LIVE - Regional Wine Industry Carbon Footprint and Recommended Climate Actions

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Introduction

Wine is an economically and culturally important product in Oregon and Washington. But like production of everything else – at present, it requires combustion of fossil fuels and consumption of resources, which result in the release of greenhouse gas (GHG) emissions, or climate pollution. This report provides a carbon footprint of the Northwest wine industry to estimate total emissions and highlight specific sources of emissions within the wine industry. The intent of this study is to focus available energy and resources towards activities that can most quickly reduce climate pollution as well as leveraging land use towards regenerative agriculture and additional land-based carbon sequestration and storage.

Regional Wine Industry Characterization

Table 1 summarizes key 2019 statistics for the wine industry in Oregon and Washington.[1] Washington's wine industry is greater in scale than Oregon's with 60K planted acres relative to Oregon's 40K, Washington produces 178 thousand tons of fruit and 17 million cases of wine. Oregon produces slightly less than half the fruit at 75 thousand tons and just over ¼ of the wine at 4.7 million cases. Oregon's production is distributed among roughly the same number of wineries as Washington, while there are nearly 4 times the number of individual vineyards in Oregon.

Table 1: Regional Wine Industry Characterization Statistics

Category	Oregon	Washington
Number of wineries	995	1,050
Number of vineyards	1,370	400
Vineyard total acreage	39,531	60,000
Wine Grape Production (tons)	75,142	178,500
Wine Sales (cases)	4,700,000	17,000,000

Regional Wine Industry Carbon Footprint

Oregon's Department of Environmental Quality (ODEQ) completed a food product environmental footprint of wine in 2017.[2] This study identified 35 carbon footprints of wines from around the globe and summarized them to highlight the major impacts. In additional to ODEQ's research, an additional 40 carbon footprints reported by LIVE members were collected, normalized, and combined with the ODEQ data to include the largest sample size possible while using the most recent and regionally specific data currently available.

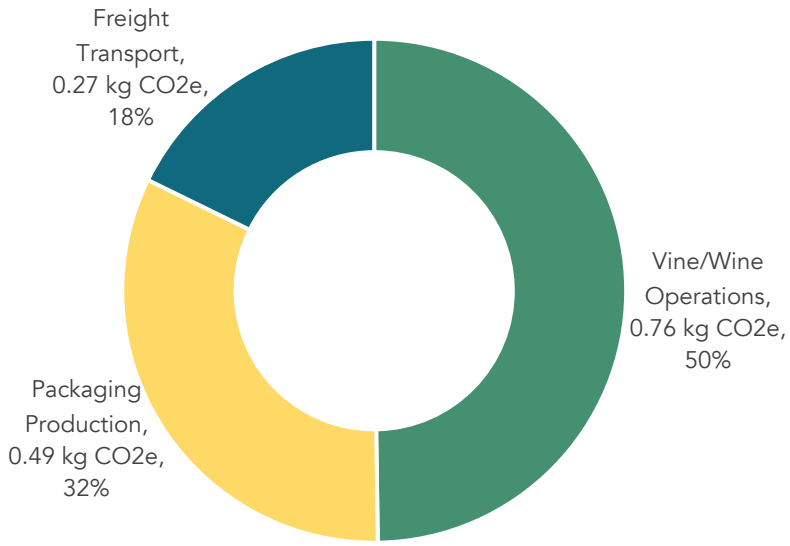
[1] Oregon statistics from University of Oregon's, 2019 Oregon Vineyard and Winery Report. Washington Statistics from Washington State Wine Commissions, Fast Facts.

[2] Food Project Environmental Footprint Literature Summary: Wine (2017). Online at https://www.oregon.gov/deq/FilterDocs/PEF-Wine-FullReport.pdf

Average Carbon Footprint per Bottle

Emissions are normalized per bottle of wine (kg CO_2e per 750ml bottle) for 3 categories of GHG emission in Figure 1.

Figure 1: Carbon footprint (kg CO2e) of wine per 750mL bottle



Vine & Wine Operations include emissions from stationary combustion of fossil fuels (like natural gas), mobile vehicle and equipment combustion of fossil fuels (like gasoline and diesel), fugitive emissions from refrigeration equipment, onsite emissions from fertilizer application, and emissions from purchased grid electricity (generated from non-renewable, fossil fuels). **Packaging Materials Production** include the GHG emissions from fossil fuel use during production of the materials (raw material extraction, production, and transport). **Product transport** considers emissions from transport and distribution of wine products to market in Oregon and beyond.

