

**8 January 2019**

**TO: Lane County Commissioners**  
**FROM: Ernie Niemi, President**  
**SUBJECT: CLIMATE CHANGE AND LANE COUNTY – AN ECONOMICS PERSPECTIVE**

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Lane County Commissioners should anticipate that changes in climate (including ocean warming and acidification) will continue to substantially alter weather, ecosystems, and the economy. These impacts will affect citizens' demands for services and the County's ability to provide those services.

The following discussion and attached materials present information regarding economic dimensions of the impacts climate change will have on Lane County. The presentation has these four sections:

- I. Climate Risks for Lane County
- II. Costs to Lane County's Households
- III. Changes in Lane County's Economy
- IV. Recommendations

I conclude with recommendations for actions Lane County should take to enhance the welfare of Lane County's residents as changes in climate emerge around them.

# I. Climate Change Poses Substantial Risks for Lane County

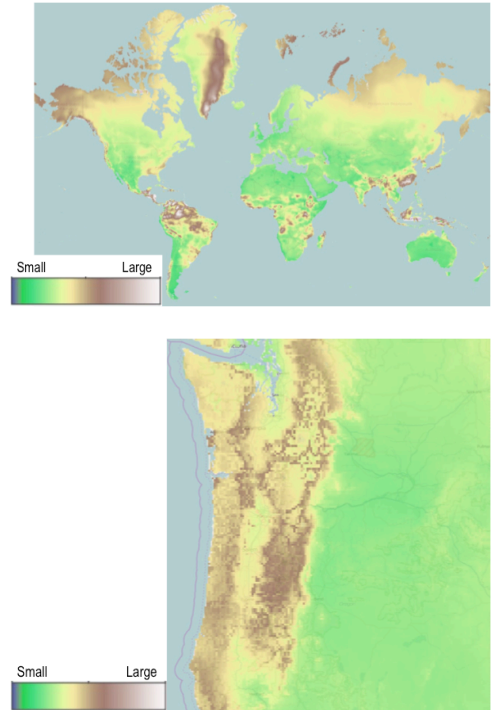
## A. Deviations from temperature-precipitation norms among the most extreme in the world

Changes in climate threaten to increase temperatures and alter precipitation patterns in Lane County. The combined effects will be among the most extreme in the world.<sup>i</sup> Lane County will see less snowpack during winter and drier, hotter soils in summer. Streams and rivers will be more susceptible to flooding in winter, and exhibit lower and warmer flows in summer.

Researchers looked at recent years, when the Cascade Mountains experienced low snowpacks, and concluded:

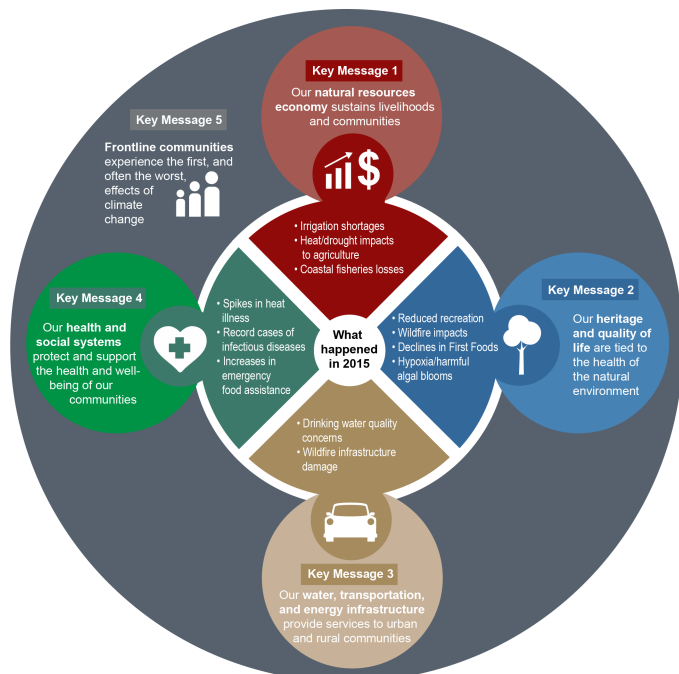
*"[W]e find that for each 1 °C of warming, there is a 28% shift from snowfall to rainfall, [snowwater equivalent] decreases up to 30%,...and the [snow disappearance date] advances by over three weeks; however, these basin-scale values are temperature-regime dependent.... With a 2 °C warming, low- and mid-elevation snow is virtually eliminated."*<sup>2</sup>

