

Chapter 6

Cost Impacts of Alternatives to Burning

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Chapter 6: COST IMPACTS OF ALTERNATIVES TO BURNING **(for each affected crop/material)**

The costs shown in this analysis are borne by growers. Growers typically pay the contractor to burn, chip, or shred the materials. The biomass facilities also pay chipping operators for the chipped material. The District is estimating incremental costs of non-burning alternatives by subtracting the cost of open burning from the total cost of the alternative. The incremental costs are then used in further analysis.

6.1 COSTS FOR OPEN BURNING

6.1.1 Costs for Orchard and Vineyard Removal by Open Burning

Since the entire orchard or vineyard removal process may be affected by the method utilized for disposal of the material, the District examined current costs for the complete removal/burning process including tree or vine extraction, transport/piling and burning. For orchard removals, the trees are typically either pushed over with a dozer or removed from the ground with an excavator. Large trees may require some breaking up for handling. After drying in the field, the downed trees are then moved to burn piles either by dozer or wheel-loader. Vineyards are typically bull dozed into piles for burning with vineyard wire in place (the wire is removed and disposed after burning is complete).

To obtain costs, orchard removal contractors in the SJV were contacted who provided expected average costs for the removal and burning for various orchard types and vineyards. All contractors requested confidentiality with respect to their pricing. Per discussions with the contractors, actual cost for a particular site will vary with specific orchard or vineyard configuration and site conditions.

The agricultural industry also provided estimates for removal/burning operations.

Average pricing provided to the District by the orchard removal contractors as well as estimates provided by the agricultural industry are as follows:

	Citrus	Average for other Orchards including nuts, stone fruit and general deciduous	Vineyards	Minimum Charge per Burning Project
Average Contractor Pricing	\$400	\$267	\$213	\$1,150
Ag Industry Estimates	\$314	-	\$267	-

The above pricing includes burning of roots, assuming the roots would be extracted from the ground prior to the burning operation. Orchard removal contractors generally indicated citrus orchard removal and burning to be somewhat more difficult than the average for other types of orchards and indicated a higher price for this specific type.

Agricultural industry estimates for open burning did not specifically address orchard removals other than Citrus. For purposes of analysis, the District will assume that the agricultural industry estimate of \$314 per acre applies to all orchards. Additionally, agricultural industry estimates did not address a minimum project charge for burning projects. For purposes of analysis, the District will assume that the minimum project charge estimated by orchard contractors will be generally applicable.

6.1.2 Costs for Disposal of Orchard Prunings by Open Burning

Disposal of orchard prunings by open burning requires that the prunings be pushed to the end of each row and then piled for burning. Pruning weights are typically 1 to 1.5 tons per acre on a wet basis (30-35% moisture) for orchards regardless of tree type per information provided both by orchard contractors and the farming industry. To burn the prunings, costs must be incurred to 1) push the prunings to the end of each row and then pile them for burning, 2) obtain a burning permit and 3) then supervise the burn. The farming industry estimates the cost of this activity at approximately \$22 per acre. It is assumed that a \$500 minimum project cost would be required by a contractor to perform these

services consistent with quoted project minimums for smaller chipping operations.

6.2 COSTS OF ALTERNATIVES TO BURNING

6.2.1 Costs for Orchard and Vineyard Removal for fuel at Biomass Power Plants

The District has identified the grinding (or chipping) of orchard removal material followed by utilization of the material as fuel for power generation as a feasible alternative to open burning. In this approach for orchard removal the trees are typically extracted or pushed over and then allowed to dry in the field for approximately four weeks prior to grinding (except for citrus for which a drying time of approximately eight weeks is required to ensure that grinding will produce a usable biomass fuel). After drying, the downed trees are typically loaded on a wheel-loader which transports them to the grinder. The grinder may be either a tub grinder or a horizontal hammer mill, depending upon the contractor and/or the specifics of the job. After grinding, the biomass is normally loaded into heavy haul trucks and transported to the biomass facility.

