Background Report Reference

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Title: Memorandum to Nelson Shan, Air Resources Board, Sacramento, CA, from Arthur Caputi, Wine Insitute, San Fransisco, CA

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Report Sect. 4
Reference 13

WINE INSTITUTE

February 24, 1994

425 Market Street
Suite 1000
San Francisco
California 94105
(415) 512-0151

Nelson Chan
Air Resources Board
Stationary Source Division
P. O. Box 2815
Sacramento, CA 95812

Dear Mr. Chan:

Members of Wine Institute's Technical Committee have had an opportunity to examine Joan Heredia's Dissertation, "Technical Assessment Document on Ethanol Emissions and Control from California Wineries." We have found a number of errors which we believe leads to a significant underestimation of the costs of control technology in this area.

On page 23, Table 1 clearly overestimates white wine fermentation emissions. All ethanol emisions data from various tests have been averaged, but upon closer examination two of these values should not have been included to determine the white wine average. The 1990 CATI value of 3.3 lb/1,000 gallons would more appropriately be grouped with red wine fermentation data because it was conducted at 80° F. This was done partially to determine the effect on emissions from red wine of the typical "pump over" procedures used with red fermentations to keep the cap wet. In this white wine test, the same temperature was used as in the red fermentations, but without the cap pump over procedure. Since white wines are not fermented at this temperature, this data point is not relevant. Also the 1988 figure for "White Wine II" of 3.55 lb/1,000 gallons is clearly an outlier and should not have been included in the set used for determining the average. I have appended a copy of Dixon's criteria for rejection of outlying measurements [Dixon, W.J. , *Biometrics* 9, 74 (1953)]. Removing these two erroneous data points changes the emission factor to 1.58 lb/1,000 gallons which, in turn, reduces the estimate of total white wine fermentation emissions from 193.6 tons per year to 122.4 tons/year in Table 3 (Page 28). It also results in the reduction of the statewide estimate from 584.6 to 513.4 tons/year.

Similarly the inclusion in the red wine emission factors of the 10.5 lb/1,000 gal figure is obviously inappropriate for the same reason. By removing this single outlier, the average for red wine emissions is reduced to 5.21 lb/1,000 gallons, and the case can certainly be made that the most accurate data are those from the more refined tests conducted in 1988, 1990, and 1991. In those experiments, the average red wine emission factor is calculated to be 4.69 lb/1,000 gallons.

Page 27 contains the statement "...the fermentation season lasts from mid-August to mid-December (120 days)." While this may be true for the entire region, the fermentation season for any given winery seldom exceeds 56 - 70 days.

Table 3 on Page 28 contains a number of erroneous assumptions. First, not all wines are fermented to dryness. Most blush wines and many dessert wines have the fermentation arrested while still sweet. Second, the division of the "SN" (Special Natural) category into 50% white and 50% red is incorrect. Virtually all Special Natural Wines are based on white wines fermented at the lower temperature. Third, the emission factors used for both red and white wine emissions are high as previously discussed. Fourth, Wine Coolers contain less than half the alcohol of normal wines - probably on the average of 4.5%. This is equivalent to roughly 40% of typical white table wine alcohol content, and the emission level would be proportionately lower. Fifth, the percentage of table wines which are actually produced as red wines is lower than shown in the table. Perhaps the author failed to take into account those red grapes which go into blush wines and are fermented at a lower temperature. A revised version of Table 3, incorporating some of the corrections noted above, is shown below. This does not incorporate the lower value for red wine production or estimate emission reduction due to incomplete fermentation, therefore this represents a worst case scenario.

