

ISSUE BRIEF

# CLIMATE CHANGE AND HEALTH IN WASHINGTON

Climate change is altering Washington's seasonal temperature and rainfall patterns, making hot days hotter, and increasing the severity of extreme events like the devastating wildfire seasons in 2017 and 2018.<sup>1</sup> As a result, Washingtonians face a variety of health threats, including more heat-related illnesses, increased risk of breathing and heart problems from smoke exposure, food and water contamination, traumatic injuries, mental health problems from flooding and other weather extremes, and increased exposure to infectious diseases.<sup>2</sup> These threats will only worsen as transportation systems and big polluters continue to pump climate-changing emissions into the air.

Washingtonians can protect themselves from these threats by moving to a cleaner and more efficient energy and transportation system and preparing more effectively for future climate and health crises.<sup>3</sup> Washington's communities and health departments must also have the resources and capacity to deal with present-day health threats.<sup>4</sup>

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## CLIMATE CHANGE WILL INCREASE UNHEALTHY WILDFIRE SMOKE

Climate change and expanding urban development in fire-prone areas are putting more Washingtonians in the path of dangerous wildfires and their smoke over longer periods of the year.<sup>5</sup> In the western United States, higher temperatures and declines in summertime rain have increased the severity of droughts, which reduce water availability and dry out vegetation. These conditions in turn fuel longer fire seasons and larger and more frequent fires.<sup>6</sup> Both the number of large wildfires (i.e., greater than 99 acres) and the area burned by them have increased in Oregon and Washington since 2000.<sup>7</sup> In the 30 years from 1971 to 2000, 512 wildfires burned more than 1.8 million acres of forest in the two states. In the 15 years from 2001 to 2015, 651 wildfires burned nearly 4 million acres of forest.<sup>8</sup>

From 1988 to 2016, wildfire smoke increased overall concentrations of unhealthy fine-particle pollution in the Northwest, even as particle pollution declined across the rest of the country.<sup>9</sup> Exposure to fine particles and other dangerous components of wildfire smoke has been linked to health problems like respiratory infections, cardiac arrest, low birth weight, and exacerbated asthma and chronic obstructive pulmonary disease (COPD).<sup>10</sup> In 2012, deaths and illnesses associated with wildfire smoke exposure in Washington resulted in approximately \$2.3 billion in health costs.<sup>11</sup>

In 2017 and 2018, smoke from fires across British Columbia and the rest of the Pacific Northwest blanketed much of Washington for multiple weeks.<sup>12</sup> During the 2017 fire season, local medical centers reported increased visits for asthma and COPD.<sup>13</sup> On August 13 and 14, 2018, the concentration of fine-particle pollution in Seattle's Chinatown-International District averaged 152 micrograms per cubic meter, more than four times the federal limit.<sup>14</sup> In response, the city of Seattle opened its first-ever clean air shelters in 2019 to protect residents from wildfire smoke.<sup>15</sup>

Fine particles from wildfires are particularly dangerous to adults age 65 and older, who are more likely to have heart or lung disease.<sup>16</sup> Older adults made up 16 percent of Washington's population in 2018 and are expected to account for 22 percent by 2040.<sup>17</sup> By that year, population growth and increased fire intensity in the western United States are expected to increase smoke-related hospitalizations among older people, and western Washington could see one of the largest increases.<sup>18</sup>

As climate change fuels longer wildfire seasons and more smoke, health care costs for the roughly 119,000 children and 547,000 adults living with asthma in Washington are likely to go up.<sup>19</sup> Asthma is already an expensive condition to treat: in 2012, the average asthma patient in Washington shouldered \$2,364 in medical costs, and asthma-related absences from work and school cost the state \$61.5 million.<sup>20</sup>

These increasing costs will have an outsized impact on low-income residents, who, due to factors like diet and

lower-quality housing, are more likely to develop asthma and be exposed to asthma triggers.<sup>21</sup> In fact, between 2008 and 2010, adults in Washington households with an annual income of less than \$15,000 were more than 2.5 times as likely to have asthma as adults in households making \$75,000 or more.<sup>22</sup>



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## EXTREME HEAT IS BAD FOR THE HEALTH OF WASHINGTONIANS—AND THE DANGER IS GROWING

Washington summers are getting longer and hotter and are likely to become more dangerous over the coming decades.