To obtain costs for conversion of orchard removal matter into biomass fuel, the District contacted several established orchard removal contractors and obtained budgetary quotations for typical orchard removal operations with conversion of the material to biomass. In addition, the agricultural industry provided cost estimates for this activity. Results of the cost survey are presented in the following table:

**Table 6-2
Cost for Orchard and Vineyard Removals by Grinding to Biomass Fuel
\$ per acre**

	Citrus		Other Orchards		Vineyards		Minimum Charge per Project	
	Orchard Contractors	Ag Industry Estimate	Orchard Contractors	Ag Industry Estimate	Orchard Contractors	Ag Industry Estimate	Orchard Contractors	Ag Industry Estimate
Average Contractor Quote/Estimate for Orchard Removal	\$525	\$580	\$388	\$400	\$225	\$380		
Transporting and Composting Roots	\$244	\$75	\$244	\$75	\$75	\$244	\$5,000	\$5,000
Removal of Vineyard Wire and Trellis	N/A	N/A	N/A	N/A	\$650	\$775		
Total Evaluated Cost Based on Average Contractor Quote or Ag Industry Estimate	\$769	\$655	\$632	\$475	\$950	\$1,399	\$5,000	\$5,000
Cost Differential Between Grinding to Biomass and Open Burning	\$369	\$341	\$365	\$161	\$737	\$1,132	\$3,850	\$3,850

Per discussions with the contractors providing budgetary estimates, the actual cost for a particular site will vary with specific orchard or vineyard configuration, site conditions, haul distance to a biomass power plant and the current price paid for biomass fuel. To ensure that the quoted costs would be comparable to those quoted for open burning, the scope included tree removal, grinding and transport to the biomass facility. The pricing did not include any impact from any federal or other incentive programs aimed at promoting use of agricultural material as biomass fuel (since such programs are considered temporary).

Similar to the pricing obtained for orchard burning, the District's discussions with orchard removal contractors also indicated that the pricing for citrus orchards is higher than the average for other orchard types, primarily due to issues with separation of dirt from the root ball in clay or rocky soil and the lower desirability of citrus as biomass fuel. This is consistent with the estimates provided by the agricultural industry which also indicate a higher pricing for citrus versus other types of orchards. Based on discussions with contractors, a value of 30 tons biomass fuel per acre was assumed for citrus orchards.

In the costs presented in the table above, the District's data assumed that the roots, after drying in the field, will be transported to a composting operation. The following cost estimates were provided by the ag industry for removing root materials: \$75 for one ton of roots and \$244 for four tons of roots. For orchard removals, District staff estimated the roots to weigh four tons per acre. For vineyard removals, District staff assumed that the roots weigh one ton per acre. Ag industry estimates were based on 1 ton of roots per acre for orchards and 4 tons per acre for vineyards.

As with open burning, the prices listed above do not include extraction of roots from the field and the loading of roots into piles for further handling because as mentioned previously, it is assumed that this cost will be incurred regardless of the approach used for orchard or vineyard removal and thus can be ignored for the District's comparative analysis.

Review of Table 6-2 indicates that the prices obtained by the District for open burning and grinding for biomass are very similar to the estimates provided by the ag industry. In addition, since the pricing differential between grinding to biomass and open burning shown in Table 6-2 is generally greater when based on the quotations obtained by the District rather than on the information provided by the ag industry, the District's cost effectiveness analysis will be performed based only on the quotations obtained by the District since this will provide the most conservative analysis with respect to industry's concerns.

6.2.2 Costs for Disposal of Orchard Prunings by Chipping

Options for chipping and recycle of prunings consist of:

1. Chipping prunings for conversion to biomass fuel
2. In-row chipping of prunings for on-site land incorporation

The practice of chipping prunings for conversion to biomass fuel is less commonly practiced in comparison to in-row chipping for land incorporation and the pricing was found to be variable depending upon the business approach by the contractor. Information provided by an operator with smaller chipping equipment indicated that prunings could be chipped for biomass at a cost of \$100 per dry ton with a minimum job charge of \$500. An operator with large grinding equipment indicated that under good conditions the cost could be \$40 - \$60 per ton with a minimum of \$6,000 per day when grinding prunings for biomass.