Wine Type	°Brix	Gallons (Millions)	Fermentation Temp. °F	Emission Factor (lb/1,000 gallons)	EtOH Emissions (tons/year)
Red Table	21	45.23	78	5.21	117.8
Rose	21	55.16	58	1.58	43.6
Dessert	21	7.9	78	5.22	20.6
White Table	20.6	154.88	58	1.58	122.4
Dessert		7.9	58	1.58	6.2
Vermouth		3.24	58	1.58	2.6
Sparkling		25.27	58	1.58	20
SN <14%		9.32	58	1.58	7.4
SN >14%		12.56	58	1.58	13.4
Wine Cooler	Equivalent to 8	42.56	58	0.63	13.4
		363.13			363.9

Page 29 also contains an erroneous assumption, but may be due to factors of which the author was unaware. The assumption is made that since 75.8 per cent of the grapes are grown in the San Joaquin Valley, 75.8 per cent of fermentation emissions must occur there. In reality a large percentage of grapes crushed in this area are not fermented at all. They are used to produce grape concentrate which is sold or used as a sweetening material. For the crop year 1990, for example, 463,165 tons of grapes were crushed and marketed as concentrate. The number for crop year 1991 is 464,100 tons and for 1992 is over 650,000 tons. Out of a total 1990 California wine grape crush of 2,583,000 tons (see attached table), 463,165 tons is significant. Assuming the San Joaquin Valley portion of that year's crush to be 1,957,914 tons (75.8% of 2,583,000) then the actual amount fermented into wine would correspond to 1,494,749 tons out of a total of 2,119,835 or 70.5% of the wine produced. Some grapes are also transported out of the San Joaquin Valley for processing elsewhere, but information on these quantities is not readily available.

With the correction of the percentage of grapes crushed in the San Joaquin Valley which are actually converted to wine, the adjustments for Special Natural Wine fermentation temperatures, and the change reflecting the fact that Wine Coolers have low alcohol contents along with the use of the more appropriate emission factors, the total emission estimate would be reduced from 584.6 tons/year to 256.5.

On page 32 the document states that "The peak observed flow rates from Table A-6 were selected as the basis for ducting design." Since the same tanks can be, and frequently are, used for both red and white fermentations, the ducting, vacuum pumps, and control device must be sized for the *maximum flow* experienced with red fermentations. In this regard you may recall that the system designed for the full-scale study was sized to accommodate 1100 CFM to capture all the emissions from a 200,000 gallon fermentor. Actual experience with a red fermentor showed that the system should have been provided with a capacity of 1340 CFM, or 8.2 CFM per 1,000 gallons fermented. This obviously affects duct and total system sizing and the resulting costs.

On page 44 the document implies that a 50,000 gallon minimum size exclusion for fermentation emission capture would apply statewide. It was our understanding that the 50,000 gallon figure came from a survey of wineries in the old Fresno APCD, and the information gathered at that time indicated fermentors smaller than 50,000 gallons accounted for only 10% of the region's fermenting capacity. Since a 90% control was the goal, this cutoff point was selected. It was indicated to our committee in several meetings that similar surveys of fermentor tank capacities would be conducted in other wine making regions of the state, and that the lower limit of tank size required for control would be based on that size above which 90% of the fermentations in the region take place.

The selection of carbon adsorption as the only control method with a reasonable chance of working in this application was based on the pilot plant experiments at California State University, Fresno. On page 57, scrubbing was suggested as a lower cost alternative. The author points out that enormous volumes of water would be required, which is certainly true, but the major problem is in disposing of this huge volume of water that contains very low levels of alcohol. Most wineries do not have access to city sewer services, and for those that do, there would be a significant cost of disposal associated with the system. For the majority of wineries in the region, only land disposal is an option, and tests have shown that the greatest amount of the captured alcohol would evaporate back into the atmosphere before any soil microorganisms could metabolize it. Similarly, the costs associated with condensation or catalytic incineration make them impractical, and we believe that there should be no implication in the document that these control methods are viable.

On page A-61 under the heading of "Cost Effectiveness" the author refers to the tax benefits derived from the fixed capital cost. The "assumed" depreciation schedule of five years (see Table A-18 on page A-64) is an extremely aggressive and unsupported accounting practice. Depreciation is relative to the useful life of the equipment. On page 32, the author anticipates that the ducting material will be stainless steel, an assumption with which we agree. Many wine storage tanks are also constructed of stainless steel, and the depreciation schedule for this equipment is generally greater than 30 years. On page 55 the author states that the equipment life "is likely 10 to 15 years." This contradicts the five year depreciation schedule and is still 15 years less than the useful life of the tanks to which the capture and control devices would be attached. It appears the author has overstated the annual tax savings and therefore overestimated the after-tax cost effectiveness of the capture and control devices.