Combined, using LIVE and ODEQ data, these sources of emissions result in an average carbon intensity of 1.52 kg CO_2e per 750mL bottle.

Carbon Footprint for Regional Wine Industry

Using the average carbon intensity per bottle combined with 2019 regional production data provides a means to estimate a regional wine industry carbon footprint.

Oregon

In 2019, Oregon produced about 4,700,000 cases of wine or roughly 56.4 million 750mL bottles of wine (at 12 bottles per case). Using the average carbon intensity per bottle multiplied by Oregon 2019 wine production results estimated emissions of 85,000 MT CO_2e.

Washington

In 2019, Washington produced about 17,000,000 cases of wine or roughly 204 million 750mL bottles of wine (at 12 bottles per case). Using the average carbon intensity per bottle multiplied by Washington 2019 wine production results estimated emissions of 310,000 MT CO_2e.

Combined Oregon and Washington 2019 estimated GHG emissions total 395,000 MT CO_2e. To better understand the scale of this total emissions – the combined total is comparable to any one of the following equivalencies:

- Additional carbon sequestered by 480,000 acres of average U.S. forest in one year
- Avoided forest to cropland conversion of 2,700 acres
- Planting 50,000 Oregon Oak and letting them grow for 50 years
- Emissions from 85,000 average U.S. passenger vehicles for 1 year
- Combustion of 45 million gallons of fossil gasoline
- Emissions from 70,000 average U.S. homes' energy use for 1 year

Note on Equivalencies: All equivalencies (except Oregon Oak) calculated with EPA's Greenhouse Gas Equivalencies Calculator. Online at https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator. Oregon Oaks calculated using data from USDA's iTree https://planting.itreetools.org/app/location/ set for Lane County Oregon, 50 years, 10% tree mortality for Oregon White Oak, 30" in diameter (DBH) in partial sun.

GHG Source Data – Comparisons and Additional Details

The following sections provide additional a comparison and additional details for the ODEQ and LIVE data sets used for this analysis.

