated with "First World" industrialization. *But in terms of the number of people impacted, air pollution is a bigger problem today than at any time in human history.* The industrial output of the developing world has skyrocketed, generating pollution of all kinds. The immediate impacts of this pollution are felt locally, but greenhouse gas emissions do not need a visa to move across borders and are everyone's problem due to their contribution to global warming.

In 2014 the WHO reported that around 7 million people died prematurely (2012 data) - one in eight of total global deaths – as a result of air pollution exposure. This was more than double previous estimates. For the WHO, the numbers "confirms that air pollution is now the world's largest single environmental health risk. Reducing air pollution could save millions of lives."[58] And in recent years numerous studies have focused on the

[57] Colin P. Kelley, Shahrzad Mohtadi, Mark A. Cane, Richard Seager, and Yochanan Kushnir, "Climate change in the Fertile Crescent and implications of the recent Syrian drought," *PNAS* March 17, 2015 112 (11) 3241-3246; first published March 2, 2015 https://doi.org/10.1073/pnas.1421533112. https://www.pnas.org/content/112/11/3241

[58] World Health Organization, News Release, "7 million premature deaths annually linked to air pollution," March 25, 2014. http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/

deteriorating air quality in countries like China and India, responsible for high levels of premature deaths.[59] In 2019, the Office of the High Commissioner for Human Rights reported that 600,000 children die prematurely every year from polluted air.[60]

In its report for COP24, the WHO stated:

> Over 90% of the urban population of the world breathes air containing levels of outdoor air pollutants that exceed WHO's guidelines. Air pollution inside and outside the home is the second leading cause of deaths from NCDs [non communicable diseases] worldwide; it is responsible for 26% of deaths from ischaemic heart disease, 24% of those from strokes, 43% from chronic obstructive pulmonary disease and 29% from lung cancer.

The WHO has devoted considerable attention to explaining the connection between illness caused by burning fossil fuels and the respective contributions those sectors make to climate change. For example, the connection between temperature increases and rising ground-level ozone levels is well established, and increases in ground-level ozone have contributed to a growth in respiratory illness and levels of premature death.[61] And concentrations of air pollutants in general, and fine particulate matter (PM) in particular, may change in response to climate change because their formation depends, in part, on temperature and humidity. Warming is known to increase the negative impacts of particulate matter (PM) which is known to affect morbidity and mortality.[62]

The WHO notes that the economic sectors that produce the most emissions – energy, transport, industry, agriculture, waste management and land use – are also the main sources of fine particulate matter and other important air pollutants. These include short-lived climate pollutants such as black carbon, methane and ground-level ozone, which also threaten human health. Approximately 25% of urban ambient air pollution from fine particulate matter is contributed by traffic, 15% by industrial activities including electricity generation, 20% by domestic fuel burning, 22% from unspecified sources of human origin and 18% from natural sources. Meanwhile, the contributions of different sectors to global GHG emissions are 14% from transport, 34.6% from energy for electricity generation and heat, 21% from industry, 6.4% from buildings and 24% from agriculture and land use change. In other words, "The sources of climate change and air pollution are therefore broadly the same: polluting energy systems."[63] Therefore, according to the WHO's calculations, "Meeting the goals of the Paris Agreement to combat climate change could save about a million lives a year worldwide by 2050 through reductions in air pollution alone."

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[59] MIT News Office, "Data from China shows that large amounts of coal emissions shorten lives," July 8, 2013. http://mitei.mit.edu/news/data-china-show-large-amounts-coal-emissions-shorten-lives; Lisa Friedman, "Coal-Fired Power in India May Cause More Than 100,000 Premature Deaths Annually," Scientific American, March 11, 2013. http://www.scientificamerican.com/article/coal-fired-power-in-india-may-cause-more-than-100000-premature-deaths-annually/

[60] https://www.ohchr.org/EN/NewsEvents/Pages/DisplayNews.aspx?NewsID=24248

[61] https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2009GL037308

[62] https://www.epa.gov/air-research/air-quality-and-climate-change-research

[63] WHO, *COP24 Special Report: Health & Climate Change*, https://www.who.int/globalchange/publications/COP24-report-health-climate-change/en/