It must also be noted that costs for sanitizing the whole system have never been determined. Nor has the need to provide skilled instrument technicians 24 hours a day to maintain and calibrate the on-line analytical devices necessary to operate the control systems. Finding qualified people to work only 8 to 10 weeks a year would not be easy. The difficulties in installing such a system in terms of logistics, safety, etc., have been the subject of previous communications to ARB staff, and none of these problems was addressed in the document. Also not addressed in the document were costs of safety and labor code compliance and true disposal costs. The cost of providing steam is also an important variable. Some wineries may have sufficient boiler capacity to handle the carbon regeneration, but many do not, and new equipment would have to be provided. Similarly, the cost of steam per gallon of wine produced was not calculated.

Finally, one of the major problems with the report is that it reverts back to the idealized calculation of the number of tanks in a winery that are required as fermentors and would have to be ducted. This type of calculation, which was used in an early CARB document on this matter, was criticised by Wine Institute as grossly underestimating the number of fermenting tanks needed and actually used in normal production. The number of tanks which would have to be connected to control devices is critical to correct cost estimates. That disparity between CARB staff estimates and those of Institute led to a tank utilization study conducted by CARB staff at three different wineries in the Fresno area. That study showed *virtually every tank* in a winery must be used as a fermentor at one time or another, and the calculations for the cost of ducting must reflect this fact. The draft Technical Assessment Document prepared by ARB staff several years ago reflected this reality and represented a more accurate picture of what would actually be required for emission capture and control in California wineries. We would suggest that your staff use Ms. Heredia's more current cost estimates for ducting, which should be properly sized, and equipment and produce an updated version of the document ARB staff put together at that time.

Sincerely yours,

Art Caputi Jr.

Arthur Caputi, Jr., Chairman
Ethanol Emissions Subcommittee

Table C.1. Criterion for rejection of outlying measurement with 1 in 20 probability of a wrong decision

Number of Measurements (n)	Criterion (r)	Critical Value of r
3		0.94
4		0.76
5	r_{10}	0.64
6		0.56
7		0.51
8		0.55
9	r_{11}	0.51
10		0.48
11		0.58
12	r_{21}	0.55
13		0.52
14		0.55
15		0.53
16		0.51
17		0.49
18		0.48
19		0.46
20	r_{22}	0.45
21		0.44
22		0.43
23		0.42
24		0.41
25		0.41

Dixon (1953), reproduced by permission.

If x_n (or x_1) is a suspected outlying value in a series of measurements arranged in order $x_1, x_2, x_3 \ldots x_{n-2}, x_{n-1}, x_n$, then the following tests can be used.
For less than eight measurements, reject x_n if

$$\frac{x_n - x_{n-1}}{x_n - x_1} > r_{10} \qquad \left(\text{or reject } x_1 \text{ if } \frac{x_2 - x_1}{x_n - x_1} > r_{10}\right)$$

Between eight and ten measurements, reject x_n if

$$\frac{x_n - x_{n-1}}{x_n - x_2} > r_{11} \qquad \left(\text{or reject } x_1 \text{ if } \frac{x_2 - x_1}{x_{n-1} - x_1} > r_{11}\right)$$

Between eleven and thirteen measurements, reject x_n if

$$\frac{x_n - x_{n-2}}{x_n - x_2} > r_{21} \qquad \left(\text{or reject } x_1 \text{ if } \frac{x_3 - x_1}{x_{n-1} - x_1} > r_{21}\right)$$

Over thirteen measurements, reject x_n if

$$x_n - x_{n-2} > r_{22} \qquad \left(\text{or reject } x_1 \text{ if } x_3 - x_1 > r_{22}\right)$$