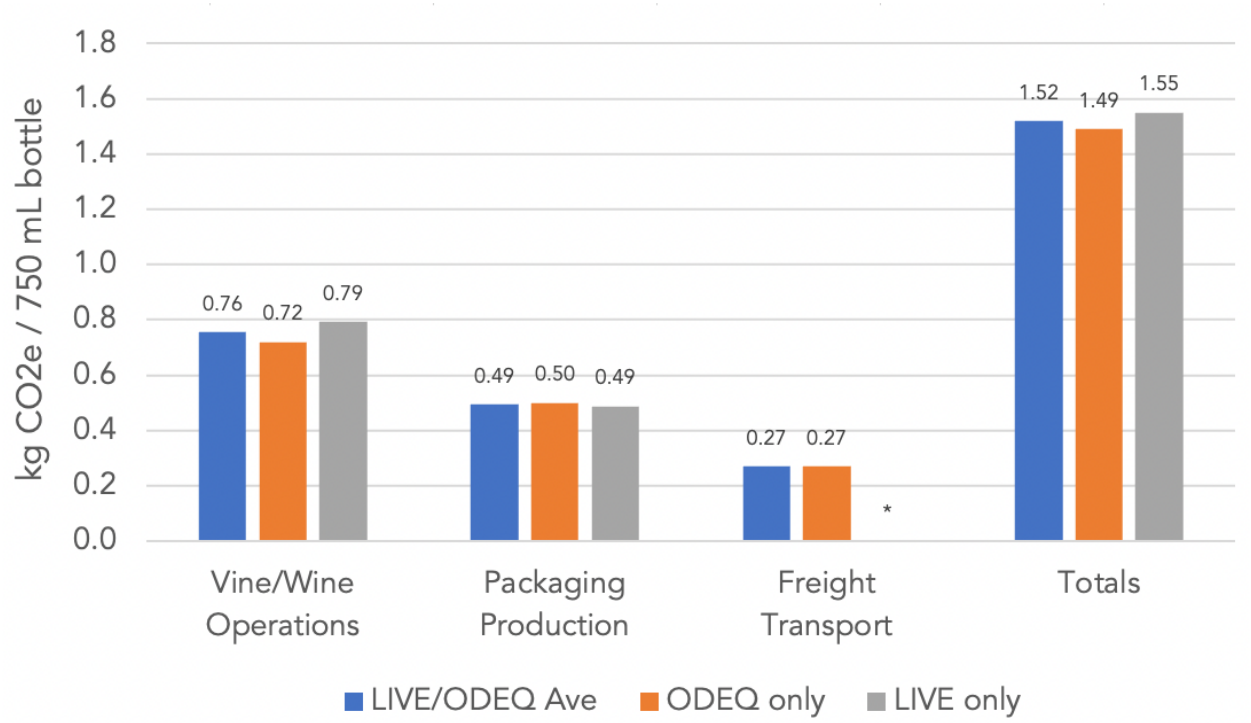
LIVE / ODEQ Data Comparison

Figure 2 compares the results, for similar sources of emissions, between the ODEQ and LIVE data sets. The average carbon footprint of these two values presented is used to estimate regional industry wide GHG emissions presented in the previous section. The values from both data sources are comparable for all sources of emissions. One notable difference is LIVE data for Vine/Wine operations is about 10% greater than ODEQ's data set. Another notable difference was that the LIVE data set contained limited and incomplete data[3] for Freight Transport (denoted

[3] It is not surprising data was limited for this accounting category given this was the first reporting year for LIVE members for GHG emissions. GHG accounting can be challenging in the first year as the data needed may not be readily available and GHG accounting methodology and reporting requires overcoming a learning curve. Data limitations are particularly acute for freight transport – as data collection typically requires coordination with freight vendors and can be challenging to decipher once received.

by *) compared to the ODEQ data set; therefore, the ODEQ data is used as a proxy for this category.

Figure 2: Comparison average carbon intensities for the ODEQ and LIVE data sets alongside an average calculated using a mixed LIVE/ODEQ data set for specific emissions categories.



LIVE Results Details

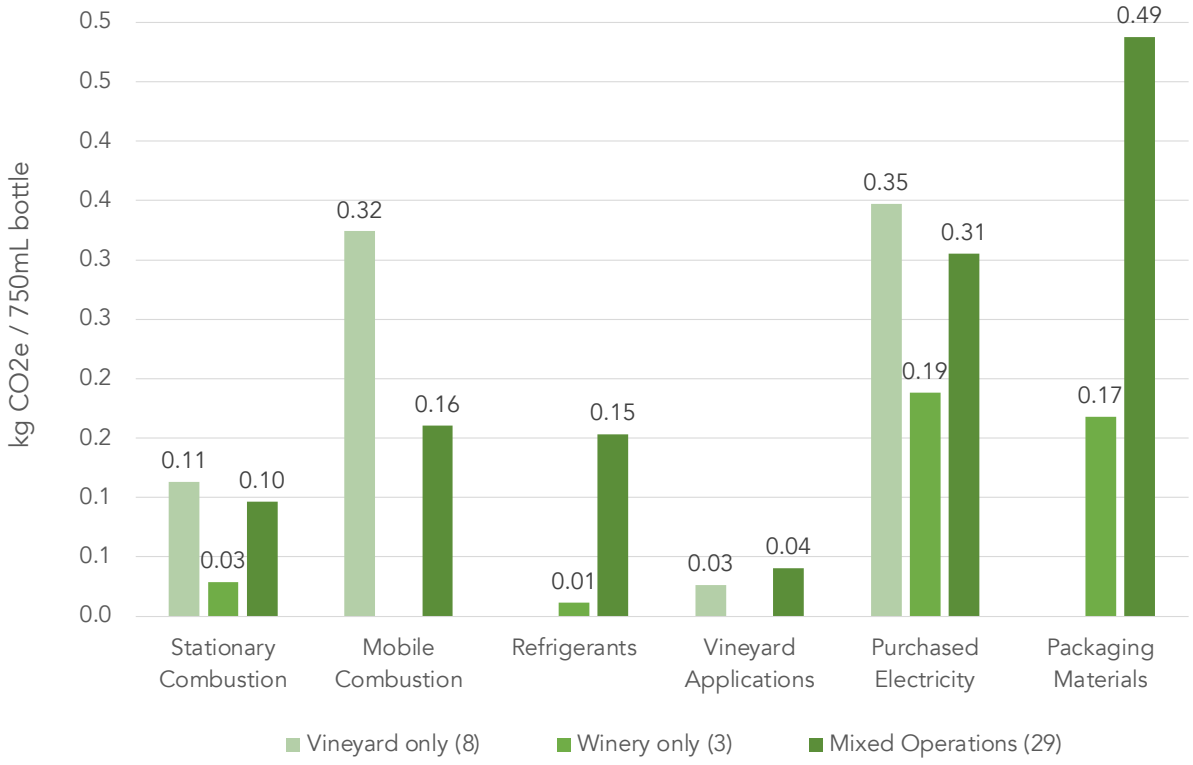
LIVE members reported their GHGs using LIVE's GHG calculator for the first time this year. 40 members reported representing three categories of operations:

- Vineyards only (8 members reported)
- Wineries only (3)
- Mixed operations (29)

Figure 3 shows average emissions per bottle for various operational and emissions categories. The sources of emissions on Figure 3 all had at least 10 reporting members across the operational categories. Other sources of emissions reported in the tool had lower reporting rates, limited data, or suspect outliers. These sources include land management, business travel, freight transport, and offsite waste. These sources may be summarized in the future for LIVE as more data is collected and use of the tool becomes more standardized and better understood by LIVE members. **LIVE members' carbon footprint data is special because it represents the largest known database of vineyard and winery data currently available.** As previously mentioned

ODEQ's literature review found 35 previous wine industry GHG inventories. This new LIVE data more than doubles that sample size.

Figure 3: LIVE data carbon intensity per bottle details by on-site operations (sample size in legend).



Additional Sources of Lifecycle Emissions for Wine

Additional sources of emissions and carbon sequestration are included in the ODEQ and LIVE data sets, but not included in the emissions reporting because of small samples sizes and significant outliers in the available data. The following sources were identified as having potential significant impacts or benefits. It is recommended that additional data be collected in the future to better assess these sources in the future.

- **Land use change** offers either significant climate impact or benefits depending on the direction of the change. Limited LIVE data indicate that conversion to cropland from natural ecosystems results could result in significant loss of stored carbon. Conversely, use of regenerative agriculture practices, including reforestation, on any available land offers equally significant additional carbon sequestration benefits.
- **Consideration of lifecycle emissions for packaging materials** (raw material production through end of life) is critical to determine how best to reduce the overall lifecycle impacts of material use in the wine industry. Selecting packaging materials that are low

weight, highly packable, recyclable, and produced with renewable electricity will reduce lifecycle emissions for packaging production and transportation impacts. These impacts are beyond the direct control of LIVE winemakers but selecting vendors based on these considerations can influence the choices of vendors leading to lower lifecycle emissions.

- **Winery customer distance and mode of travel** was found by ODEQ to be a significant impact, specifically for those traveling long distances in a private, fossil gasoline powered vehicles. Consider installing a Level 2 electric vehicle charger (or provide access to a wall plug) at rural winery locations as a benefit to existing customers, a draw for new customers, and to support the regional transition to electric transportation.
- **Production of carbon dioxide (CO_2) from fermentation** is a well-known source of emissions to winemakers and therefore it might come as a surprise that this source is not considered here. The exclusion of "biogenic" CO_2 from GHG inventories is best accounting practice as these emissions are part of the carbon cycle and considered short-term and net-zero emissions form a climate change perspective. The primary driver of climate change is human-made emissions outside of the natural carbon cycle – primarily from the combustion of fossil fuels. ODEQ noted similar in their Wine lifecycle analysis report. If there are financially beneficial opportunities within the wine industry to capture and utilize fermentation CO_2, without adding significant emissions for associated process energy – it is recommended. All actions that reduce GHGs from the atmosphere are beneficial and important, given the urgency of climate change, and as we move toward net-zero emissions goals. That said - near-term climate action (next 10 years must include rapid adoption of fossil fuel alternatives as a core strategy.
- **Grape vines store carbon,** as do all plants, so some reading this report may wonder why a "credit" is not given for this storage. While grape vines do store carbon, the quantity being stored is likely much less acre-for-acre compared to native regional forest or grassland habitats (such as Oak savanna). Given that natural habitat was converted to develop vineyards – at some moment in the past – there was likely a net loss of carbon storage during that land use conversion. Carbon storage is only counted as a benefit when action is taken to plant new and additional long term carbon storage compared to current conditions by reforesting, use of cover crops, or implementing other regenerative agriculture practices.