In Washington, average temperatures from June to August have climbed 1.7 degrees Fahrenheit since 1895.<sup>23</sup> From 2007 to 2016, 82 percent of all state residents (more than 5.7 million people) lived in counties that experienced more than nine extreme heat days per year, more than expected from local historical averages (Figure 1).<sup>24</sup> If carbon emissions remain high, Washington could see an annual average of 9.9 days above 95 °F from 2040 to 2059, compared with 2.6 such days per year from 1981 to 2010.<sup>25</sup>

Heat already poses a range of health threats to Washington residents, from minor illnesses like heat cramps to deadly conditions like heat stroke or heat-related heart attacks.<sup>26</sup> Between 2007 and 2017, an annual average of 49 Washington residents were hospitalized for illnesses directly related to heat.<sup>27</sup> This likely underestimates the true health costs of heat, as it does not include hospitalizations for conditions exacerbated by heat, such as asthma.<sup>28</sup> In that five-year period in King County, the most populous county in Washington, days with a maximum heat index above 85.5 °F were associated with an 8 percent increase in emergency medical service calls.<sup>29</sup> Another study of King County, from 1980 to 2010, found that days with a humidex above 97 °F saw a 10 percent increase in the relative risk of death.<sup>30</sup> (Heat index and humidex are both metrics that combine heat and humidity using different equations.)

Anyone can get sick from extreme heat, but outdoor workers, young children, older adults, people experiencing poverty, and people with chronic diseases like diabetes

and heart disease are particularly vulnerable.<sup>31</sup> Heat vulnerabilities associated with age, occupation, and socioeconomic factors can be more pronounced in cities, which are warmer than surrounding areas because of the urban heat island effect.<sup>32</sup> This phenomenon, which adds to the climate warming driven by carbon pollution, is caused by elements of the urban built environment, such as heat-absorbing asphalt and airflow-blocking tall buildings. In Seattle, for instance, daily summer temperatures from 2004 to 2013 were an average of 4.1 °F higher than in nearby rural areas.<sup>33</sup>

Low-income households and communities of color are often concentrated in the hottest urban neighborhoods.<sup>34</sup> In King County, the 20 census tracts with the largest percentages of people of color had more than four times as much paved surface area as the 20 census tracts with the largest percentages of white people.<sup>35</sup> Tree cover can help lessen the heat island effect, but increasingly dense urban development is replacing some of Seattle’s tree cover. From 2000 to 2010, vegetative cover in Seattle neighborhoods with a higher concentration of people of color declined 8 percent, compared with 3 percent over the entire city.<sup>36</sup> Furthermore, air conditioning is even less common among Seattle households headed by people of color than those headed by white people. In 2017, 44 percent of white households had air conditioning, compared to 33 percent of Hispanic households and 26 percent of Black households.<sup>37</sup> During periods of heavy wildfire smoke, residents unable to afford air conditioning face the choice of keeping doors and windows open to improve cooling—thus letting in dangerous particle pollution—or leaving windows closed to avoid the smoke but putting themselves at greater risk of heat-related illnesses.<sup>38</sup>

Extreme heat can also make strenuous outdoor activity more dangerous, particularly for workers wearing heavy protective gear.<sup>40</sup> For instance, a study from 2000 to 2012 found that the odds of traumatic injury among Washington cherry harvesters were 53 percent higher when the humidex rose in June and July above safe occupational thresholds.<sup>41</sup> Extreme heat can be particularly dangerous for foreign-born farmworkers, who may face language barriers or have concerns about their legal status, potentially hindering their access to information or willingness to report illness.<sup>42</sup> About 40 percent of Washington’s agriculture, forestry, fishing, and hunting workers are immigrants.<sup>43</sup>