Costs for chipping prunings for land incorporation have been included in a number of recent studies by the University of California Cooperative Extension as presented in Table 6-3:

UC Report	Title	Date	Cost per Acre to Shred Prunings
NC-VS-09	Sample Costs to Establish and Produce Nectarines	2009	\$41
OL-SV-09	Sample Costs to Produce Olives	2009	\$10
PH-VS-09	Sample Costs to Establish and Produce Peaches	2009	\$41
WN-VN-07	Sample Costs to Establish and Produce Walnuts	2007	\$27
AM-VS-08-1	Sample Costs to Establish and Produce Almonds	2007	\$24

In addition, a chipper operator was contacted to obtain a budgetary quotation. This contractor indicated an in-row chipping price of \$26 per acre with a \$500 project minimum, regardless of tree type. An analysis provided by the farming industry indicated that the in-row chipping operation for almonds would cost \$30-\$65 per acre depending upon the age of the trees. For purposes of this analysis and based on the information above, the District will assume that the prices for in-row chipping for land incorporation may vary from \$30 to \$60 per acre.

6.3 COST EFFECTIVENESS OF ALTERNATIVES TO OPEN BURNING

6.3.1 Approach

In general, the reduction of agricultural material from the pruning or the removal of orchards and vineyards by grinding or chipping followed by conversion to either biomass fuel or land incorporation results in fewer emissions when compared to open burning; however, these operations may incur extra costs over those associated with open burning. To examine the cost feasibility of these alternatives, cost effectiveness (CE) in dollars per ton of emission reduction is defined as the cost differential between chipping or grinding and open burning in dollars per acre divided by the difference between burning and chipping in per acre total emissions ($PM_{2.5} + NO_x + VOC$), or:

$$CE = \left(\frac{((\$/acre)_{chip} - (\$/acre)_{burn})}{(\text{tons-emissions/acre})_{burn} - (\text{tons-emissions/acre})_{chip}} \right)$$

The cost effectiveness calculated by the above expression will primarily be a function of the type of tree or plant (which determines the difficulty of removal and the amount and fuel quality of the material, affecting both the denominator and numerator of the above expression) and of the total acreage which affects the numerator of the above expression since operations on smaller acreages cost more per acre due to the project minimums imposed by most orchard contractors.

6.3.2 Emissions Due To Open Burning

Open Burning of Orchard Removals

Emissions of $PM_{2.5}$, NO_x and VOC from open burning operations have been estimated by the District based on the following:

- Emissions estimates for orchard removals include:
 1. Highway vehicle emissions to deliver mobile equipment to the site
 2. Emissions from a dozer used to remove the trees or vines
 3. Emissions from a wheel loader used to stack trees or vines into piles for burning
 4. Tractor emissions for collection and stacking of roots for burning
 5. Emissions from open burning of trees, vines and roots

- Emission factors for open burning are taken from the District's 2008 Area Sources Emission Inventory Methodology (revised 01Jun09) for orchard removals. Values are:

PM_{2.5} 7.3 lb/ton material burned
NO_x 5.2 lb/ton material burned
VOC 5.2 lb/ton material burned
- Highway vehicle emissions for delivery of equipment assumes two 100 mile round-trips for a heavy haul truck to deliver a dozer and a wheel loader.
- Dozer emissions are estimated based on a 300 hp Tier 2 diesel engine requiring one hour of operation for 70 tons for material.
- Wheel loader emissions are estimated based on a 250 hp Tier 2 diesel engine operating at a rate of one hour per acre.
- Tractor emissions required for piling and burning of roots are estimated based on an 80 hp tier 2 diesel engine operating at a rate of one hour per acre.

Open Burning of Orchard Prunings

Emissions of PM_{2.5}, NO_x and VOC from open burning operations have been estimated by the District based on the following:

- Emissions estimates for orchard removals include:
 1. Highway vehicle emissions to deliver mobile equipment to the site
 2. Emissions from a wheel loader used to stack trees or vines into piles for burning
 3. Emissions from open burning of prunings
- Emission factors for open burning are taken from the District's 2008 Area Sources Emission Inventory Methodology (revised 01Jun09) for orchard removals. Values are:

PM_{2.5} 7.3 lb/ton material burned
NO_x 5.2 lb/ton material burned
VOC 5.2 lb/ton material burned
- Highway vehicle emissions for delivery of equipment assumes one 100 mile round-trip for a heavy haul truck to deliver a wheel loader to the site.