Ultraviolet Radiation and Ozone

Solar ultraviolet radiation (UVR) exposure causes a range of health impacts. Depletion of the ozone layer in the atmosphere—the layer of atmospheric gas that absorbs UVR— leads to increased UVR exposure. Ozone depletion can result from natural causes, but is greatly increased by certain refrigerants (like freon), propellants (in aerosols) and solvents. The greatest health burdens of UVR exposure result from cortical cataracts and cutaneous malignant melanoma. Climate change will alter human exposure to UVR exposure in several ways, although the balance of effects is difficult to predict. It is anticipated that higher ambient temperatures will influence clothing choices and time spent outdoors, potentially increasing UVR exposure in some regions and decreasing it in others. In addition to having a detrimental effect on human health, increased UVR affects terrestrial[64] and aquatic[65] ecosystems, impacting everything from drought and rain cycles on land, to ocean acidification and warming.

Climate change is also associated with exposure to elevated concentrations of ozone at ground level, which has led to increased hospital admissions for pneumonia, chronic obstructive pulmonary disease, asthma, allergic rhinitis and other respiratory diseases, and with premature mortality. It bears mentioning that increased ozone on the ground is as detrimental to human health as depleted ozone is in the sky. Tropospheric ozone is ground level ozone—the main component of smog.

[64] Caldwell, et. al., "Terrestrial ecosystems, increased solar ultraviolet radiation, and interactions with other climate change factors." Photochemical and Photobiological Sciences. 6:252-266, 2007. http://pubs.rsc.org/en/content/articlelanding/2007/pp/b700019g/

[65] Häder, et. al., "Effects of solar UV radiation on aquatic ecosystems and interactions with climate change." Photochemical and Photobiological Sciences. 6: 267-285, 2007

5. Towards A Global Agenda for Action

The energy and emissions trends described above provide a crucial backdrop for making use of the information on health impacts presented in this report. In the longer term, unless we collectively act to shift what is happening with energy production, distribution and use, then making meaningful inroads to tackling the health impacts of climate change will become increasingly difficult and costly. While the IPCC's *SR15* states that limiting overall warming to 1.5C is still possible from a technical standpoint, doing so requires "rapid, far-reaching and unprecedented changes in all aspects of society," involving essentially all aspects of modern society: land, energy, industry, buildings, transport and cities.

The necessity and urgency of making such profound systemic changes has implications for how nurses can make the best use of health-related information. In the context of that challenge, and complemented by the information on energy and emissions, nurses and their allies may find the health-specific information especially useful in educating their members about the kinds of dangers that are on the horizon if we are not able to unite and rally the social forces that can bring about the "rapid, far-reaching and unprecedented changes" necessary for a change of course.

Any honest assessment of the current energy and emissions trends can only lead to one conclusion: the world is going to get warmer in the coming decades, and without decisive intervention "from below," this warming will alter the planet's climate system even further, producing yet more warming, and even greater threats to human health. With aggressive action to reduce fossil fuel use, the levels of warming could be kept within relatively "safe" limits. But there is as yet no evidence that the currently dominant approach to climate policy from elite institutions and political leaders will deliver such action.

As a starting point, there is a clear need for the global health community—including its key voices—to recognize that the transition to a low-carbon future is not "well under way," nor in any sense "inevitable." Nurses' unions have a key role to play in communicating this reality. The health of billions depends on it.

Nurses in the Struggle Against the Climate and Health Emergency

Nurses' unions are already playing an important role in the fight for climate justice. Nurses have been at the forefront of struggles against the expansion of fossil fuel infrastructure, and thousands of nurses have provided relief for the victims of extreme weather events in various parts of the world.

There are many ways in which nurses can continue and step up these struggles. The following list is not exhaustive, but aims to identify six key areas where nurses and their unions can make use of their expertise and political strength in the fight against the climate and health emergency, and for climate and health justice.

