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# The Health Benefits of Climate Change Mitigation in Washington State

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## **Executive Summary**

Climate change is affecting people in Washington State now. From sea-level rise to increasing temperatures and more severe wildfires, these changes pose significant health and safety threats to our communities. In order to avoid global temperatures rising above 2 degrees Celsius and significantly worse impacts due to climate change, current models confirm the need to cut greenhouse gas (GHG) emissions in half by 2030, and to achieve net-zero emissions by the year 2050.

The good news about taking action to mitigate climate change is that the same policies that reduce carbon emissions can provide *immediate* and significant health benefits. Active transportation, reducing air pollution from transportation and energy production, greening our public spaces, prioritizing plant-based foods, and utilizing passive cooling methods are both good for our health *and* good for our climate. What's more, *any* reduction in emissions yields health benefits because it helps reduce climate change and its related harmful impacts on health. In an era where climate science is continually questioned, the cost savings and health benefits of climate change mitigation offer powerful justification for policy change.

As health professionals, we urge meaningful action to reduce climate-warming pollution as a health benefit at the local, state, and federal levels.

We believe Washington State must enact policies that do the following:

### **1. Promote clean, renewable energy over fossil fuels**

- Transition to a clean, renewable energy economy that supports workers and communities that are disproportionately impacted by pollution and climate change
- Promote incentives to speed this transition, already in progress
- Limit new and expanded coal, oil, and gas projects, including export terminals, refineries, storage facilities, pipelines, and rail infrastructure
- Tax health-harming carbon pollution from greenhouse gas emissions

***The health benefit:*** Reduction of harmful air pollution generated from burning fossil fuels, improved respiratory and cardiovascular health, and reduced premature deaths

### **2. Incentivize active transportation and reduce transportation pollution**

- Prioritize walking and cycling with appropriate and safe infrastructure
- Prioritize expanded and equitable public transit access
- Reduce the carbon-intensity of fuels through a clean fuel standard
- Implement congestion pricing to reflect the true cost of emissions associated with vehicle transportation
- Encourage vehicle electrification

***The health benefit:*** Promotion of physical activity and cardiovascular and mental health, reduction of risk of diabetes and obesity, decreased pollution from vehicles

### **3. Promote “Green” public spaces**

- Encourage parks, greenways, and other open spaces and green infrastructure in urban land use planning
- Ensure that dense, urban communities have adequate green public space
- Ensure that people at all income levels have sufficient access to safe green public space

***The health benefit:*** Increased life expectancy, improved respiratory health, and positive mental health and cognitive benefits

#### **4. Promote a diet rich in plant-based whole foods and reduce food waste**

- Support public campaigns to encourage plant-based food choices as a public health opportunity
- Encourage organizations and institutions to offer more plant-based meals and whole foods in addition to animal protein, and in place of highly processed, sweetened foods
- Engage communities and organizations in targeted food waste reduction efforts

**The health benefit:** Lower risk of heart disease, diabetes, cancer and obesity; reduced carbon and methane emissions and degradation of certain natural ecosystems for conversion to agricultural use

#### **5. Promote and Subsidize Passive Cooling**

- Reduce energy consumption
- Increase the use of renewable energy
- Reduce local indoor and outdoor air temperature - such as urban heat islands

**The health benefit:** Reduced exposure to extreme temperatures, promotion of thermoregulatory acclimatization, reduced risk and impacts of blackouts during extreme heat events

## **Section I: Health Co-Benefits Defined**

With worsening wildfires, more frequent extreme weather events, and rising temperatures, and sea levels, the negative long-term consequences of our current climate crisis - globally and in Washington state - are clear. This paper seeks to consider what is possible *today* when we reframe efforts to reduce greenhouse gas pollution – often termed “mitigation” – in order to prevent, or at least slow, these adverse effects. “Mitigation refers to efforts to reduce or prevent the emission of greenhouse gases, or to enhance the absorption of gases already emitted, thus limiting the magnitude of future warming,” according to the Intergovernmental Panel on Climate Change.

As health professionals, we began this paper in an effort to explore the tangible, immediate benefits of actions taken to mitigate climate change. We know there will be future benefits to health and wellbeing, but what might be the *immediate* health benefits of taking these actions?

Co-benefits refer to the ancillary, positive outcomes from actions that reduce the pollutants that lead to climate change. These co-benefits can be realized immediately, which could be a powerful driver for taking action sooner rather than later. They range from increased energy independence and green jobs, to improved individual and public health. Policies designed to limit global warming to 2°C could prevent the 197,000 premature deaths attributed nationwide each year to US air pollution from combustion emissions (Caiazzo, et al., 2013), simply due to the health benefits of breathing cleaner air.

If that seems astounding, consider the primary sources of greenhouse gas emissions in Washington: tailpipe emissions, which not only emit climate-warming gases but also emit air pollutants. A reduction in personal car use could lead to greater physical activity, resulting in better health, reduced air pollution, *and* lower greenhouse gas emissions.

Research on the health co-benefits of climate change mitigation is a burgeoning field. We are excited to add our voice to this emerging conversation, with specific focus on Washington state.

## **Section II. Health Impacts of Air Pollution, Unhealthy Diets, and Inactivity**

Acknowledging the negative impacts of air pollution, physical inactivity, and poor diet is essential to understanding the value of co-benefits. To achieve and maintain good health, the primary recommendations given to the vast majority of individuals are to exercise more and make healthier food choices. In addition to these individual behaviors, health professionals recognize that proximity to air pollution can cause and exacerbate a variety of serious negative health outcomes, including heart attacks, asthma, and premature death.

### **Vulnerable Communities and Unequal Impacts**

People of color and low-income communities are disproportionately exposed to pollution and these health burdens, both nationally and here in Washington. A [study published in the medical journal \*The Lancet\*](#) found that life expectancy in King County varied nearly two decades by neighborhood between 1990 and 2014, highlighting severe geographic inequity in health outcomes driven by race and class (Dwyer-Lingren, et al., 2015). The leading causes of years of lost life – ischaemic heart disease and tracheal, bronchus, and lung cancer – all have been shown to connect directly to air pollution, physical activity, and diet. A 2019 collaboration between the Washington Department of Health, University of Washington, and Front & Centered [mapped environmental health disparities in Washington](#). Their findings confirm that low-income and communities of color are often most unfairly impacted by air pollution and other environmental health disparities.