- Wheel loader emissions are estimated based on a 250 hp Tier 2 diesel engine operating at a rate of one hour per acre.

6.3.3 Emissions Due to Grinding and Conversion of Material to Biomass Fuel

Grinding and Conversion of Material from Orchard Removals to Biomass Fuel

Emissions of PM_{2.5}, NO_x and VOC from grinding and conversion have been estimated by the District based on the following:

- Emissions estimates for grinding and conversion of material to biomass fuel include:
 1. Highway vehicle emissions to deliver mobile equipment to the site, deliver ground material to the biomass plant and to deliver roots to a composting operation
 2. Emissions from an excavator or dozer used to remove the trees or vines
 3. Emissions from two wheel loaders used to stack trees, vines, and roots into piles for burning
 4. PM_{2.5} emissions from grinding of trees, vines and roots
 5. Engine emissions (PM_{2.5}, NO_x, and VOC) from the grinder
 6. Dozer operation at the biomass facility to receive and handle the fuel
 7. Power plant emissions due to fuel burning
- The PM_{2.5} emission factor for grinding (0.05 lb per ton) was based on a review of existing District permits for grinding wood material and vineyard materials. A review of four existing permits indicated a range of 0.0088 lb/ton to 0.08 lb/ton with an average of 0.03.
- Emission factors for biomass power plant operation are based on reported operation for the Delano plant. Values are:

PM_{2.5} 0.86 lb/ton material burned
NO_x 1.92 lb/ton material burned
VOC 0.38 lb/ton material burned
- Highway vehicle emissions calculations assume four 100 mile round-trips for a heavy haul truck to deliver a tubgrinder, an excavator and two wheel loaders to the site, one (1) 100-mile round trip for every 24 tons of ground material for delivery to the biomass power plant, and one (1) 100-mile round trip for every 24 tons of roots for delivery to composting operation.
- Excavator emissions for orchard removal are estimated based on a 240 hp Tier 1 diesel engine requiring one hour of operation per acre.

- Wheel loader emissions associated with the grinding operation are estimated based on a 250 hp Tier 2 diesel engine operating at a rate of three hours per acre.
- Tub grinder emissions are estimated based on a 1000 hp Tier 2 diesel engine operating at a rate of one hour per acre.
- Dozer emissions for receiving and handling material at the biomass power plant are estimated based on a 300 hp Tier 2 diesel engine requiring two hours of operation for 70 tons for material received.
- Wheel loader emissions required for gathering and loading roots for transport to a composter are estimated based on a 250 hp Tier 2 diesel engine operating at a rate of one hour per acre.

Grinding and Conversion of Orchard Prunings to Biomass Fuel

Emissions of PM_{2.5}, NO_x and VOC from grinding and conversion have been estimated by the District based on the following:

- Emissions estimates for grinding and conversion of material to biomass fuel include:
 1. Highway vehicle emissions to deliver mobile equipment to the site and deliver ground material to the biomass plant
 2. Emissions from one wheel loader used to handle prunings
 3. PM_{2.5} emissions from grinding of prunings
 4. Engine emissions (PM_{2.5}, NO_x, and VOC) from the grinder
 5. Dozer operation at the biomass facility to receive and handle the fuel
 6. Power plant emissions due to fuel burning
- The PM_{2.5} emission factor for grinding (0.05 lb per ton) was based on a review of existing District permits for grinding wood material and vineyard materials. A review of four existing permits indicated a range of 0.0088 lb/ton to 0.08 lb/ton with an average of 0.03.
- Emission factors for biomass power plant operation are based on reported operation for the Delano plant. Values are:

PM_{2.5} 0.86 lb/ton material burned
NO_x 1.92 lb/ton material burned
VOC 0.38 lb/ton material burned

- Highway vehicle emissions calculations assume two 100 mile round-trips for a heavy haul truck to deliver a grinder and a wheel loader to the site and one (1) 100-mile round trip for every 24 tons of ground material for delivery to the biomass power plant.
- Wheel loader emissions associated with the grinding operation are estimated based on a 250 hp Tier 2 diesel engine operating at a rate of three hours per acre.
- Grinder emissions are estimated based on a 100 hp Tier 2 diesel engine operating at a rate of one hour per acre.
- Dozer emissions for receiving and handling material at the biomass power plant are estimated based on a 300 hp Tier 2 diesel engine requiring two hours of operation for 70 tons for material received.

