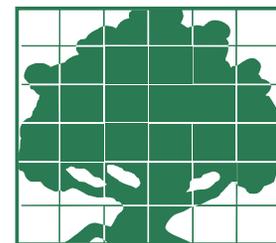


# Agricultural and Resource Economics UPDATE



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## Reducing Volatile Organic Compound Emissions from Pre-plant Soil Fumigation: Lessons from the 2008 Ventura County Emission Allowance System

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In 2008, the California Department of Pesticide Regulation implemented a volatile organic compounds emission allowance system for emissions from the use of fumigants. We evaluate lessons from this program for the design and implementation of any future emission allowance systems.

Volatile organic compounds (VOCs) contribute to the formation of ground-level ozone, a pollutant regulated under the Clean Air Act due to its harmful effects on human health and the environment. Several regions in California are “non-attainment areas,” meaning that their ozone concentrations exceed the regulatory standard for too many days during the peak ozone season of May through October, when weather conditions most favor ozone formation. The use of some pesticide products results in the emission of VOCs. In cooperation with the California Air Resources Board (CARB), the California Department of Pesticide Regulation (CDPR) is responsible for reducing pesticidal VOC emissions in order to help bring California’s non-attainment areas into compliance with federal standards.

As part of its plan for meeting its commitment to reduce VOC emissions from pesticide use, CDPR issued regulations regarding VOC emissions from field fumigation in January 2008. Low-emission application methods were required for fumigation conducted during the peak ozone season. In addition, CDPR specified that it could impose limits on the amount of fumigation by individual growers if its projections estimated that the use of low-emission application methods would not be sufficient to achieve its targeted reduction. While CDPR proposed a

four-year phase-in period that had been approved by CARB, the phase-in was rejected by the federal district court in December 2007. Consequently, CDPR had to implement restrictions on the amount of fumigants used by individual growers in Ventura County. CDPR issued emission allowances to growers for the 2008 peak ozone season—May 1 to October 31. The emission allowances were discontinued September 3, 2008, in the wake of a federal appellate court ruling in favor of CDPR’s appeal of the original 2006 federal court order regarding CDPR’s efforts to reduce VOC emissions from pesticide use. Although the allowance system was not even in effect for an entire season, some lessons can be drawn from the experience that may prove useful if another system for limiting fumigant use by individual growers must be implemented in the future, whether in Ventura County or elsewhere.

In early 2008, growers submitted requests specifying product, acreage, and field location to the Ventura County Agricultural Commissioner. That office checked to ensure that the application method was allowed under the regulations, and to ensure that the grower controlled the field in question. The requests were then forwarded to CDPR, which calculated the percentage of requests that would be issued to growers as emission allowances. If the requested fumigation treatments were identical to

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**Table 1. Gross Crop Revenues Per Pound of Emission Allowance by Crop: Requested Pre-Plant Soil Fumigation Products, Application Methods, and Application Rates, 2008**

Crop	Revenue/ lb. Emission Allowance	Crop's Total Requested Allowance	Cumulative Requested Allowance
Lemons	\$913	13,677	13,677
Raspberries	\$713	46,620	60,297
Avocados	\$510	2,820	63,117
Tomatoes	\$456	166,281	229,398
Flowers	\$445	39,936	269,334
Strawberries	\$219	1,915,340	2,184,674
Turf/Sod	\$218	3,278	2,187,952
Peppers	\$110	187,600	2,375,552

Source: CDPR (2008b) and VCOC (2007).

the implemented fumigation treatments, then this approach would have resulted in an identical percentage reduction in fumigated acreage across growers.

As the system was administered, growers were not required to use the product, application method, or application rate specified in their emission allowance requests. The first lesson of the 2008 VOC emission allowance system in Ventura County is that this administrative decision meant that the across-the-board cut in emission allowances had different effects on growers' actual capacity for fumigated acreage. The vast majority of requests were for

methyl bromide-chloropicrin products, although the use of methyl bromide had declined in Ventura County in recent years. Unsurprisingly, growers did not actually always use the product listed in their requests. They utilized other active ingredients for a substantial share of applications. Growers with greater scope to move to fumigation choices that result in lower emissions per acre were able to fumigate a greater percentage of the acreage specified in their emission allowance requests. Although one might argue that this is a desirable outcome because it provides growers with an incentive to adopt