### **Air Pollution's Impact on Health**

Outdoor air pollution [kills 4.2 million people annually](#) (WHO, 2019). Inhalation of particles emitted by the transportation sector and both industrial and residential energy use cause and exacerbate heart attacks, asthma, and premature death. Coal-burning pollutants have been shown to [multiply risk of death](#) from heart disease five times as much as other air pollutants (Betts, 2011). The process of [extracting natural gas](#) through hydraulic fracturing, also called fracking, releases toxic gases including proven carcinogens and known toxicants to the nervous system (Gottlieb, et al., 2017).

In Washington State, more than a third of residents have at least one medical condition exacerbated by air pollution from vehicles. The Washington State Department of Ecology estimated that pollution from PM<sub>2.5</sub> (small particulate matter that enters our air through the burning of fossil fuels) [caused 1,100 premature deaths in 2009 in our state alone](#). Annual effects also included 1,500 nonfatal heart attacks, 1,900 incidents of acute bronchitis, and thousands of worsened asthma cases. The Department additionally estimated the direct and indirect costs of these diseases to be nearly \$190 million a year (Department of Ecology, 2009).

Some of Washington's cities and counties are among the country's most polluted. In 2017, The American Lung Association [recognized](#) Yakima as the 16th most polluted city for short-term particulate pollution, with the Seattle-Tacoma metro area at 17th. King, Pierce, Clark, Yakima, and Snohomish counties received failing grades for particulate pollution in 2016, which is exacerbated by burning fossil fuels (American Lung, 2016). Researchers looking at future

climate change impacts found that air pollution, due to wildfire smoke, will get significantly worse in Washington if rapid action is not taken (Liu, 2016).

### **Diet (*Eating the Planet, or Eating for the Planet?*)**

The Global Burden of Disease Study 2010 reported that dietary risk factors and physical inactivity together accounted for 10% of global DALYs, a combined measurement of years lived with disability and years of life lost (Lim et al., 2012). These two lifestyle factors play an important role in climate change.

One of the best dietary changes a person can adopt for improved health is a reduction in consumption of animal products, especially red meat. High-meat diets tend to be lower in fruits and vegetables, and they are associated with many chronic health problems. Concomitant with the increase in meat consumption worldwide, chronic disease has likewise surged in recent years. This includes more cancer, cardiovascular disease, stroke, obesity, and type II diabetes. For all of these diseases, research suggests that a diet rich in fruits and vegetables is protective, while a high-meat diet elevates risk. The CDC reports that [36.6% of adults](#) in Washington State eat less than one serving of fruits and vegetables a day, compared to the recommended 7-9 servings (CDC, 2017). [For more information on the co-benefits of a healthy diet, see Section VI. Health Co-Benefits of Lower-Carbon Food Choices]

### **Physical (In)activity**

While diet is paramount, adequate physical activity is also an essential contributor to good health. Lifestyles across the globe are becoming increasingly sedentary as urban centers grow, bringing more motorized transportation, less walking, and work that is less active. Coupled with the rise in consumption of meat and other high-fat foods, physical inactivity has led to skyrocketing overweight and obesity rates. Being overweight [raises the risk](#) of heart disease and stroke, type II diabetes, osteoarthritis, and some cancers (WHO, 2017). According to the [World Health Organization](#), an estimated 1.9 million deaths each year worldwide result from cardiovascular disease, cancer and diabetes due simply to physical inactivity (WHO, 2005).

Although Washington State outperforms [other states](#) in meeting or exceeding the Center for Disease Control's [recommendation](#) of physical activity (150 minutes of moderate activity per week), 48% of adults here do not meet these essential health targets (CDC, 2017).

### **Not Just an Issue of Lifestyle, an Issue of (in)Justice**

People of color and low-income communities face disproportionate impacts of high-fat diets and inactivity, such as acute and chronic diseases. These impacts are the result of generations of systematic marginalization, stigmatization, and oppressive policies that have resulted in food deserts, lack of access to traditional foods, lack of access to green space, lack of access to preventative care and treatment, neighborhoods unconducive to active transport and exercise, less personal time to exercise or cook healthy meals, and less overall autonomy in one's life.



### **Section III: Health Benefits of Reducing Transportation-Related GHG Emissions**

While fossil fuel-based transportation has long delivered many important societal benefits, such as ready access to goods and services that are key to our economy and overall well-being, it also has come to result in degraded health for large numbers of people, due to the unhealthy emissions generated by fossil fuel combustion across the transportation sector. The transportation sector as a whole accounts for 23% of global energy-related greenhouse gas emissions and 26% of emissions in the United States. Of that, land transportation energy consumption accounts for 80% of transportation-sector emissions worldwide and is growing more rapidly than any other sector (Metz, 2017). In Washington, the proportion of emissions from transport – typically reliant on petroleum products such as gasoline and diesel – is much higher, accounting for approximately 40% of in-state greenhouse gas emissions (Department of Ecology, 2012).

Policies aimed at increasing public transportation and active transportation, usually in the form of urban walking and cycling, may be the most important immediate steps to mitigate climate change given the direct co-benefits from reducing pollution and increasing physical activity (Patz, 2014). Reducing the carbon-intensity of transportation fuels has also [proven an effective strategy to reduce emissions and harmful air pollution](#) (O'Connor et al., 2014). Strategies driving the shift toward active transport have been deemed by the World Health Organization as higher impact in terms of co-benefits and more cost-effective in terms of reducing greenhouse gas emissions than strategies primarily focused on fuel efficiency (WHO, 2017). While physical inactivity is a global problem contributing to millions of annual deaths, outdoor air pollution [kills 4.2 million people annually](#). Potential lives saved globally from changes in transportation policy are a staggering 5.9 million annually (WHO, 2017; Patz, 2014).