1. Resist New Fossil Fuel Projects

- ***Nurses will continue to support and participate in campaigns to stop the expansion of fossil fuel use.***

Despite the officially recognized need to move rapidly away from fossil fuels, new fossil fuel infrastructure projects are either under construction or at the planning stage in many countries around the world. New drilling operations, pipelines, export terminals, and coal- and gas-fired power stations risk creating "carbon lock in" for decades to come, effectively destroying any chance of limiting the danger of global warming and

climate change. Reaching "net zero emissions" will require a dramatic phase-down of fossil fuel use. Any new projects will make that task far more difficult.

2. Make Emergency Response and Recovery Services "Climate Ready"

- ***Nurses will demand that vital services are fully staffed and capable of responding to climate instability.***

Even if the world stopped burning fossil fuels immediately, global warming will continue for many years to come. This means that extreme weather events are likely to increase in both frequency and severity, and medical services risk becoming besieged by unanticipated outbreaks of diseases like dengue, zika, etc. The experience of Puerto Rico in the aftermath of tropical storm Maria tragically demonstrated the need for emergency services to be able to provide medical care to those suffering chronic health problems. Nurses can play a vital role in strengthening the ability of emergency and health systems to prepare for this challenge.

3. Work with Allies at the Global Level on Preparedness

- ***Nurses can use their voice in helping to ensure that countries and regions plan for the future in ways that can best protect vulnerable populations.***

Until mid-century, climate change is expected to primarily exacerbate existing health challenges. This means that investing in health and social safety nets must be a top priority. This includes the need to provide access to safe water and improved sanitation, and enhancing access to essential services such as vaccination. In many vulnerable regions, agriculture-related adaptation will be particularly important. By coordinating at the global level and sharing ideas, experience and expertise, nurses and their unions can ensure essential services are effective and appropriate.

4. Fight Poverty and Racism. Defend Worker Rights and Protections

- ***Nurses will continue to draw attention to the roles that poverty, racism, and the lack of workers' rights play in exposing oppressed people to the worst impacts of climate change.***

Whether in factories or fields, on construction sites or roadsides, rising temperatures pose a threat to economically vulnerable workers and the poor. These workers are often members of racial minorities or ethnic groups that find themselves on the receiving end of various forms of exclusion, discrimination and oppression. A more equal society—including one where everyone has access to heath care as a human right—is therefore crucial to the protection of hundreds of millions and perhaps billions of people against the worst effects of climate change. Addressing these injustices adds to the capacity of communities to adapt to warming temperatures and climate instability.

5. Articulate and Advocate for a Pro-Public Shift in Policy

- ***Nurses will continue to push for a shift towards a "public goods" approach to climate and health policy, anchored in adequately funded public services.***

Current policies, committed to an investor-focused and profit-based approach to decarbonization, have failed to alter the rise of energy demand and emissions. We can prepare for a warming world, but the levels of warming that current policies will produce are likely to create a world that, by 2100, will bear little

resemblance to the world of today. The problem is not lack of “ambition” or “political will”; the problem is deeply rooted in a capitalist economy that is programmed to pursue ever higher levels of extraction and exploitation of our ecosystems, including our labor. Nurses can play a crucial role in emphasizing that emissions reductions and effective adaptation measures should be seen as “public goods,” rather than as a frontier for speculation and money-making.

6. Energy Democracy: Extend Public Control Over Energy Generation and Use

- ***Nurses understand that a successful struggle for control over energy is crucial, which is why nurses’ unions advocate for ‘energy democracy’ at all levels.***

The decarbonisation of energy supply and the reduction of energy demand are both essential to reducing emissions over the longer term. This can only be achieved by extending public ownership over energy generation and management. The struggle for new public energy systems anchored in a public goods approach is gaining momentum in many parts of the world. Control over energy will allow us to plan the phase out of fossil fuel use; bring socially owned renewable energy to scale, develop fully electric public transport systems, and reduce energy use in buildings.