



Vinexpo New York – March 4, 2019
Global Climate Change and the Wine Industry: Challenges and Options

Speaker:

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This talk summarizes current scientific understanding of global climate change and its impacts around the world, with particular emphasis on wine-growing regions; it addresses the specific ramifications—ongoing and projected—for wine production; and it surveys briefly the options available to society for reducing the pace and ultimate magnitude of human-caused climate change and the options available to the wine industry for adapting to the changes that can no longer be avoided.

Pattern of human-caused climate change and its impacts

Natural influences were slowly cooling the world for 6,750 years, before the start of the Industrial Revolution about 250 years ago, at which point there was an extremely sharp turnaround. Greenhouse gases accumulated to the point they were canceling out the natural cooling tendency that was in effect at the time. Causes of this turnaround were roughly balanced between human and natural until around 1900 when human influences took over completely, resulting in steep warming.

The past five years have been the hottest in the nearly 140 years of recorded temperature. We know now that human activities are responsible for virtually all of this observed warming. The most important of greenhouse gases we have added to atmosphere is carbon dioxide, through burning of fossil fuels, deforestation and certain agricultural practices.

In general, warming in the mid continents in the Northern Hemisphere has been 1.5-2 times as fast as the global average, while in the Arctic and West Antarctic it has been 2-4 x. That nonuniformity contributes to changes in atmospheric and oceanic circulation.

Dr. Holden emphasized that while changes in the global average sound modest, it has had an enormous effect on the extremes. What used to be one-in-500-year events are now in some cases one-in-five-year events. And the changes are not just about temperature—climate covers weather patterns, averages, extremes, timing and spatial distribution.

Climate change entails disruption of the patterns.

Small changes in the index correspond to big changes in the system.

Climate change is already causing a wide variety of damages. We are seeing increases in long droughts, large wildfires, violent hail storms, extreme heat waves, flooding, powerful hurricanes, range and vigor of pests and pathogens, sea-level rise and more – all of which were predicted to result from human-caused climate change.

What's coming?

Temperature will continue to rise. We can't stop it in its tracks, but how much it rises depends on future emissions. If relatively little is done by 2100 the average temperature will rise by around eight degrees Fahrenheit. The best scenario, which assumes worldwide societies act quickly and with vigor to reduce emissions drastically, would see the average temperature rise around two degrees Fahrenheit—a huge difference.

Summers will get hotter. By 2040, the percentage of summers warmer than the current 95th percentile will be 90-100% in the vast majority of the world if we stay on our current path. In 2003, a heat wave in parts of France, Spain and Italy killed 70,000 people and reduced agricultural production by 30%. By the 2040s, summers as hot as 2003 will be the norm and by 2070, those temperatures would be considered unusually cool.

Droughts will increase. From 1961 to 1990, droughts averaged at half a drought or one drought per 30 years. In the last third of the 21st century, the average will be three, four or even five major droughts in a 30-year period in vast parts of the world.

In addition, wildfires will increase sharply in the western U.S. and precipitation extremes will continue to worsen. Sea level rise will continue in all scenarios and will accelerate in most scenarios.

Climate change influences on wine production

Climate change will have a negative impact on viticulture. Already, hailstorms last year damaged thousands of acres of vineyards in Bordeaux, imperiling the 2018 vintage. Depending on the wine-growing region, anticipated damages will include sun-burned grapes, more rapid ripening, changes in fruit chemistry, heat and drought-related impacts on production and water requirements, damaged fruit from more intense storms, soil erosion, sea level rise introducing salt into aquifers serving coastal vineyards, and increased damage from pests and pathogens.

Among the wine pests and pathogens that will expand their geographic ranges are mealy bugs, grass grubs, erinose mites, five European vineyard moth species, Asian lady beetle, bois noir phytoplasma disease, Pierce's disease, and powdery mildew. These are all afflictions of vines that are expanding under climate change.

Threats to wineries include spoilage due to heat, the effects of higher sugar and alcohol levels on fermentation, and the effects of carbon dioxide on oak structure and chemistry, affecting cask

performance. Threats to wineries and vineyards alike include increased wildfires—such as the Malibe and Chile fires in 2018—and inundation from river flooding and sea-level rise.