#### **Increased Physical Activity via Active and Public Transportation**

Despite general public knowledge of the important health benefits of regular exercise, the physical activity level of the average American continues to decline, in large part due to a continued drop in occupational and transportation-related activity (Ng et al., 2012). Daytime sedentary hours correlate with adverse health, even in people who meet guidelines for moderate to vigorous recreational activity (Biswas et al., 2015). Physical inactivity is a risk factor for many chronic diseases and [contributes to 3.2 million deaths annually](#) in the United States (Lim et al., 2012). Policies that promote active transport may increase overall active hours and therefore have a beneficial impact on the risk of obesity, diabetes, cardiovascular disease and overall mortality (Patz, 2014).

Use of public transportation not only reduces emissions from single-occupancy vehicles, but also promotes physical activity - commuters need to get from their homes to bus stops and transport stations, and from bus stops and stations to their workplaces. Greater use of public transportation increases the proportion of the population who is sufficiently active to realize health benefits (Besser and Dannenberg, 2005).

Active transportation – commuting by walking or cycling – has been found to [reduce the risk of cardiovascular disease](#), cancer and overall mortality (Morales et al., 2012). Other studies have shown an association of active commuting with reductions in colon cancer and cardiovascular

disease (Hamer et al., 2008). US cities with the highest level of active transport have [20% lower prevalence of obesity and 23% lower prevalence of diabetes](#) when compared to those with the lowest level of active transport (Pucher et al., 2010). Additional benefits of shifting to active transport include reduced traffic-related injury and noise stress (WHO, 2017). Significant reductions in mortality are achieved by increased active transport even after accounting for the potential for injury. These reductions in illness and mortality also generate significant cost savings (Chang, 2014; Macmillian, 2017).

## Reducing Pollution

The adverse health consequences of exposure to air pollution are well documented (Di et al., 2017; Brook, 2010), with small particulate matter (PM<sub>2.5</sub>) being particularly damaging (Di et al., 2017; Wang et al., 2016). Transportation-related emissions account for a large portion of the basal and peak urban levels of PM<sub>2.5</sub> (WHO). A 2017 study showed that PM<sub>2.5</sub> exposures well below the US National Ambient Air quality standards [have an adverse effect on mortality](#) in the population over 65 years of age (Di et al., 2017). The risk is dose-dependent and linearly related to intensity and duration of exposure (Brook et al., 2010). Adverse effects of air pollution on mortality appear to be additive, affecting lower income populations more adversely for any given level of exposure (Di et al., 2017).

While reduction of greenhouse gas emissions will be associated with a reduction in other air pollutants in all sectors of the economy, the land transport sector is particularly attractive for co-benefits. Pollution tends to occur most where people are concentrated. Between now and mid-century, the health co-benefits and cost savings associated with reduction in fine particulate matter are greater than that for CO<sub>2</sub> (Chang, 2014; Selin et al., 2009; Garcia-Mendez et al., 2015). The cost savings estimates from improved air quality range from \$2 to \$380 per ton of CO<sub>2</sub> (Chang, 2014). Considering that Washington State emitted [94.4 million metric tons of CO<sub>2</sub> equivalent](#) in 2013, those savings could be quantified well into the billions (Department of Ecology, 2013).

Policies that reduce the carbon intensity of transportation fuels are one important option to address transportation pollution. In California, a Low Carbon Fuel Standard policy is expected to contribute to over \$8 billion of healthcare cost savings due to its air quality benefits by 2025 (O'Connor et al., 2014). Washington State is poised to consider a Clean Fuel Standard in the 2020 legislative session, and the Puget Sound Clean Air Agency (PSCAA) is considering a regional rule for its four-county jurisdiction. In an [analysis of the rule's projected impacts](#), PSCAA found that the clean fuel standard would save \$45 million in avoided mortality incidence. This estimate is likely conservative and does not account for total healthcare cost savings; PSCAA's analysis focused only on particulate matter and did not consider other pollutants such as nitrogen oxides or volatile organic compounds. Additionally, it only assessed human mortality due to the cardiovascular impacts of particulates (ICF, 2019).

## Policy Recommendations

Improving walkability, bicycle-friendliness, and public transit access offer the greatest potential immediate co-benefits relative to other climate change mitigation policies (Dannenberg et al., 2011). These policies would also need to be accompanied by actions that make driving less attractive. Safe bike lanes, bike share programs, pedestrian bridges, and increased bus and rail

density must be accompanied by increased fuel cost via putting a price on carbon pollution. To see the greatest benefit from these changes, they should be focused on communities historically excluded from public investment, such as low-income communities and communities of color.

Seattle is one of the few major cities in the US to offer reduced public transit fares for low-income residents, one of the factors contributing to a [steady growth in the city's transit ridership](#). To further increase access and utilization of public transportation across the state, Washington communities should look to adopt a similar equitable transit fare system in their local jurisdiction.

While the biggest benefits accrue to those who get around without automobiles, policies that encourage cleaner fuels, electric and fuel-efficient vehicles will reduce both toxic pollutants and greenhouse gases while complementing public transport and active transport policies. Fuel-efficient vehicles can be promoted by establishing regulatory emissions standards and by offering tax rebates for their purchase. Congestion charges and other modified vehicle pricing mechanisms have also been [correlated with improved health outcomes](#) from reduced vehicle use (Shaw et al., 2013).

Since few prospective studies of transport policy on climate-related health exist (Haines, 2017; Shaw et al., 2013; Chang, 2014), any new policy should be evaluated for effects on both CO<sub>2</sub> emissions and health co-benefits (including improved air quality and increased physical activity). Lessons from such prospective evaluations should then inform decisions on future climate mitigation policies.

### **Actions for Health Care Providers**

Healthcare providers should already be advising their patients to engage in regular physical activity for the prevention of heart and vascular disease, obesity, and diabetes. However, many healthcare providers, and therefore most of their patients, could benefit from greater awareness of the adverse impacts of air pollution on health. This should be a normal part of discussions between clinicians and patients during every health maintenance visit. The additional benefits of active commuting - in terms of reducing immediate air pollution and long-term climate effects via CO<sub>2</sub> emissions reductions - add weight to the argument to get out of the car and onto a bike, the sidewalk or public transport.

#### **IV. Health Benefits of Renewable Energy**

Increasing the use of renewable energy sources for electricity, including solar and wind technology, carries profound climate and public health benefits. Fossil fuel infrastructure used for electricity production – often from coal and natural gas – generates health-harming air pollution and carries the risk of environmental contamination, explosions and fires.