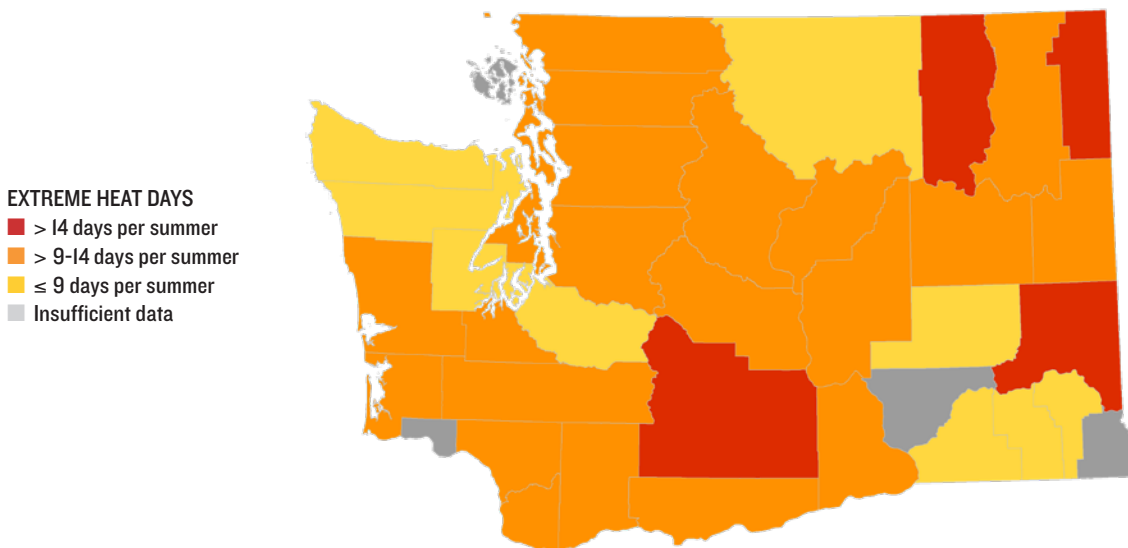
Finally, more than 12,000 people in Seattle and the surrounding King County were homeless in early 2018.<sup>44</sup> More than half of those people were unsheltered, and about 44 percent reported mental health conditions like post-traumatic stress disorder. People living with mental illnesses can be particularly sensitive to extreme heat if they take medications that interfere with the body’s natural cooling mechanisms, fail to take protective action against the heat, or have associated sleep disorders that are exacerbated by heat.<sup>45</sup>

### DROUGHTS WILL LIMIT WATER SUPPLIES AND MAY AFFECT MENTAL HEALTH

Washington relies on melting snowpack for its water supply during dry summer months.<sup>46</sup> Although total annual precipitation is not projected to change much in Washington, winter temperatures will rise across the state.<sup>47</sup> This means winter precipitation will shift from snow to rain, limiting snowpack accumulation.<sup>48</sup> This effect was on full display in 2015, when the average April

**FIGURE 1: AVERAGE NUMBER OF EXTREME HEAT DAYS EACH YEAR IN WASHINGTON COUNTIES, 2007–2016**

“Extreme heat days” are defined as June, July, and August days from 2007 to 2016 on which the maximum temperature at a given weather station fell within the top 10 percent of readings made at that station from 1961 to 1990. Nine extreme heat days per summer, on average, would be expected if temperatures were not increasing over time. More detail on methodology and data sources can be found in NRDC’s 2017 “Climate Change and Health: Extreme Heat” map.<sup>39</sup>





snowpack was 25 percent of normal despite a relatively normal amount of winter precipitation.<sup>49</sup> By 2100, rising temperatures could reduce Washington's April snowpack by 70 percent, increasing the risk of summer drought.<sup>50</sup>

Drought can be a slow-moving disaster with the potential to affect human health by limiting supplies of clean water, reducing water quality by concentrating toxins and pathogens, and imposing financial hardship on farmers and workers in other water-dependent industries.<sup>51</sup> Scientists are investigating the link between drought and mortality in western states.<sup>52</sup> A recent study of the western United States from 2000 to 2013 found the average risk of mortality from all causes among Medicare recipients was 1.55 percent higher during periods of high-severity, worsening drought than during non-drought periods.<sup>53</sup>

Drought and heat threaten Washington's lucrative fruit harvest, something seen in 2015 when blueberry growers lost \$10 million in fruit.<sup>54</sup> These crop losses could lead to job losses and increased financial insecurity among farmworkers.<sup>55</sup> The effects of drought on the mental health of Americans is not well understood, but work from rural Australia suggests extended drought can increase the risk of suicide among men and increase behavioral problems among teens.<sup>56</sup> In California's Tulare and Mariposa Counties, surveys of agricultural communities in late 2015 found that personal financial losses related to drought increased the probability of negative health effects and acute stress.<sup>57</sup>

## SEA LEVEL RISE THREATENS WASHINGTON'S COASTAL COMMUNITIES

Coastal Washington, which is home to more than 4.6 million people, faces significant risks from rising sea levels.<sup>58</sup> Under continued high levels of carbon pollution, there's an 83 percent chance that relative sea levels (the combination of the height of the ocean surface and the elevation of land) could rise in Olympia by 0.7 feet by 2050 and 2 feet by 2100, relative to average sea levels from 1991 to 2009.<sup>59</sup> Two feet of sea level rise in Olympia would turn what are currently considered 100-year floods (floods that have a 1 percent chance of occurring in any given year) into annual floods.<sup>60</sup>