Table 3

Utilized Grape Production and Commercial Grape Crush, by States, 1989 and 1990

Category	1,000 Tons 1989	1,000 Tons 1990 3/	Percent Change	Percent of Total 1989	Percent of Total 1990 3/	Dollars per Ton 1/ 1989	Dollars per Ton 1/ 1990 3/	Millions of Dollar 1989	Millions of Dollar 1990
Utilized Production									
California									
All Varieties	5,390.0	5,185.0	-3.8	90.9	91.6	314.00	289.00	1,691.2	1,499.0
Wine Varieties	2,190.0	2,195.0	0.2	---	---	340.00	308.00	745.2	676.3
Table Varieties	630.0	645.0	2.4	---	---	449.00	429.00	283.0	276.7
Raisin Varieties	2,570.0	2,345.0	-8.8	---	---	258.00	233.00	662.0	545.8
Arizona	26.5	26.0	-1.9	0.4	0.5	674.00	870.00	17.9	22.6
Arkansas	5.9	5.0	-81.1	0.1	0.1	319.00	327.00	1.9	1.6
Michigan	43.0	46.0	73.6	0.7	0.8	265.00	291.00	11.4	13.4
Missouri	3.6	1.3	-95.1	0.1	0.0	348.00	354.00	1.3	0.5
New York	152.0	144.0	443.4	2.6	2.5	277.00	286.00	42.1	41.2
North Carolina	1.7	1.5	-94.3	0.0	5/	406.00	533.00	0.7	0.8
Ohio	8.0	7.7	-70.9	0.1	0.1	266.00	304.00	2.1	2.3
Oregon	7.5	7.0	-73.6	0.1	0.1	740.00	780.00	5.5	5.5
Pennsylvania	60.0	53.0	100.0	1.0	0.9	274.00	285.00	16.4	15.1
Washington	229.0	180.0	579.2	3.9	3.2	302.00	316.00	69.2	56.9
Other States	2.9	3.3	-87.5	5/	5/	783.00	780.00	2.3	2.6
United States Total	5,930.1	5,659.8	-4.6	100.0	100.0	314.00	294.00	1,862.0	1,661.5
Grapes Crushed 4/									
California									
All Varieties	2,726.0	2,583.0	-5.2	95.6	95.7	297.00	276.00	809.6	712.9
Wine Varieties	2,145.0	2,145.0	0.0	---	---	342.00	306.00	733.6	656.4
Table Varieties	211.0	170.0	-19.4	---	---	128.00	127.00	27.0	21.6
Raisin Varieties	370.0	268.0	-27.6	---	---	132.00	126.00	48.8	33.8
Arkansas	1.2	1.0	-16.7	0.0	5/	300.00	310.00	0.4	0.3
Michigan	2.4	2.2	-8.3	0.1	0.1	343.00	370.00	0.8	0.8
Missouri	1.6	0.7	-55.4	0.1	0.0	425.00	416.00	0.7	0.3
New York	56.7	54.7	-3.5	2.0	2.0	270.00	263.00	15.3	14.4
Ohio	1.2	0.9	-25.0	5/	5/	277.00	448.00	0.3	0.4
Oregon	7.5	7.0	-6.0	0.3	0.3	740.00	780.00	5.5	5.5
Pennsylvania	8.5	8.0	-5.9	0.3	0.3	416.00	312.00	3.5	2.5
Washington	43.0	38.0	-11.6	1.5	1.4	443.00	468.00	19.0	17.8
Other States	2.0	2.5	23.2	0.1	0.1	386.00	531.00	0.8	1.3
United States Total	2,850.1	2,698.0	-5.3	100.0	100.0	300.00	280.00	855.9	756.2

1/ Average grower returns. Generally represents returns on bulk fruit at grower's first delivery point.
2/ Total grower returns. For California, sum of components does not equal total due to rounding.
3/ Preliminary.
4/ Commercial crush by wineries and distilleries. State figures except California are by state grown and include grapes crushed at facilities in other states. California figures include only grapes crushed at California facilities. California crush figures may include a minor amount crushed by facilities other than wineries and distilleries but not reported separately.
5/ Less than 0.05 percent.

Sources: Prepared by Economic Research Department, Wine Institute, from reports of Agricultural Statistics Board, U.S. Depart-