In the US, pollution from fossil fuel-based electricity generation has been found to [cause 52,000 premature deaths annually](#) (Barret et al., 2015). It is worth acknowledging that these studies omitted hydroelectric generation, a major source of Washington State's electricity. Some studies on the health impacts of fossil fuel-based electricity have also suggested links between exposure to these types of pollutants and neurological disorders including autism and Alzheimer's disease (Jung et al., 2015; Cacciottolo et al., 2016). Studies have shown that thousands of lives can be saved per year through reduction of fossil fuel-fired electricity generating units (Levi et al., 2016). Moving away from coal and gas and towards solar and wind technology offers a tangible step towards both reducing emissions and bettering air quality.

Fortunately, according to the US Department of Energy, Washington is [currently at 92.5% renewable energy](#) production. In 2019, Washington became one of the first states to commit to a clean energy transition when a bill passed in the legislature required utilities to be carbon-neutral by 2030 and to use only clean power sources by 2045. However, recent proposals to expand natural gas infrastructure, including Puget Sound Energy's liquefied natural gas (LNG) project in Tacoma, are concerning to health professionals. These facilities threaten the state's climate progress and [create health and safety risks](#) due to the high volatility of natural gas (Kullberg et al, 2019).

#### **Cardiovascular and Respiratory Health**

The burning of fossil fuels for electricity production emits air pollutants including fine particulate matter (PM<sub>2.5</sub>), nitrogen oxides (NO<sub>x</sub>), volatile organic compounds (VOCs), and sulfur dioxide (SO<sub>2</sub>). Reducing GHG such as black carbon emitted from gas and diesel engines and black carbon plus methane from coal-fired power plants could have immediate benefits for local air quality and long-term co-benefits for human health; both are detrimental to air quality and have a shorter atmospheric lifetime than carbon dioxide. The health effects of exposure to these pollutants include asthma, respiratory disease, and heart attacks. These particles can go deep into the lungs, exacerbating and causing respiratory and cardiovascular ailments and even contributing to premature death.

A 2015 study linking the Clean Power Plan (a strategy for reducing electricity generated nationwide from coal) to a reduction in premature death found that its resulting reduction in carbon pollution by 32% from 2005 levels would [save 3,600 lives per year](#) (Buonocore et al., 2015). In 2016, a Harvard study of the health co-benefits of a carbon pricing initiative in Massachusetts showed that, between 2017 and 2040, reduction in fossil fuel-based electricity production would result in fewer hospitalizations for cardiovascular and respiratory health, [saving 340 lives over that time period](#). In total, the study valued these health benefits at \$2.9 billion per year in Massachusetts (Buonocore et al., 2016).

Other studies have demonstrated the tangible health benefits of solar energy. A recent examination of the US Department of Energy’s SunShot Initiative, which promotes solar electricity generation targets of 14% of total electricity by 2030 and 27% by 2050, found that achieving the Initiative’s goals would eliminate between 25,000 and 59,000 premature deaths in the United States between 2015 and 2050. The [study](#) additionally quantified health cost savings during that period at \$167 billion (Wiser et al., 2016).

Another study found that achieving the solar energy generation goals set forth in the SunShot Initiative could save up to 437 lives per year by 2030. It additionally found that 348,787 minor restricted activity days, when air quality advisories keep children inside, could be eliminated per year due to improved air quality (Wiser et al., 2016).

## **Policy Recommendations**

Washington is emerging as a national leader in clean, renewable energy policies. While WAstate’s current clean energy mix is strong, natural gas expansion presents a more urgent threat and health opportunity. Proposals for a fracked gas-to methanol refinery in Kalama, WA, and the LNG project in Tacoma will significantly raise Washington’s emissions; a 2018 study found that the Kalama plant’s emissions would be equivalent to adding 260,000 cars on the road. Policies that require a more accurate assessment of true climate impact of methane are essential.

Additionally, local and state policies can help reduce fossil fuel use in buildings by promoting efficiency and limiting new natural gas infrastructure. Buildings account for 27% of Washington’s greenhouse gas emissions. An important Clean Buildings policy passed in the 2019 legislature is creating efficiency incentives, a strong energy performance standard, and requiring gas utilities to set targets for energy efficiency. Cities and counties are considering following the leadership of Berkeley, CA, and preventing new natural gas hookups. Doing so can reduce harmful air toxicants from gas stoves in homes and further reduce demand for fracked gas.

On a global and national level, policies encouraging a transition to clean, renewable energy offer examples of clear strategies to support the significant health co-benefits of moving away from fossil fuels. While global and national policies, including the Paris Climate Accord and the US Clean Power Plan, encourage broad and meaningful reductions in greenhouse gas emissions, state-level efforts to price and cap carbon emissions from electricity generation offer an increasingly useful means of moving forward amidst inaction on climate from the US federal government.

## **Actions for Healthcare Providers**

While switching to renewable sources of energy for electricity would be the best way to protect health in the long term, there is a need to reduce exposure to harmful pollution now. The voice of healthcare professionals carries significant credibility. As Washington state continues to see proposals for fossil fuel export and transport facilities – including coal, oil, liquified natural gas, and toxic petrochemicals – health professionals can have significant impact in halting these types of harmful projects.

Hospitals and health care systems can set an example by reducing their fossil fuel consumption through efficiency improvements and by purchasing clean power. The healthcare sector creates 8% of total commercial building sector greenhouse gas emissions in the US. [Research from the Healthcare Climate Council](#) found that a 30% reduction in the sector's carbon pollution from electricity consumption would prevent 4,130 premature deaths, 85,000 asthma attacks, and save \$1.2 billion in health costs from reduced greenhouse gas emissions by 2030 (Climate Council, 2017). In Washington, hospitals such as Harborview Medical Center and Seattle Children's Hospital have prioritized these co-benefits by [installing solar panels](#) and electric vehicle charging stations.

## **Section V: Health Benefits of Increasing Carbon Sequestration in Plants and Green Spaces**

Increases in urban green space and improved land conservation have been shown to result in a number of health benefits while contributing to lowered greenhouse gas emissions. These health benefits include reduced temperature and heat island effect, reduced noise, enhanced safety, psychological benefits, and better self-perceived health status (IPCC, 2013). A World Health Organization review of urban green spaces cited studies that [showed a decrease in mortality](#) related to higher residential “greenness” (Egorov et al., 2016).