On the Olympic Peninsula, sea level rise is already threatening the Quinault Indian Nation, which lives along the Pacific coast. Tribal leaders have decided to move their community to a higher elevation to avoid inundation.<sup>61</sup> Though the tribe chose to move to avoid future disaster, forced migrations like theirs can have significant mental health consequences.<sup>62</sup> If the rate of sea level rise is on the higher end of current projections, neighborhoods all along Washington's coast might soon be facing a similar choice. For example, 57 percent of the people in the city of Hoquiam currently live in homes that will be at risk of chronic tidal flooding by 2045.<sup>63</sup>

Sea level rise is also expected to damage Washington's coastal wastewater treatment plants, interfere with regular operations, and require plants to relocate in cases of permanent flooding.<sup>64</sup> Additionally, wastewater treatment plant failures can lead to outbreaks of gastrointestinal infections such as norovirus, Crypto, and giardia.<sup>65</sup> One



foot of sea level rise above 1988 levels could flood four Washington wastewater treatment plants that serve about 174,000 Washingtonians in total.<sup>66</sup> Under a high-carbon scenario, there is about a 17 percent chance that Seattle will experience more than 1 foot of relative sea level rise by 2050.<sup>67</sup>

### MORE EXTREME RAINFALL WILL INCREASE DEADLY FLOODS AND LANDSLIDES

Climate change is expected to increase the intensity and frequency of extreme rainfall events in Washington. Near Seattle-Tacoma International Airport, for example, the amount of rainfall during two-year storms (storms with a 50 percent chance of occurring in any given year) could increase by 14 to 36 percent by the 2080s, relative to 1970 to 1999.<sup>68</sup> Across the entire Pacific Northwest, warming may increase the “probable maximum precipitation”—a theoretical amount of rainfall used to safely design infrastructure like dams—by 50 percent by 2099, compared with the period of 1970 to 2016.<sup>69</sup>

More extreme rain will increase the likelihood of landslides in Washington, which already occur hundreds to thousands of times each year across the state.<sup>70</sup> In 2014 the devastating Oso landslide in northwest Washington was partially triggered by more than double the usual amount of precipitation.<sup>71</sup> The landslide debris, which moved at an average of 40 miles per hour, killed 43 people, injured 10, and destroyed 35 homes.<sup>72</sup> Oso was the deadliest landslide in U.S. history and the second-most expensive in Washington since 1984.<sup>73</sup> In a small study of survivors about a year after the landslide, residents reported increased use of alcohol, insomnia, and marital difficulties.<sup>74</sup>

Heavier rainstorms and the shift from snow to winter rain will also swell rivers, increasing the risk of floods.<sup>75</sup> By the 2080s, for instance, average river flows from October through March could increase by as much as 25 percent for the Snoqualmie River (relative to the 1970 to 1999 average).<sup>76</sup> Under a scenario of continued high carbon emissions, the frequency of 100-year floods may more than double in some parts of Washington by the 2040s and 2050s (compared with a 2001 to 2020 baseline).<sup>77</sup> That



could expose an estimated 2.1 million Washingtonians to much more frequent flooding.<sup>78</sup> Floods pose multiple health threats, including drowning, bodily injuries, skin infections, waterborne illnesses, respiratory illnesses associated with mold growth, and impacts on mental health and well-being.<sup>79</sup>

### WARMING WATERS ALONG WASHINGTON'S COAST THREATEN FOOD SAFETY

Washington is known for productive marine waters along its more than 3,000 miles of coastline.<sup>80</sup> But rising temperatures could boost the growth of harmful bacteria and promote toxic algal blooms, threatening the safety of the shellfish that live off Washington's coast.<sup>81</sup>

Vibriosis, a human illness caused by bacteria-laden seawater or seafood, can cause symptoms ranging from nausea to skin infections.<sup>82</sup> This illness affects an estimated 80,000 people and causes about 100 deaths in the United States every year.<sup>83</sup> In 2016 and 2017, there were 159 reported cases of vibriosis in Washington, including one death.<sup>84</sup> Anyone can get vibriosis, but severe complications are more likely for people with weakened immune systems or chronic diseases like cancer or liver disease, or for those who take medications to reduce stomach acid.<sup>85</sup>