Expected Change, 2000 – 2070:  
Temperature + Precipitation



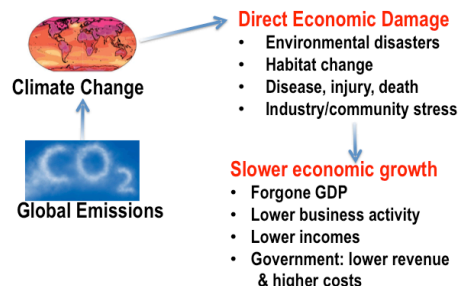
## B. Stress on and degradation of:<sup>3</sup>

- Natural resources
- Quality of life
- Infrastructure
- Public health
- Public services



## II. These Risks Will Impose Costs on Lane County’s Residents

Changes in climate (including ocean warming and acidification) resulting from greenhouse-gas (GHG) emissions already impose numerous costs on Lane County’s households, or soon will do so (Table 1).



### A. Multiple costs to Lane County’s residents and to Lane County Government

It is impossible to know exactly when and how these costs will materialize. Available evidence however, clearly indicates that many costs already have materialized. The climate-related costs will intensify. Some, such as those associated with climate-related wildfires or heat waves, could intensify almost immediately. Others likely will evolve over time. Recent events and research, however, suggest that changes in climate are occurring more rapidly than anticipated earlier, increasing the likelihood that numerous costs will burden Lane County’s households before mid-century.

**Table I. Illustrations of climate-related costs to Lane County’s households**

More frequent and intense extreme weather	Psycho-social trauma for individuals and communities
Increased variability in weather conditions	Direct, in-state impacts of sea-level rise
Changes in the productivity of marine ecosystems	Increased air conditioning and refrigeration
Changes in the productivity of terrestrial ecosystems	Heat stress for agricultural production
Degradation of infrastructure from extreme weather	Irrigation-water shortages for agricultural production
More water- and food-borne diseases	Increases in agricultural pests and diseases
Spread of tropical and sub-tropical diseases	Accelerated spread of undesirable invasive species
Increased stress on at-risk species	Increased human migration
Increases in fish and wildlife diseases	Violence linked to unusual high temperatures
Reduced opportunities for outdoor recreation	Degraded quality of municipal water supplies

### B. Expect costs of \$15,000 per household in the near future

A recent analysis looked at seven categories of costs climate change will soon impose on Oregon’s households (Table 2).<sup>4</sup> If recent trends in GHG emissions continue unabated, these seven will grow until, sometime in the near future, they impose additional costs, relative to today, totaling about \$15,000 per household per year.

**Table 2. Potential annual cost per Oregon household, relative to today, from climate change**

	Potential additional cost in the near future <sup>a</sup>
Climate-related increases in food prices	\$1,000 – \$1,400
Lost income from climate-related slowing of GDP	\$2,400 – \$4,200
Suppression and other costs from climate-related wildfires	\$1,200 – \$3,000
Costs from 7-day exposure to smoke from climate-related wildfires	\$5,200
Premature deaths of Oregonians from climate-related heat	\$1,000 – \$1,600
Climate-related reductions in salmon populations	\$500 – \$700
Reductions in availability of federal, non-climate services	\$600 – \$1,000
<b>Total</b>	<b>\$12,000 – \$17,000</b>

<sup>a</sup> Additional costs relative to today, expressed as equivalent dollar estimates in today's economy. Numbers rounded.

It would be prudent to anticipate that the actual climate-related costs imposed on Lane County's residents will exceed those shown in Table 2, insofar as many costs have yet to be quantified.