### **Physical Activity and Health**

Urban and rural land use planning that promotes green spaces has been shown to influence physical activity, a key factor in health. One international study found that a number of environmental attributes were significantly, positively, and linearly related to physical activity: net residential density, intersection density, public transit density and number of parks. Urban environments designed to promote transit access and green space are associated with increased physical activity, with similar findings in many different cities (Sallis et al., 2016). A study that compared indoor treadmills to outdoor mountain hiking found that the outdoor hiking felt less strenuous to people and raised mood scores (Niedermeier et al., 2017). For youth in urban areas, access to a safe park was positively associated with regular physical activity (Babey et al., 2008).

### **Mental Health, Cognitive, and Social Benefits**

Some studies have shown mental health is better in greener urban areas. [One recent study](#) showed that mental health improved within a year of a move to a greener area and the benefits persisted for at least 2 more years (Alcock et al., 2014). Green space has also been shown to have a buffering effect on stress. Participants with a high amount of green space nearby were less affected by a stressful life event than those with a low amount (Van den Berg et al., 2010).

Exposure to natural features can reduce exposure to negative conditions such as traffic and overcrowding. Nature can help people restore their adaptive resources. Studies report a strong restorative advantage of nature. Community gardening additionally has social benefits, as it brings people into contact with nature and with community members (Hartig et al., 2014). The WHO has similarly noted that [green spaces foster social interactions and a sense of community](#). It also described benefits of natural environments in reducing noise pollution and in production of natural sounds (WHO, 2016).

Being in nature has also been shown to enhance attention (Hartig et al., 2014). Some studies cited by the WHO showed cognitive development benefits for children. Vitamin D levels, which can be low in northern countries, can be positively affected by time outdoors. Exposure to natural light can normalize circadian rhythms, and some studies show that access to natural environments reduces the prevalence of insufficient sleep (Egorov et al., 2016).

### **Heat Stress, Air Quality, and Other Benefits**

While there are many demonstrated benefits of urban green space, the presence of trees and vegetation in landscapes can yield both positive and negative impacts on air quality and health. It is important to note that some trees and plants release pollen, aggravating allergies. On the other hand, trees improve air quality indirectly when they cool urban environments via evapotranspiration, and reduce building energy demands (Hartig et al., 2014).

Some studies described by the WHO review of green spaces and mental health have noted that visiting forests is linked to beneficial immune responses. Another recent review (Braubach et al., 2017) has additional references on beneficial immune responses. Reduced cardiovascular morbidity, beneficial health outcomes to pregnant mothers, and reduced prevalence of type 2 diabetes have been found in a number of studies. A systematic review indicated a reduction of risk of cardiovascular disease in areas with higher greenness (Egorov et al., 2016).

### **Policy Recommendations**

Policies that encourage both urban green spaces and careful conservation and land management can help realize a range of important health benefits. Local communities can improve and expand public parks, especially in areas without access to green spaces. Land use and planning should encourage green spaces even in dense urban areas, and should prioritize walking, bicycling and accessible public transit.

Land conservation, investments in forest health, and supporting agricultural practices that sequester carbon and manage soil health are additionally important to mitigate emissions. Healthy forests provide important recreational opportunities linked to mental health benefits, and a robust agricultural economy can support stable rural communities and provide healthy food to a broader population.

### **Actions for Healthcare Providers**

Providers can give patients a “green prescription”, advising them to get outside for physical activity and to participate in programs for walking and physical activity. They can discuss barriers to outside activities, such as safety concerns, time, and weather. Activities done in a social context – such as gardening, walking with others, and sports programs – can be especially reinforcing.



## **Section VI. Health Benefits of Lower-Carbon Food Choices**

The current nutritional status of our earth's population includes over 820 million living without sufficient food on a daily basis, and 2.1 billion people who are overweight or obese (WHO, 2018). Climate change adaptations for agriculture must consider not only the footprint of feeding an estimated 10 billion people on earth by the year 2050, but also dietary patterns that promote population health rather than increase risk of disease.

Newer research suggests that we not only have to consider adapting agricultural practices and technologies to reduce emissions and feed a significantly larger population of people; we will also have to take into account how rising atmospheric CO<sub>2</sub> is impacting the nutritional value of our food. One recent discovery is that higher CO<sub>2</sub> speeds up plant photosynthesis, resulting in higher concentrations of carbohydrates like glucose and lower levels of other nutrients like protein, iron, and zinc (Myers et al., 2014 and Zhu et al., 2018).

The [Lancet EAT Commission](#) report in January 2019 offers agricultural guidelines for food consumption-based mitigation. In summary it argues, "Food is the single strongest lever to optimize human health and sustainability on earth." (Willet et al., 2019). Specific guidelines offered by the Lancet EAT commission call for increasing consumption of healthy plant-based foods such as fruits, vegetables, legumes, and nuts by more than 50%, and reducing consumption of less healthy foods like added sugar and red meat by over 50%. Shifts toward this more sustainable, plant-based diet could help avert an astounding 10.8-11.6 million deaths per year (Willet, et al., 2019).

### **Health and Environmental Impacts of Animal Agriculture, Consumption**

Twenty-four percent of global agricultural-related greenhouse gas (GHG) emissions come from livestock (including meat, milk, and eggs) (IPCC, 2018). Although these foods offer high amounts of protein and other nutritional value, livestock production is significantly more energy-intensive than plant-based agriculture. The average GHG impact of 50 grams of protein from beef is approximately 17.7kg CO<sub>2</sub>; from poultry is approximately 2.9kg CO<sub>2</sub>; and from beans is approximately 0.4kg CO<sub>2</sub> (Poore and Nemecek, 2018).

Life cycle assessments demonstrate that lamb, beef, cheese, and pork have the highest GHG emissions during production, largely because of the methane that is generated during their digestive process (enteric fermentation) – as well as the deforestation required to provide new land for grazing animals. Methane is 25 times more potent than carbon dioxide, and animal manure releases these emissions in concentrated amounts. In 2007, US livestock released approximately 500 million tons of manure a year, estimated at three times the amount produced by humans in the US. Livestock manure is the [fastest growing source of methane](#), increasing by 60% from 1990 to 2008 (FAO, 2009).