Chipping of Prunings for Land Incorporation

Emissions of PM_{2.5}, NO_x and VOC from grinding and conversion have been estimated by the District based on the following:

- Emissions estimates for chipping of prunings for land incorporation include:
 1. Highway vehicle emissions to deliver mobile equipment to the site
 2. Emissions from a wheel loader used to handle the prunings
 3. PM_{2.5} emissions from grinding of prunings
 4. Engine emissions (PM_{2.5}, NO_x, and VOC) from the grinder
- The PM_{2.5} emission factor for grinding (0.05 lb per ton) was based on a review of existing District permits for grinding wood material and vineyard materials. A review of four existing permits indicated a range of 0.0088 lb/ton to 0.08 lb/ton with an average of 0.03.
- Highway vehicle emissions calculations assume two 100 mile round-trips for a heavy haul truck to deliver a grinder or chipper and one wheel loader to the site.
- Chipping or grinding emissions are estimated based on a 415 hp Tier 1 diesel engine requiring one hour of operation per acre.

- Wheel loader emissions associated with the grinding operation are estimated based on a 250 hp Tier 2 diesel engine operating at a rate of one hour per acre.

6.3.4 Per Acre Costs and Per Acre Emissions

Table 6-4 presents the results of the District's evaluation of emissions and per acre costs for converting orchard removal material to biomass fuel by grinding versus open burning for orchards other than citrus. Likewise, Table 6-5 presents the results of the District's evaluation emissions and per acre costs for converting orchard removal material to biomass fuel by grinding versus open burning for citrus orchards. The tables present results for plot sizes between 1 and 20 acres, with the expected emissions and cost for burning per acre, expected emissions and cost for grinding per acre, differential emissions and differential cost per acre. The cost structure shown in the tables reflects a \$5,000 minimum charge required for orchard removals by grinding to biomass and a minimum charge of \$1,150 for orchard removal by open burning. The "per acre" charge indicated in Table 6-2 only becomes effective after the minimum project cost is exceeded. As a result, per-acre cost is generally higher for smaller acreages, trending to a lower fixed value for larger acreages as would be expected. Per acre emissions are also somewhat higher for smaller acreages primarily due to the emissions associated with mobilization of equipment at the site.

Table 6-6 presents a similar analysis for vineyard removals with a pricing structure similar to Tables 6-4 and 6-5. As with orchards, per-acre costs and cost effectiveness value is generally higher for smaller acreages, trending to a lower fixed value for larger acreages.

Table 6-4
Per Acre Emissions and Costs Using District Data
Open Burning versus Grind and Haul for Orchards other than Citrus