### III. Climate Change Will Alter Lane County's Economy

The Oregon Global Warming Commission concluded that, "Costs for health care, fire fighting, commercial freight interruptions, reduced hydropower generation, drought effects on agriculture, and coping with other economic impacts of advancing climate change are increasingly apparent to Oregonians."<sup>5</sup> The following discussion provides additional information about some of the alterations that climate change will impose on Lane County's economy.

#### A. Stress and trauma for workers, families, and communities

Commissioners should anticipate and prepare for the stressful, traumatic impacts changes in climate will have on residents throughout Lane County.

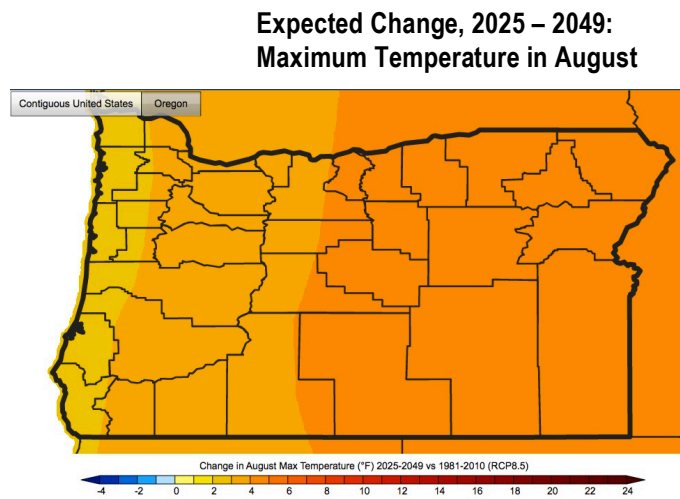
Many will experience stress from high temperatures. For most of Lane County, the average maximum temperatures in August will rise about 4°F over the next several decades.<sup>6</sup> Some workers – both indoors and outdoors – will become less productive, or may be unable to work. Some families may require shelter from heat. Abnormally high temperatures likely will bring increases in social conflict and violence in rural and urban areas of Lane County.<sup>7</sup>

Climate-related stress may leave some individuals, families, and communities suffering from traumatic psychological and social disorders.<sup>8</sup> The impacts on Lane County's indigenous citizens likely will be especially severe:

*"Communities on the front lines of climate change experience the first, and often the worst, effects. Frontline communities in the Northwest include tribes and Indigenous peoples, those most dependent on natural resources for their livelihoods, and the economically disadvantaged. These communities generally prioritize basic needs, such as shelter, food, and transportation; frequently lack economic and political capital; and have fewer resources to prepare for and cope with climate disruptions. The social and cultural cohesion inherent in many of these communities provides a foundation for building community capacity and increasing resilience."<sup>9</sup>*

#### B. Ecosystem services

Climate change is diminishing the ability of Lane County's ecosystems to provide residents and visitors with valuable services. The diminution of these services imposes costs on households directly and by reducing the demand for goods and services produced by Lane County's businesses. The Oregon Global Warming Commission described the general magnitude of some



of the losses:

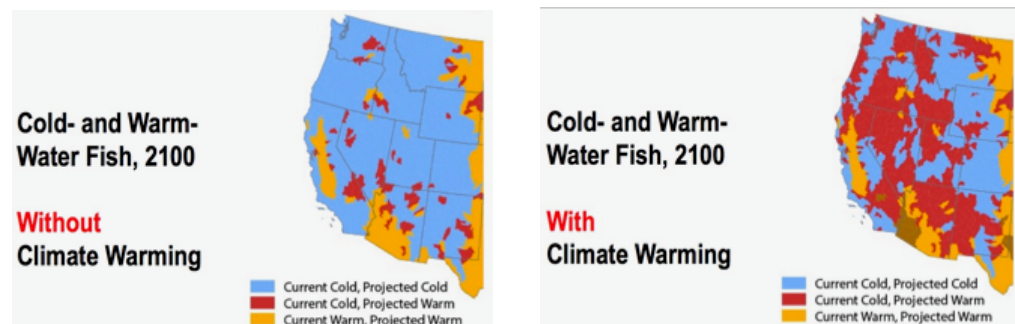
*“Oregon’s forests provide Oregonians with “ecosystem services,” the value of which can in many cases be quantified. Intact, sustainably functioning forest ecosystems provide the Pacific Northwest with \$3.2 million per year in water purification, \$5.5 million in erosion control (in the Willamette Valley alone), and \$144 per household per year in cultural and aesthetic benefits (e.g., hiking, camping, and viewing). Climate change in Pacific Northwest forests could cost the region \$650 million in recreation revenue losses by 2060 [citations omitted].”<sup>10</sup>*