Numerous studies have expanded our understanding of the inextricable link between nutrition and health. Diets high in plant-based foods and lower in animal products, particularly processed meat, have been [associated with lower risk of obesity, diabetes, and some forms of cancer](#) (Wang et al., 2014; Boeing et al., 2012). In 2017 the American Heart Association (AHA) released an [advisory](#) summarizing research on the impact of diet on cardiovascular disease. Its conclusion was that lowering intake of saturated fat (higher in animal products such as red

meat, full fat dairy, and butter plus tropical oils like coconut and palm oil) and replacing these with unsaturated fats (higher in nuts, seeds, avocado, and olive oil) helped reduce Cardiovascular Disease (CVD) by approximately 30%, similar in efficacy to taking a statin drug (Sacks et al., 2017). A recent Lancet study (Afshin, et al., 2019) found that unhealthy diets (lower in whole grains, fruits, vegetables, nuts, and seeds; higher in unhealthy fats, processed meats, salt, and sugar) are “a larger determinant of ill health than either tobacco or high blood pressure”. It also estimated that one in five deaths worldwide (approximately 11 million) each year are associated with poor diet.

Global meat production [tripled from 1971 to 2010](#), while the world’s population grew by around 81% (US Census Bureau, 2011). Americans consume 60% more meat than Europeans (FAO, 2009). While increasing animal products in the diet has been a rising trend over the past decade – with the prevalence of Atkins and “Paleo” diets promoting higher consumption of animal-based saturated fat – research consistently shows that higher intake of red meat and animal-based fat is [associated with higher incidence of CVD and diabetes](#) (Micha et al., 2010).

Underlying these trends is the compounding issue of higher federal subsidies to support the meat and dairy industries. The U.S. government spends \$38 billion annually to subsidize these industries, 63% of all federal food subsidies. Meanwhile they spend a mere \$17 million (a mere 0.04%) to subsidize fruits and vegetables (USDA, 2019). A JAMA publication sought to quantify health impacts associated with consumption levels of various subsidized foods. Their findings suggest those who ate the most subsidized foods, compared with the lowest, were 37% more likely to be obese, 41% more likely to have abdominal adiposity (belly fat), 34% more likely to have elevated C-reactive protein, 14% more likely to have high cholesterol, and 21% more likely to have abnormal blood glucose levels (Siegel et al., 2016).

Concerted individual and policy efforts to reduce consumption of resource-intensive, unhealthy, and highly-processed foods while boosting efforts to support the consumption of nutrient-rich, plant-based whole foods suggest enormous co-benefit potential not only to significantly reduce global GHG emissions, but to reduce mortality and prevent disease across the lifespan.

### **Reducing Palm Oil and Sugarcane Consumption: Beneficial for Environment and Human Health**

The consumption of palm oil continues to increase due to a growing demand for these ingredients, even when their production contributes significantly to environmental degradation and deforestation globally. According to [USDA data](#), US imports of palm oil more than doubled between 2005 and 2012, with the US importing 2.7 billion pounds in 2017 (USDA, 2017). Much of the imported palm oil ends up in snack foods such as cookies, crackers and microwave popcorn, or is mixed with other oils, such as canola, soy or coconut, before being added to food products.

Palm oil is high in saturated fat. Higher consumption of saturated fat has been associated with an increase in LDL or “bad” cholesterol and triglycerides, both of which have been linked to cardiovascular disease. The totality of scientific research to date suggests that lowering saturated fat in the diet and replacing it with unsaturated fats, particularly polyunsaturated fat (e.g., walnuts, chia seeds, salmon) will [help lower the incidence of cardiovascular disease](#) (Sacks et al., 2017).

The mass production of palm oil has led to devastating deforestation of massive areas of tropical rainforest to accommodate palm plantations. A 2015 analysis found that limiting expansion of new palm oil plantations to areas without forests could reduce GHG emissions in Indonesia by as much as 60% (Austin et al., 2015).

The processed foods manufactured with palm oil often contain high quantities of added sugar. Today in the US, over 75% of foods have some form of sugar added during processing. Not only does consuming added sugar trigger dopamine reward centers of the brain, resulting in heightened physiological desire for more sugar after consumption; added sugar offers no nutritional value and is considered to be “empty calories”. Excess intake of added sugar has been linked with a number of adverse health effects including non-alcoholic fatty liver disease, weight gain, diabetes, and cardiovascular disease (Schulze et al., 2004).

In conclusion, reducing the consumption of processed foods that contain palm oil and added sugar may confer numerous protective health benefits while simultaneously reducing the significant environmental footprint from deforestation.

### **Health Benefits of Increasing Plant-based Protein, Whole Foods in the Diet**

Increasing the consumption of plant-based foods such as fruits, vegetables, nuts, seeds, and whole grains increases phytonutrients and fiber in the diet while reducing animal-based fat, offering numerous benefits to human health and environment. Chickpeas, beans, peas, and lentils are a rich source of plant-based protein and soluble fiber. Studies show that consuming these foods alone or in combination with a high fiber diet [improves a number of health outcomes](#), including markers of glycemic health and lipids (Zhou et al., 2014; Ha et. al., 2014).

Several large studies have also demonstrated that those consuming a diet lower in meat and higher in vegetables and fruit tend to have a significantly lower body mass index. This may be due in part because plant-based diets are high in fiber not found in animal products. Fiber in the diet, particularly soluble fiber, increases satiety and confers benefits for blood sugar and cholesterol (Wang et al., 2014).

Studies have also conferred economic benefits inherent in plant-based versus meat-based diets. One study compared the cost of a plant-based diet with olive oil to the USDA “MyPlate” (a combination of vegetables, fruits, whole grains, both animal and plant-based proteins, and dairy) and found that the incorporation of animal protein in MyPlate costs \$746.46 more per year than a plant-based diet. Additionally, climate change economists estimate that combined health and environmental benefits of shifting to a more plant-based diet globally could be [anywhere from one to 31 trillion US dollars](#) by the year 2050 (Springman et al., 2015).