Currently the risk of vibriosis is fairly low. The Washington State Public Health Laboratory, which routinely monitors oysters for the pathogens that cause vibriosis, detected *Vibrio vulnificus* bacteria in oysters in 2013.<sup>86</sup> However, this was only the second time the bacteria were found in Washington oysters since 2007. Furthermore, the only known cases of *V. vulnificus* infections in Washington residents were associated with travel to the Gulf Coast.<sup>87</sup> However, studies from around the world suggest that rising temperatures are increasing the number and geographical range of *V. vulnificus* and other *Vibrio* bacteria, leading to more illnesses worldwide.<sup>88</sup> In 2015, for example, Canada had its largest vibriosis outbreak from raw oysters on record. More than two-thirds of the cases were from oysters from British Columbia, where sea surface temperatures were approximately 1 to 8.5 °F warmer than usual for much of the first part of the year.<sup>89</sup>

Warming waters are also expected to extend the growing season for harmful algal blooms in Washington’s Puget Sound.<sup>90</sup> Harmful algal blooms form when some species of naturally occurring algae rapidly accumulate in bodies of water and produce toxins.<sup>91</sup> Higher ocean temperatures can speed up algal growth, promote the expansion of blooms into new areas or new times of the year, and even make some species of algae more toxic.<sup>92</sup>

In Washington, toxins from *Alexandrium* algal blooms can cause paralytic shellfish poisoning in people, leading to symptoms such as vomiting, seizures, and paralysis.<sup>93</sup> Death can occur just half an hour after eating highly contaminated seafood.<sup>94</sup> To protect the health of its residents, the state of Washington closes beaches where it is dangerous to harvest seafood.<sup>95</sup> By 2050, rising temperatures in Puget Sound could lead to an average of 30 more days each year with conditions favorable for *Alexandrium* blooms.<sup>96</sup> At the same time, a laboratory study from California suggests that the absorption of carbon pollution into the oceans could make *Alexandrium* algae more toxic.<sup>97</sup>

Toxic algae particularly threaten tribal communities in Washington for whom wild-caught shellfish is an important source of protein and an economic and cultural cornerstone.<sup>98</sup> A recent study of 60 Native Americans from coastal Washington found memory problems among frequent consumers of razor clams considered to have “safe” levels of the algal toxin that causes amnesiac shellfish poisoning.<sup>99</sup> Study participants who consumed high numbers of razor clams were about five times more likely to report “everyday memory” problems (e.g., forgetting to do a planned activity).<sup>100</sup> In 2015, the largest West Coast algal bloom on record forced the Washington Department of Health and the Quinault Indian Nation to close razor clam and Dungeness crab fisheries to keep people from getting sick.<sup>101</sup>

## CLIMATE CHANGE MAY REDUCE HEALTHY OUTDOOR OPPORTUNITIES FOR WASHINGTONIANS

Washingtonians spend an average of 56 days a year relaxing and playing outside, and demand for outdoor recreation facilities in the state is growing.<sup>102</sup> However, rising temperatures, reduced snowfall, more severe wildfires, worsening air and water quality, and other manifestations of climate change could reduce opportunities for safe and enjoyable outdoor recreation in Washington.<sup>103</sup> In August 2018, for example, some Washington parks were forced to cancel activities, and outdoor recreation businesses reported financial losses as people heeded warnings to stay inside to avoid wildfire smoke.<sup>104</sup>

Recreating in national parks, national forests, and other wild areas provides a host of physical and mental benefits, including improved heart and lung health and reduced psychological stress.<sup>105</sup> In nearby Oregon, for instance, adult participation in downhill skiing and snowboarding

in 2017 saved \$8.1 million to \$14.1 million in annual health costs, and day hiking saved \$33.2 million to \$45.6 million.<sup>106</sup> Reductions in outdoor physical activity could increase the risk of chronic diseases and worsen mental illnesses among some Washingtonians.<sup>107</sup>

In addition to making it more difficult and dangerous—or just less fun—for Washington residents to participate in outdoor activities, climate change will fundamentally alter the landscapes of some favorite recreation destinations. For instance, beetle infestations, which are made worse by rising temperatures and drought, kill and damage tens of thousands of acres of forest trees each year in Washington.<sup>108</sup> In 2018, high numbers of dying trees across parts of the state prompted worried calls from the public to the Washington Department of Natural Resources.<sup>109</sup> Climate-related losses of familiar landscapes that contribute to a sense of identity and cultural connection have the potential to harm the mental health and well-being of people in Washington.<sup>110</sup>

## ACTING ON CLIMATE CAN PROTECT OUR HEALTH

The good news is that slashing fossil fuel use and switching to cleaner energy will help limit the dangerous effects of climate change and protect our health.