Commissioners should anticipate and prepare for broad, negative impacts on the county’s ecosystems.

### C. Salmon

In 2015, the U.S. Environmental Protection Agency (EPA) described the potential impacts of climate change on the ability of streams in the western U.S. to provide suitable habitat for fish that require clean, cold water. The analysis determined that, if unchecked, climate change will destroy most habitat for salmon and other cold-water fish in Lane County.<sup>11</sup>

#### If unchecked, climate change will destroy most habitat for salmon in Lane County



Commissioners should anticipate and prepare for these dramatic reductions in the county’s salmon populations by implementing programs that will slow or offset the adverse impacts of climate change on stream flows and temperatures.

### D. Agricultural and marine productivity

Commissioners should anticipate and prepare for impacts on agricultural and marine productivity. Changes in climate will stress the current agriculture-production system. Ocean warming and acidification will adversely affect marine fish and shellfish production.

*“Some agricultural crops may benefit from added carbon dioxide supporting growth, but other crops (and farm earnings) stand to suffer from heat, insect predation, weed growth, reduced precipitation and irrigation water during summer months, excessive precipitation in winter months, reduced temperatures for fruit set, and impaired nutrient value of food crops.”*

*“Rural communities, where livelihoods are more tightly interconnected with agriculture, are particularly vulnerable to the agricultural volatility related to climate. ... Ocean warming and acidification pose high and growing risks for many marine organisms, and the impacts of climate change on ocean ecosystems are expected to lead to reductions in important ecosystem services such as aquaculture, fishery productivity, and recreational opportunities.”*

*“The Pacific Northwest seafood industries (including scallops, oysters, mussels, and crabs), which subject to ocean acidification and hypoxia, will be affected, as will commercial and recreational fishing (a \$9.5 billion industry in the two states, with 84,000 jobs at stake). Ocean salmon, herring, mackerel, and other commercial finfish, dependent on food chain base species such as pteropods, whose shells are being damaged by ocean acidification, are likely to be adversely affected.”<sup>12</sup>*

## **E. Tourism**

Commissioners should anticipate that climate change likely will adversely affect many activities that support Lane County’s outdoor tourism industry. For example, the Oregon Global Warming Commission reported that, “Nearly \$51 million in tourism revenue was lost in Oregon [in 2017] because of wildfires,” according to a study conducted by Travel Oregon [citation omitted.”<sup>13</sup> Much of this loss occurred in Lane County. Additional costs to the tourism industry will occur as climate change reduces salmon populations and other natural resources that constitute the foundation for outdoor recreation.

## **F. Timber**

Commissioners should anticipate and capitalize on mounting pressures to dramatically increase forest cover and reduce log production.

- 1. Logging is Oregon’s largest source of CO<sub>2</sub> emissions: 34 million metric tons per year.**
  - These emissions equal the emissions from the world’s second-largest coal-fired generator.
  - They almost equal emissions (38 MMT CO<sub>2</sub>) from PacifiCorp’s 22 coal-fired generators.
- 2. The costs to society from Oregon’s logging-related CO<sub>2</sub> emissions exceed the value of the logs by at least 40-to-1, and, perhaps, 80-to-1.**
- 3. To meet emission-reduction targets, Oregon must increase the amount of wood in standing trees and decrease logging-related emissions via:**
  - **Afforestation**
  - **Reforestation**
  - **Longer timber-rotation periods**

## **G. Wildfire safety**

Commissioners should anticipate that wildfires will become larger, more intense, and occur over a longer portion of future years. Fires can devastate families and communities not prepared for them. The lack of preparation can increase the risk of devastation and impose costs on the county’s residents prior to a fire, or even if no fire occurs. County programs should focus primarily on reducing the likelihood that people will be harmed or structures will be damaged if a fire should approach.