### **Reducing Food Waste – Can We Measure Co-Benefits?**

The benefits of reducing food waste has diverged into two thought arenas as it applies to climate mitigation: 1) increasing efficiencies in our agricultural and food delivery systems can reduce overall food waste during production and divert landfill waste and its associated GHG

emissions, and 2) reducing the overconsumption of calories as a form of food waste by the consumer may reduce the risk of obesity and associated adverse health risks.

An estimated one-third of global food produced is unconsumed, and economic models estimate that a 20-50% reduction global in food waste by 2030 could [save US \\$120-\\$300 billion per year](#) (Alexander et al., 2017). About 40% of all food produced in the US is wasted and ends up in landfills where it contributes to GHG emissions. The majority of food wasted from the production end occurs because food is not consumed before its expiration date, resulting in mass amounts of food being discarded in waste systems, some of it being repurposed for animal feed or other uses. The estimated GHG emissions associated with food waste alone, not including emissions for land use change, is approximately 3.3 gigatons of CO<sub>2</sub> equivalent annually. If global food waste were to be calculated as a country, it would be the third largest emitter of GHG after the US and China (FAO, 2013; WRAP, 2015). The Sustainable Development Goals (SDG) outlined by the Paris Climate Agreement target a 50% reduction in food waste by the year 2050.

Global food production utilizes about 40% of land on earth (Vermeulen et al., 2012) and 70% of freshwater (Steffent, et al., 2015). Addressing the overproduction of food beyond the needs of the population, and reducing the overconsumption of calories beyond nutritional needs (particularly less healthy calories like those from added sugar and red meat) could reduce the land, water, and agrichemicals used in production and reduce greenhouse gas emissions (Environment Reports, 2017).

## Policy Recommendations

Policies that include consideration of livestock production in climate mitigation efforts can help realize these co-benefits. This has been done in the United Kingdom, where the Committee on Climate Change created a goal of reducing emissions by 80% from 1990 to 2050. In a case study by Friel, et al. (2009), strategies for GHG reductions include a 30% reduction in livestock production to help meet the target. Their models suggest this decrease in saturated fat consumption would correlate to a [15% decrease in ischemic heart disease](#) (equivalent to 2850 disability-adjusted life-years per million people in one year) (Friel et al., 2009).

Policies that promote whole and plant-based foods while removing public subsidy of energy-intensive livestock production can additionally promote these co-benefits. Increasing access to fruits and vegetables, and equitably incentivizing behavior change policies through subsidies, campaigns like “Meatless Mondays” (days where organizations are encouraged to serve meals without meat) should be paired with large-scale interventions to shift our current food system’s prioritization of animal agriculture and processed food production. Many health care institutions have worked with organizations like [Health Care Without Harm](#) to create healthier hospital menus and food waste reduction programs that support these co-benefits.

## Actions for Healthcare Providers

In June 2017, the American Medical Association House of Delegates issued a [policy statement](#) calling for the reduction of sweetened beverages and processed meats being served in hospitals (AMA, 2017). The statement not only calls on physicians to discuss contributions of poor diet with their patients – increasing risk of diabetes, heart disease, stroke, and cancer; it

also challenges hospitals as institutions to lead by example, by serving healthier food options. The American College of Cardiology also endorsed new [guidelines](#) urging hospitals to remove processed meats (bacon, sausage, ham, and hot dogs) and increase plant-based meals on their menus (ACC, 2017).

As providers, health professionals can encourage patients to eat fewer processed foods and animal products to protect against the health-harming consequences of a diet laden with these energy-intensive foods, both for their own health and the health of the planet. Providers can also help to foster patient understanding of the health-promoting benefits of consuming a diet high in plant-based whole grains, fruits, vegetables, nuts and seeds, and how to access these foods at a lower cost if needed. Health care institutions are rapidly adopting similar health-promoting practices by supporting community gardens and on-site farmer's markets as well as promoting cultural norms like "Meatless Mondays" and reducing the price of vegetarian meal options. Health care providers and institutions can also play a significant role in supporting patients' reduction of food waste with practices like meal planning and "Ugly Produce" distribution programs.

## **Section VII: Health Benefits of Passive Cooling Technology**

Climate change continues to increase the health risks associated with hot ambient temperatures, by raising global temperatures and increasing the frequency, intensity, and duration of extreme heat events (IPCC, 2014). Relatedly, [energy demand for air conditioning is the fastest growing source of energy consumption for buildings worldwide](#), with this demand projected to skyrocket in the decades to come. [This will make air conditioning one of the top drivers of electricity demand](#). Today, air conditioning is the primary source of building cooling consumption, which accounts for office buildings, factories, warehouses, commercial, and residential homes - [with 90% of U.S. households having air conditioning](#) according to the International Energy Agency. This growing global demand creates a detrimental feedback loop, where communities increasingly rely on energy-intensive air conditioning to reduce the impacts of climate change-exacerbated extreme temperatures. Passive cooling interventions encompass a wide range of modern and traditional urban and architectural design strategies, along with interventions that reduce local ambient temperatures. These strategies, are greatly under-utilized, and can reduce human carbon emissions while providing benefits to human health by reducing ambient temperatures.

According to the 2015 U.S. Census Bureau - American Housing Survey, only 33% of Seattle residents have air conditioning, compared to 70% in Portland, Oregon (Lee, 2017). This presents a unique opportunity for Washington state to implement passive cooling strategies before air conditioning utilization becomes the new norm.

Extreme heat kills more people in the United States on average every year than every other extreme weather event (Watts et al., 2018). A [recent study published in Science Advances estimates that 725 people in Seattle could die during extreme heat waves](#) if the planet warms 2C above current temperatures. Air conditioning is an effective, yet energy-intensive, method of cooling a building. However, widespread reliance on and regular use of the technology comes at a significant cost to individuals and communities. For example, regular use of air conditioning can reduce the body's physiological acclimatization to warm weather, making individuals more prone to heat stress when outdoors or during power outages. Air conditioning window units can increase outdoor temperatures, contributing to the urban "heat island" effect and raising the risk of heat stress for people living without air conditioning (Ohashi et al., 2007; Salamanca et al., 2014).