Adaptation in the Wine industry

Winemakers are already adopting measures to adapt to climate change, from misters to cool vines to drip irrigation for water conservation, canopy management for additional shade, altered row orientation to reduce direct sunlight, increased vine crop load to delay early maturation, integrated pest management, grafting or replanting with varieties matched to new climate, winter cover crops to reduce erosion, and night harvesting for lower berry temperature and reduced spoilage. But even with such measures, suitability for viticulture will be reduced or lost in many wine-growing regions.

In areas where viticulture suitability is significantly reduced, the only adaptation will be moving higher in altitude and/or latitude. Many producers are already acquiring land higher up to adapt to those changes.

Dr. Holdren stressed that while people have criticized the 2013 climate report as too pessimistic, he considers it overly optimistic because it doesn't consider the extreme—and that's what will impact suitability most.

He went on to make a few key points about adaptation: increases will be a benefit for some grapes in some regions and a liability elsewhere but increases in extremes will be damaging everywhere. No place will do better with more hailstorms and more hot days. Premium varieties are most at risk because of their high sensitivity to conditions. Pinot noir, for one, is an extremely finicky grape that does poorly outside of a narrow range of conditions.

Dr. Holdren used a hockey analogy to illustrate that wine producers will need to consider where climate change is going, not just where it stands currently: “you have to skate to where the puck is going to be, not where it is.”

Most adaptation measures will increase production costs and moving will sometimes intrude on other valued land uses. Also, adaptation will be more difficult, more costly and less effective the bigger the change in climate to which we're trying to adapt.

The Path Forward

Wine producers have a variety of options and more are likely to be developed with further study and experimentation. But the costs and limitations of adaptation means the wine industry has a large stake in progress to reduce global emissions causing the problem.

Modifying practices to reduce carbon dioxide emissions from viticulture and winemaking is a start, but it is more crucial for wine producers to advocate for aggressive emissions reductions across every sector of the global economy.

The challenge is enormous and complicated. The low policy case gives a 35% chance of a more than eight-degree temperature increase by 2100. The Paris Increased Ambition case, which requires we do

everything called for in the Paris agreement and ramp up ambition every five years, shows only a 30% chance to hold the temperature increase below 3.6 degrees F by 2100. But meeting that goal is crucial to avoid unmanageable impacts on wine and much else.

To hold the increase to 3.6 degrees F or less will require:

- A global price on CO2 emissions, increasing over time, to be collected by national governments to incentivize use of best-available low emissions technology and the research and development of better ones
- A massive program of technological innovation on clean energy and energy efficiency
- A similarly massive set of partnerships focused on developing and implementing adaptation measures across all sectors of society

In response to a question from the audience. Dr. Holdren observed that changes in viticulture suitability have already led to wine grapes being grown in parts of England that never grew them before, and a northward motion in other parts of Europe. Wine grapes are starting to be grown in Sweden and will soon extend to northern Poland.

Another question concerned the trend to organic and biodynamic cultivation. Dr. Holden remarked that just two years ago at Vinexpo Bordeaux, vintners involved in that domain did not want to advertise it because historically organic wines were thought of as low end. Now, customers are demanding it. Organic and biodynamic practices reduce fossil fuel use and improve carbon dioxide retention in soil, which is even more important to the greenhouse gas problem.

Asked what else consumers can do to advocate for awareness in the industry to combat emissions, Dr. Holdren responded that the first step is for people who are aware to talk to friends and neighbors. While 70% of Americans believe climate change is real, historically it is only 17th or 18th on their list of what keeps them awake at night, below healthcare, their job, drugs, etc. People need to make it a voting issue in the way guns and abortion are, organize other people to vote, and decide to run for office.

Economic concerns have more sway than does a moral imperative. A powerful message is that ultimately climate change will damage the economy. When Trump withdrew from the Paris agreement claiming it would damage the U.S. economy, 600 CEOs signed a letter to him begging him to stay in because to withdraw would harm the economy. New technology is an economic driver and countries that pursue it will make a lot of money, while those that don't will be buying their tech from those that do. What's more, the costs of ignoring global climate change are far worse than the costs of addressing it.

A final question concerned collapsology—is the current economic growth model sustainable into the future? So far the benefits have outweighed the risks, answered Dr. Holdren, but it is sensible to ask how long growth based on production of materials can continue before we run into unmanageable problems. Driving economic growth into the future based on burning coal and releasing carbon dioxide into the atmosphere won't work.

Download the presentation [here](#).