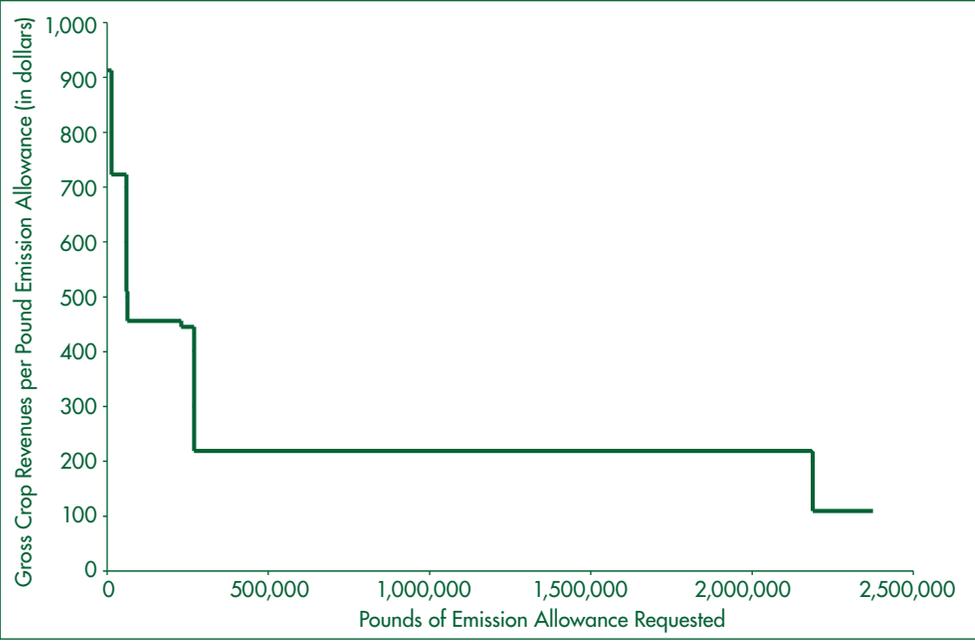
lower-emission techniques, its scope for doing so is limited, and offset by the relatively weak constraint on growers' ability to overstate intended treated acreage in their allowance requests.

Because the emission allowances are not tradable among growers, and because the allowances were allocated based on requests that did not include the economic value per unit of emissions, the marginal benefit per unit of VOC emission allowance varies across growers. The second lesson from the 2008 VOC emission allowance system implemented in Ventura County is that the decision to make allowances non-tradable led to inefficient outcomes. The value of a unit of emission allowance varied across crops, but growers with higher values were not able to purchase additional allowances from growers with low values.

We use the information supplied in the allowance requests to provide a crude measure of the differences in the value of a unit of emission allowance across crops. The ideal measure would be the risk-adjusted net returns per unit for each crop but since these numbers are not available, gross crop revenues per unit are used instead. To the extent that net returns per acre as a percentage of revenues per acre are the same across crops, using revenues rather than net returns will result in the same ordinal ranking by crop even though the absolute values will be different.

Crops can be grouped by their revenues per pound of emission allowance, as shown in Table 1. Lemons have a substantially higher willingness to pay than other crops. Raspberries, avocados, tomatoes, and cut flowers have a substantially higher willingness to pay than strawberries and turf/sod, which in turn have a substantially higher willingness to pay than peppers. Economic theory predicts that the price of a pound of emission allowance will be determined by its marginal revenue product, which will be determined by the net returns

**Figure 1. Gross Crop Revenues per Pound of VOC Emission Allowances: Requested Products, Application Methods, and Application Rates, 2008**



per pound of emission allowance for strawberries and/or turf/sod, because these two crops would account for the lowest-valued unit of emission allowance given the total amount of emission allowances. Growers who have higher valuations for a unit of emission allowance would be willing to pay at least as much per unit. Growers who have lower valuations per unit of emission allowance will be willing to sell at this price. Because products' emission potentials vary, and application rates and methods vary, crops with the highest value of production per acre are not necessarily the crops with the highest gross crop revenue per pound of emission allowance. Flowers, which have the highest value of production per acre, have only the fifth highest gross crop revenue per pound of emission allowance. Again, we emphasize that this analysis assumes that the ordinal ranking of risk-adjusted net returns per unit of emission allowance is represented adequately by the ordinal ranking of gross returns per unit of emission allowance. If a crop's net returns as a percentage of gross returns are substantially higher or lower than those for other crops, or if crops vary greatly in the riskiness of their net returns, then ordinal rankings are more likely to differ.

Figure 1 plots emission requests by crop in decreasing order of gross crop revenues per pound of VOC emission allowance. It shows that if growers had used their requested treatments, a market for emission allowances would have resulted in a substantially different allocation across crops than the across-the-board percentage cut used in the 2008 process did. Based on preliminary data, growers' actual fumigation choices were very different from those in their emission allowance requests. To the extent that growers of crops with relatively low gross revenues per pound of emission allowance adopt lower emission approaches than

Table 2. January–July Pre-Plant Soil Fumigated Acreage, 2004–2008

Year	-----Crop-----											
	Strawberries		Unspecified Crop		Peppers		Tomatoes		Lemons		Outdoor Flowers	
	Jan-Apr	May-Jul	Jan-Apr	May-Jul	Jan-Apr	May-Jul	Jan-Apr	May-Jul	Jan-Apr	May-Jul	Jan-Apr	May-Jul
2004	639	5,337	419	703	1,052	150	258	1,055	224	3	48	69
2005	--	4,203	180	833	443	389	344	332	11	31	24	29
2006	76	3,416	373	1,505	342	193	212	510	19	68	15	40
2007	20	2,680	235	1,409	551	64	--	100	72	--	19	--
2008	873	1,416	1,501	443	798	33	760	217	152	24	7	41

*Source: PUR data, various years, CDP. 2008 data are preliminary.*

growers of the crops with the highest gross revenues per pound of emission allowance do, then the difference in their willingness to pay for a unit of VOC allowance will decrease. Conceivably, their ordinal ranking may even change. Another consideration is that, in practice, a variety of products with various active ingredients are used on a given crop, implying that some growers of a given crop will have a higher willingness to pay than others will.