Air conditioning may be necessary for vulnerable individuals and the general public during times when temperatures surpass acclimatization thresholds and non-air conditioning interventions are unable to keep ambient temperatures at safe levels. However, over reliance on air conditioning, particularly when it is people's first choice, increases energy consumption, reduces physiological resilience, exacerbates urban heat islands, and burdens energy infrastructure - often increasing the risk of brownouts and blackouts, which disproportionately harms vulnerable individuals and communities (Anderson, Bell, 2012).

Passive cooling interventions can serve as either alternatives to air conditioning, or delay air conditioning use - reducing seasonal energy consumption. Passive cooling technology encompasses a wide range of traditional and modern techniques that cool the exterior urban and indoor environments without reliance on the energy infrastructure. Traditional passive cooling techniques can be found all over the world, especially in regions that normally

experience high temperatures. Modern passive cooling technologies often build off of traditional knowledge, such using new insulation materials, paints, or architectural and urban design techniques (Taleb, 2014).

## Examples of Passive Cooling

**Cool Roofs:** one of the most accessible and affordable passive cooling strategies involves increasing the albedo of buildings, reflecting light which in turn reduces heat absorption. Two well documented examples include the [CoolRoofs Campaign in New York City](#) and the [Ahmedabad, India Heat Action Plan](#).

**Insulation:** another affordable passive cooling strategy involves better insulating buildings to reduce heat absorption and reduce the escape of cool air. Historically, building materials such as stone, stucco, and other materials have been used to reduce interior temperatures. With an increasing number of structures being made from brick, wood or metal - which are poor insulators - insulation should be added to reduce energy consumption. [In 2018 Los Angeles Mayor Eric Garcetti and the Department of Water and Power created an \\$100 million dollar incentive program for residents to insulate their homes.](#)

**Green Spaces:** when water evaporates, it cools the surrounding area, the same mechanism which allows sweat to cool the human body. The combination of tree shade and water evaporating from plant leaves (called evapotranspiration) means parks and other green spaces are often several degrees cooler than surrounding areas. The same mechanisms can be used inside houses, by increasing houseplants to block direct sunlight, cool the surrounding environment, and reduce indoor air pollution [see Health Co-Benefits of Increasing Carbon Sequestration in Plants and Green Spaces, p. 12, for more information on the benefits of green spaces].

**Public Fountains:** public fountains and ponds cool the surrounding environment via evaporation, and offer [an accessible location for people and pets to cool down by getting wet](#). There are many communities around the world that utilize public fountains and ponds, ranging from [Zurich Switzerland's 1,200 public fountains](#) to [India's stepwell architecture](#). During the Chicago 1995 heat wave, fire hydrants were illegally opened by desperate residents looking to cool down. Tragically, the opening of hydrants reduced the neighborhood water pressure, dangerously cutting off drinking water to many residents. Providing accessible, public access to fountains can reduce heat stress, provide a cooler environment for people, decrease reliance on indoor air conditioning, and ultimately reduce the number of people facing desperate circumstances. Drowning deaths often spike during heat waves due to an increased number of people swimming. Fountains and shallow ponds offer a safe alternative to swimming, especially for individuals and communities with limited swimming experience.

There are many other forms of passive cooling technology and techniques for individual buildings and community-wide urban planning utilize the following cooling mechanisms: evaporative cooling, reflecting or blocking sunlight, radiative cooling, earth coupling, ventilation, or a reduction of heat transfer (insulation). The implementation of multiple passive cooling technologies and techniques can further reduce reliance on air conditioning and produce substantial benefits to human health.

## **Policy Recommendations**

Similar to seismic codes, building codes should support passive cooling strategies to reduce indoor temperatures and urban heat islands. Incentives and subsidies for homeowners, landlords, and renters to retrofit homes and other buildings with passive cooling technology is vital for the adoption of technologies that are often inaccessible and unaffordable, and to promote a culture change away from air conditioning as the primary or sole choice for cooling.

Setting higher efficiency standards for air conditioning technology can reduce energy consumption, essential for times when ambient temperatures surpass acclimatization and passive cooling capabilities, resulting in the need for wide-scale use of air conditioning.

Support urban planning projects that create neighborhood wind tunnels, increase green spaces and access to green space, install public fountains and ponds, and utilize other traditional and technological passive cooling strategies.

Finally, policy makers need to understand that due to past and current greenhouse gas emissions, ambient temperatures will continue to increase for decades without rapid mitigation and the implementation of wide-scale carbon capture technology. This necessitates that equitable access to air conditioning must also be considered in combination with passive cooling strategies, as dangerously hot temperature events, which surpass passive cooling benefits, are projected to increase. Providing people with the means to implement a variety of active and passive cooling strategies (as opposed to only air conditioning for non-vulnerable individuals) can decrease energy consumption, reduce the likelihood of brownouts or blackouts, and decrease risks to human health.

## **Section VIII: Summary and Conclusion**

As health professionals, we know that climate change poses significant risk to human health, both globally and in Washington State. In a political environment in which climate science is continually questioned, these health co-benefits are compelling tools to advocate for immediate action in response to climate change.

Not only are the actions recommended in this report free from many of the cost barriers associated with other climate change mitigation efforts; they yield immediate and profound benefits to health and well-being. As healthcare professionals, we already advocate for individual- and community-level actions that reduce systemic barriers to accessing healthy foods and exercise, and encourage individual behavior change that promotes a healthy lifestyle. The low-cost and immediate health benefits of these climate mitigation efforts offer us another powerful justification.

We must also recognize that not all communities are equally impacted by the consequences of inaction on climate. Enacting the behaviors we advocate here could require resources and investment, especially in communities most vulnerable to the effects of climate change. Policies



supporting access to healthy foods, green space, public transit, and more breathable air must be equitable and just.

Beyond encouraging individual behavior shifts, advocating for policies that support these co-benefits is crucial. Efforts to put a price on carbon pollution have been shown to reduce thousands of hospital visits and save hundreds of lives (Buonocore, 2016). Local, state, and national measures to promote green space, support safe active transportation, encourage and incentivize whole and plant-based foods, prioritize electricity generation free from fossil fuels, and incentivize passive cooling should be discussed, both as powerful climate change mitigation efforts *and* as concrete actions to support human health immediately.

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