*“The most effective pathway to fire coexistence is to: (1) limit ex-urban sprawl through land-use zoning; (2) lower existing home ignition factors by working from the home-out with vegetation management and home retrofitting (defensible space), instead of the wildlands-in (logging); (3) thinning of small trees and prescribed burning in ecologically appropriate settings (e.g., flammable plantations) while prioritizing wildland fire use in most forests away from homes; (4) store more*

carbon in ecosystems by protecting public forests and incentivizing carbon stewardship on non-federal lands; and (5) shift to a low-carbon economy as quickly as possible. Anything else will not achieve desired results to scale.”<sup>14</sup>

## H. Surprises

Commissioners should develop an appropriate risk-management program that anticipates abnormal events, such as extreme heat waves and storms.

*“Oregon, and the nation, must also anticipate that climate change may not be linear. While average temperatures and other effects may take place predictably, their consequences may surprise and shock us with a kind of climatic “suddenness.” The Fourth National Climate Assessment Volume 1 (USGCRP, 2017) includes Chapter 15, “Potential Surprises, Compound Extremes and Tipping Elements.” It contemplates multiple events reinforcing each other and compounding their effects, such as warm, wet winters followed by early and drier springs and summers; heavy rain on snow exacerbating flooding; or powerful ocean wind storms leveraging higher sea levels to create extreme tidal storm surges.”<sup>15</sup>*

Programs that emphasize making structures and infrastructure less susceptible to fire can generate more jobs and higher incomes for workers from nearby communities.

*One general strategy takes the forest-altering approach, which entails logging/thinning across large areas of the forest to alter the behavior of fires before they come near a community. ... The other general strategy for improving wildfire safety takes the defensible-space approach. It directly prevents buildings from igniting from wildfires by trimming vegetation within 200 feet of the buildings and modifying the buildings (e.g., replacing shingle roofs with fire-safe materials). The defensible space-approach has been shown to be highly effective in protecting homes from wildfire. ... Workers’ wages under the defensible-space approach would exceed the wages under the forest-altering approach by a ratio of 1.4-to-1 for all workers and by 1.8-to-1 for workers directly employed by the contractors.<sup>16</sup>*



## IV. Recommendations

### A. Start now, build momentum

### B. Join with others. Declare your commitment

Add Lane County as a supporter of this resolution of the County Climate Coalition:<sup>17</sup>

#### **DECLARATION OF COUNTY CLIMATE COALITION AFFIRMING COUNTIES' COMMITMENT TO THE PARIS CLIMATE ACCORD, ENVIRONMENTAL SUSTAINABILITY, AND COMBATING CLIMATE CHANGE**

Consensus exists among the world's leading climate scientists that we face a major global climate crisis caused by greenhouse gas emissions, with rising sea levels and melting ice sheets creating increasingly unpredictable and unhealthy living environments as we approach a dangerous threshold of global warming. Documented impacts of global warming include but are not limited to increased occurrences of extreme weather events, significant impacts to human health and safety, destruction of ecosystems, and reduced economic productivity.

In 2015, all but two countries signed the United Nations Paris Climate Accord ("Paris Accord"), a historic international agreement aimed at reducing carbon emissions, slowing rising global temperatures, and helping countries deal with the effects of climate change. Signatories to the Paris Accord committed to enact programs to limit global temperature increase to less than two degrees Celsius above pre-industrial levels, with an expectation that this goal would be reduced to one and a half degrees in the future. The United States ratified the Paris Accord on September 3, 2016 and committed to its own target of reducing carbon emissions by 26 to 28 percent by 2025.