### Progress to Date

From 2007 to 2015, Washington’s wind and solar power plants averted nearly 18 million metric tons of carbon dioxide emissions, equivalent to the emissions from passenger vehicles driven nearly 44 million miles.<sup>111</sup> These renewable power plants also averted more than 5,000 metric tons of sulfur dioxide (a dangerous air pollutant) and more than 14,000 metric tons of dangerous nitrogen oxides (key building blocks of smog and particle pollution).<sup>112</sup>

In 2008, the Washington legislature passed a law directing the state to cut climate changing pollution to 1990 levels by 2020, go 25 percent below 1990 levels by 2035, and reduce emissions to 50 percent below 1990 levels by 2050.<sup>113</sup> As of 2015, the most recent year for which data are available, Washington was not on track to meet its goals; total greenhouse gas emissions were 7.4 percent higher than 1990 levels.<sup>114</sup> Furthermore, the state’s own Department of Ecology has determined that existing emissions targets are not stringent enough to avoid the worst effects of climate change, recommending that the 2035 and 2050 reductions be strengthened to 40 and 80 percent below 1990 levels, respectively.<sup>115</sup>

Fortunately, the Washington legislature made significant strides to a safer climate future in April 2019 by passing a suite of bills that will eliminate coal-fired electricity generation, move the state to a 100 percent carbon-free electricity system by 2045, “maximize the full potential of energy efficiency” opportunities in new and existing buildings, and transition to more climate-friendly versions of gases used to cool buildings and appliances.<sup>116</sup>



### Next Steps on Reducing Carbon Pollution

The legislature did not, however, pass key bills that would have reduced the amount of carbon pollution in vehicle fuels and increased clean vehicle choices for consumers.<sup>117</sup> That's a problem, because transportation is Washington's largest source of climate changing pollution, accounting for more than 42 percent of emissions in 2015.<sup>118</sup>

In addition to passing clean transportation legislation, Washington should fully implement its updated long-range state transportation plan, which was issued in early 2018.<sup>119</sup> The plan contains strategies to reduce carbon pollution and ensure that existing transportation assets and services are prepared for climate extremes. For example, the Department of Transportation will work over the next 20 years to enhance the state's cleaner and car-free travel options (e.g., electric vehicles, public transit, and bicycle infrastructure), particularly for underserved populations like people living in rural areas. The plan could deliver numerous health benefits such as less traffic-related stress, improved response times by paramedics, better access to public health services, and better infant health and fewer premature deaths thanks to improved air quality and increased physical activity.<sup>120</sup> Improved air quality will be particularly beneficial to African-American and Asian Washingtonians, who are more likely to be exposed to tailpipe pollution due in part to historic patterns of housing discrimination.<sup>121</sup> In fact, in 2010 Washington had the sixth-worst disparity in the country in tailpipe pollution exposures between Asian residents and white residents and the tenth-worst disparity in tailpipe exposures between African-American residents and white residents.<sup>122</sup>

### Next Steps on Climate Adaptation

The state government and some Washington counties have started to prepare for the health impacts of climate change, which will only become more severe in the coming decades.<sup>123</sup> For example, the Washington State Department of Health partnered with the University of Washington Climate Impacts Group to study how climate change will impact health, and climate change was recently added to the mandate of the state's Office of Emergency Preparedness and Response.<sup>124</sup> The state also has a publicly available tracking network to monitor indicators of climate change such as heat-related hospitalizations and drought-prone areas.<sup>125</sup> The Department of Health should expand this monitoring network to include more metrics. It should also quickly develop a climate vulnerability assessment that combines data on socioeconomic and other health risk factors with information about the ability of communities, health providers, and key institutions to cope with future health consequences of climate threats.<sup>126</sup> Such an assessment will help the state make evidence-based choices about which climate impacts to emphasize in local climate preparedness plans and how to best help the people most vulnerable to those impacts.<sup>127</sup>

The bottom line is that Washington residents have much to gain from climate action—and lives to lose if we fail to cut our emissions and build resilience to the damage already being done.

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