Implementing a market for emission allowances would equalize the value of a pound of emission allowance across uses. Growers would be allowed to sell allowances or to use them for pre-plant soil fumigation once the allowances were assigned. Initially, the state could sell emission allowances, or allowances could be allocated across growers based on historical use or other criteria. In the former case, the revenues from the sale of emission allowances could be used to cover program administration costs and fund research into means of reducing VOC emissions from fumigants, including research regarding alternatives to fumigation. Either being required to purchase emission allowances or having the opportunity to sell unneeded emission allowances to other growers will provide an incentive for growers to adopt lower emission production methods.

The final lesson of the 2008 emission allowance system is that growers

do have the flexibility to move at least some pre-plant soil fumigation treatments outside of the peak ozone season. Table 2 reports fumigated acreage by crop and year for the January–April and May–July time for the years 2004–2008 due to the effect of the emission quotas, using preliminary 2008 Pesticide Use Report (PUR) data from CDP. As CDP's appeal progressed, growers and others began to anticipate that CDP's phase-in of emission allowances would be reinstated. By August the reinstatement appeared quite likely. Because growers' expectations likely influenced their decisions, we focus on the January–July period when the outcome was less certain.

The table includes acreage treated with pre-plant soil fumigation for an unspecified crop. Field-level analysis of pesticide use reporting data suggests that a significant share of the acreage in this category is planted with strawberries, although certainly not all of it. In 2008, the California Strawberry Commission reports there were 3,157 acres of summer-planted strawberries in Ventura County—substantially more than the 2,299 reported pre-plant soil fumigated acres for strawberries during the first seven months of 2008. Consistent with this difference in 2008, in 2005, 63% of the acreage treated with pre-plant soil fumigation for an unspecified crop also had reported pesticide applications for strawberries,

**Table 3. Monthly Share (percent) of January–July Pre-Plant Soil Fumigated Acreage, 2004–2008: Strawberries**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul
2004	1	0	0	10	8	48	33
2005	0	0	0	0	7	58	35
2006	0	0	1	1	2	50	45
2007	0	0	0	1	13	74	13
2008	0	0	0	38	3	50	9

*Source: PUR data, various years, CDPR. 2008 data are preliminary.*

and an additional 11% had reported pesticide applications to strawberries and at least one other crop.

Table 3 reports the share of acreage fumigated monthly for the January–July period for the years 2004–2008 for strawberries. Comparing 2008 to previous years, a substantial share of pre-plant soil fumigation treatments were performed prior to the peak ozone season on land intended for strawberries. Applications were shifted into April, while the percentage in May and June declined. For the other crops, the annual pattern of applications was much less consistent for the 2004–2007 period, so it is difficult to draw any conclusions regarding a change in the monthly shares of fumigated acreage in 2008.

The emission allowance system is not in effect for 2009. CDPR projections indicate that its field fumigant use regulations will achieve the reduction in VOC emissions from pesticide use that is required to comply with the

larger cap specified under the phase-in. Under the phase-in of emission quotas, more emission allowances are available to growers over the next few years. The immediate effect is to reduce the direct impact of emission quotas on growers. The longer-term effects pose a challenge. If the phase-in period is simply treated as a means to continue current pre-plant soil fumigation practices, then the only effect of the phase-in will be to reduce short-term regulatory impacts. If the phase-in period is used to identify and implement economically feasible lower-emission alternatives to current fumigation practices, then the phase-in period will also mitigate the longer-term effects of post-2012 regulations. In the event that CDPR must again implement emission allowances in Ventura County or elsewhere, the 2008 experience provides some guidance for the design of future systems.



As part of its plan for meeting its commitment to reduce VOC emissions from pesticide use, CDPR issued regulations regarding VOC emissions from field fumigation in January 2008. Comparing 2008 to previous years, a substantial share of pre-plant soil fumigation treatments were performed prior to the peak ozone season on land intended for strawberries.

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### For More Information, the Authors Recommend:

Goodhue, Rachael, Richard Howitt, Peter Howard and Henry An. “Effects of the January 2008 CDPR Field Fumigation Regulations: Ventura County Case Study.” Final report submitted to California Department of Food and Agriculture. April 2009. [www.cdpr.ca.gov/files/pdf/GoodhueHowitt042309.pdf](http://www.cdpr.ca.gov/files/pdf/GoodhueHowitt042309.pdf).

California Department of Pesticide Regulation. “Volatile Organic Compound (VOC) Emissions from Pesticides.” 2009. [www.cdpr.ca.gov/docs/emon/vocs/vocproj/vocmenu.htm](http://www.cdpr.ca.gov/docs/emon/vocs/vocproj/vocmenu.htm).