On June 1, 2017, President Trump announced his intention to withdraw the United States from the Paris Accord despite the dire consequences of the planet's rising temperatures and opposition from communities across the country and world. The United States' withdrawal could result in an additional three billion tons of carbon dioxide being released into the atmosphere each year, and an additional increase of as much as 0.3 degrees Celsius in global temperatures by end of the century.

The County Climate Coalition takes sharp exception to President Trump's unilateral intention to withdraw the United States from the Paris Accord and urges the federal government to adhere to its emissions reduction commitments under the Paris Accord. Regardless of whether the United States ultimately withdraws from the Paris Accord, the undersigned local governments intend to continue working toward meeting the United States' commitment under the Paris Accord through results-oriented strategies to reduce greenhouse gas emissions. By combating climate change through renewable solar energy development, alternative community energy providers, enhanced waste diversion, environmentally friendly vehicles, reduction of water usage, and other local solutions, the undersigned local governments will continue their efforts to slow the dangerous pace of global warming while advancing environmental sustainability, protecting public health, and leading innovation.

### C. Develop a science-based plan. Capitalize on the work of others. Take advantage of local expertise

1. Promote afforestation and reforestation
2. Anticipate safety and health needs of employees and citizens
3. Manage risks to the county's operations and to citizens
4. Promote a better-informed citizenry

## V. Credits and Contact Information

Ernie Niemi prepared this report for Natural Resource Economics, a consultancy in Eugene, Oregon USA, which remains solely responsible for its contents. The report draws extensively from his earlier efforts to describe the costs climate change will impose on households and communities. In particular, it draws on the work of a team of economists, which he directed, that, in 2009, developed the first detailed estimates of potential climate-related costs for Oregon, Washington, and New Mexico. It also draws on his assessments of potential climate-related costs in Kenya and Lebanon.

For more information, please contact:

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## IV. References

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- <sup>1</sup> Stepinski, Tomasz. 2018. [CimateEx Interactive Map](#).
- <sup>2</sup> Cooper, M.G., A.W. Nolin and M. Safeeq. 2016. "[Testing the recent snow drought as an analog for climate warming sensitivity of Cascades snowpacks](#)." *Environmental Research Letters*.
- <sup>3</sup> U.S. Global Change Research Program. 2018. "[Northwest](#)." *Fourth National Climate Assessment*. p. 147
- <sup>4</sup> Niemi, E. 2018. [Paying for Oregon's Future: Costs Climate Change Will Impose on Oregon's Households](#).
- <sup>5</sup> Oregon Global Warming Commission. 2018. [Biennial report to the legislature](#).
- <sup>6</sup> US Geological Service. 2016. [National climate change viewer](#).
- <sup>7</sup> Hsiang, S.M., M. Burke, and E. Miguel. 2013. "[Quantifying the influence of climate on human conflict](#)." *Science*.
- <sup>8</sup> Doppelt, B. 2016. [Transformational resilience: How building human resilience to climate disruption can safeguard society and increase wellbeing](#).
- <sup>9</sup> U.S. Global Change Research Program. 2018. "[Northwest](#)." *Fourth national climate assessment*. p. 145
- <sup>10</sup> Oregon Global Warming Commission. 2018. [Biennial report to the legislature](#).
- <sup>11</sup> USEPA. 2015. [Climate Change in the United States: Benefits of Global Action](#). Office of Atmospheric Programs, EPA 430-R-15-001.
- <sup>12</sup> U.S. Global Change Research Program. 2018. "[Report in brief](#)." *Fourth national climate assessment*. pp. 44-89.
- <sup>13</sup> Oregon Global Warming Commission. 2018. [Biennial report to the legislature](#).
- <sup>14</sup> Dellasala, D.A., T. Ingalsbee, and C. Hanson. 2018. [Everything you wanted to know about wildland fires in forests, but were afraid to ask: lessons learned, ways forward](#).
- <sup>15</sup> Oregon Global Warming Commission. 2018. [Biennial report to the legislature](#).
- <sup>16</sup> Niemi, E. 2018. [Potential jobs and wages from investments in defensible-space approaches to wildfire safety](#).
- <sup>17</sup> [County Climate Coalition](#).