Climate Action Planning using Inventory Results

Based on known, large sources of emissions within wine production – the following actions may be used to reduce sources of climate impacts and increase beneficial land use.

Vineyard Actions

- Purchase **renewable electricity** through your utility or through Oregon Community Solar Program (for Portland General Electric or Pacific Power customers).[4] Alternatively, consider developing onsite solar generation. Purchasing renewable electricity from a utility or vendor is the simpler of those two options and can be implemented immediately. For those in Pacific Power or PGE territory – this action offers a significant opportunity to reduce emissions without significant time or capital investment. It also has the additional benefit of increasing demand for carbon-free electricity, which incentivizes a lower carbon electric grid.
- Substitute **renewable diesel** for fossil diesel fuel in all equipment. Renewable diesel is truly a drop in fuel, able to be used without any equipment modification, and is accepted and preferred by most public agencies in Oregon including Oregon Department of Transportation. Cost for this fuel varies, but in large part is no different than conventional fossil, in large part due to Oregon's Clean Fuels Program. Retail outlets in California in 2021 report the average cost of renewable diesel as similar to fossil diesel.[5] This fuel is available from multiple Oregon-based fuel suppliers. Unfortunately, it is not readily available at retail fuel stations, but that is expected to change soon with the first retail facility opening last year in Bend, Oregon.
- **Electrify** all gasoline powered vehicles and equipment as technology allows. Passenger vehicles are cost effective and available in the marketplace right now. Oregon's EV rebate program[6] supports this transition by offering financial incentives for electric vehicles.
- **Avoid land use change** that converts existing natural habitat and explore opportunities to increase carbon sequestration on managed lands by planting trees, shrubs, and grass.

Winery Actions

- **Implement vineyard actions** (described above) as appropriate in your operations.
- **Maintain refrigeration equipment** and select equipment with refrigerants that have a low global warming potential when purchasing. There are many types of refrigerants, and

[4] For details visit https://www.oregoncsp.org
[5] For details see Figure 16 in USDOE's Alternative Fuels Price Report https://afdc.energy.gov/files/u/publication/alternative_fuel_price_report_october_2021.pdf
[6] For details visit https://www.oregon.gov/deq/aq/programs/Pages/Applying-for-EV-Rebate.aspx.

they have a wide range of impacts – from 10 to 1,000s of times more impactful than carbon dioxide pound for pound in the atmosphere.

- **Select packaging materials** that are made from renewable energy; contain post-consumer recycled materials; can be recycled; are low weight; and are highly packable.
- **Choose EPA SmartWay registered freight companies.** EPA's SmartWay Transport Partnership helps companies and organizations achieve their freight supply chain sustainability goals by providing credible tools, data, and standards—at no cost—for measuring, benchmarking, and improving environmental performance. For more information visit https://www.epa.gov/smartway/learn-about-smartway.
- **Purchase Carbon Offsets**[7] from regional vendors to mitigate impacts for sources of emissions currently difficult to reduce, such as natural gas. This action is appropriate to reach climate goals when other previously listed actions are not operationally, commercially, or economically viable. One example of an offset is Northwest Natural Gas who offers on-bill offset purchasing as part of their SmartEnergy Program.[8] Other known high-quality in the region include Bonneville Environmental Foundation[9] and The Climate Trust[10]. Other reputable U.S. vendors include Native Energy, Renewable Choice Energy, and 3Degrees, among others.[11]

[7] For details visit https://www.offsetguide.org/high-quality-offsets/
[8] For details visit https://www.nwnatural.com/about-us/carbon-offset-program/about-smart-energy
[9] For details visit https://www.b-e-f.org/programs/bef-carbon-offsets/
[10] For details visit https://climatetrust.org/action/
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