Cost Basis: Chipper Contractor Quotations Jan 2010

Orchard Removal Size	Open Burning				Grind & Haul				Difference			
	Emissions Tons per Acre		Cost \$/acre	VOC	Emissions Tons per Acre		Cost \$/acre	VOC	Emissions Reduction Tons per Acre		Cost \$/acre	VOC
	NO _x	PM _{2.5}			NO _x	PM _{2.5}			NO _x	PM _{2.5}		
1	0.0945	0.1240	\$1,150	0.1075	0.0575	0.0145	0.0065	\$5,244	0.0370	0.1095	0.1010	\$4,094
2	0.0925	0.1243	\$575	0.1073	0.0503	0.0143	0.0065	\$2,744	0.0422	0.1100	0.1008	\$2,169
3	0.0918	0.1242	\$383	0.1072	0.0480	0.0142	0.0065	\$1,911	0.0438	0.1100	0.1007	\$1,527
4	0.0915	0.1241	\$288	0.1073	0.0468	0.0141	0.0065	\$1,494	0.0447	0.1100	0.1008	\$1,207
5	0.0913	0.1242	\$267	0.1072	0.0465	0.0141	0.0065	\$1,244	0.0448	0.1101	0.1007	\$977
6	0.0912	0.1242	\$267	0.1072	0.0460	0.0141	0.0065	\$1,077	0.0452	0.1101	0.1007	\$810
7	0.0911	0.1241	\$267	0.1072	0.0459	0.0141	0.0065	\$958	0.0452	0.1100	0.1007	\$691
8	0.0910	0.1242	\$267	0.1072	0.0456	0.0141	0.0065	\$869	0.0454	0.1101	0.1007	\$602
9	0.0909	0.1242	\$267	0.1072	0.0456	0.0141	0.0065	\$800	0.0453	0.1101	0.1007	\$533
10	0.0909	0.1242	\$267	0.1072	0.0453	0.0141	0.0065	\$744	0.0456	0.1101	0.1007	\$477
12	0.0908	0.1242	\$267	0.1072	0.0450	0.0140	0.0065	\$661	0.0458	0.1102	0.1007	\$394
14	0.0908	0.1242	\$267	0.1072	0.0450	0.0141	0.0065	\$632	0.0458	0.1101	0.1007	\$365
15	0.0908	0.1242	\$267	0.1072	0.0449	0.0141	0.0065	\$632	0.0459	0.1101	0.1007	\$365
16	0.0908	0.1242	\$267	0.1072	0.0448	0.0141	0.0065	\$632	0.0460	0.1101	0.1007	\$365
18	0.0907	0.1242	\$267	0.1072	0.0448	0.0141	0.0065	\$632	0.0459	0.1101	0.1007	\$365
20	0.0907	0.1242	\$267	0.1072	0.0447	0.0141	0.0065	\$632	0.0460	0.1101	0.1007	\$365

Basis:

- 30 BDT/acre for other orchard
- 4 BDT/acre for roots
- Roots are burned in burning case
- Roots are transported to composting operation for grinding case
- Grind & haul cost includes \$244 for root composting

**Table 6-5
Per Acre Emissions and Costs Using District Data
Open Burning versus Grind and Haul for Citrus**

Cost Basis: Chipper Contractor Quotations Jan 2010

Orchard Removal Size	Open Burning						Grind & Haul						Difference		
	Emissions Tons per Acre			Cost \$/acre	Emissions Tons per Acre			Cost \$/acre	Emissions Reduction Tons per Acre			Cost \$/acre			
	NO _x	PM _{2.5}	VOC		NO _x	PM _{2.5}	VOC		NO _x	PM _{2.5}	VOC				
1	0.0945	0.1240	0.1075	\$1,150	0.0575	0.0145	0.0065	\$5,244	0.0370	0.1095	0.1010	\$4,094			
2	0.0925	0.1243	0.1073	\$575	0.0503	0.0143	0.0065	\$2,744	0.0422	0.1100	0.1008	\$2,169			
3	0.0918	0.1242	0.1072	\$400	0.0480	0.0142	0.0065	\$1,911	0.0438	0.1100	0.1007	\$1,511			
4	0.0915	0.1241	0.1073	\$400	0.0468	0.0141	0.0065	\$1,494	0.0447	0.1100	0.1008	\$1,094			
5	0.0913	0.1242	0.1072	\$400	0.0465	0.0141	0.0065	\$1,244	0.0448	0.1101	0.1007	\$844			
6	0.0912	0.1242	0.1072	\$400	0.0460	0.0141	0.0065	\$1,077	0.0452	0.1101	0.1007	\$677			
7	0.0911	0.1241	0.1072	\$400	0.0459	0.0141	0.0065	\$958	0.0452	0.1100	0.1007	\$558			
8	0.0910	0.1242	0.1072	\$400	0.0456	0.0141	0.0065	\$869	0.0454	0.1101	0.1007	\$469			
9	0.0909	0.1242	0.1072	\$400	0.0456	0.0141	0.0065	\$800	0.0453	0.1101	0.1007	\$400			
10	0.0909	0.1242	0.1072	\$400	0.0453	0.0141	0.0065	\$769	0.0456	0.1101	0.1007	\$369			
12	0.0908	0.1242	0.1072	\$400	0.0450	0.0140	0.0065	\$769	0.0458	0.1102	0.1007	\$369			
14	0.0908	0.1242	0.1072	\$400	0.0450	0.0141	0.0065	\$769	0.0458	0.1101	0.1007	\$369			
15	0.0908	0.1242	0.1072	\$400	0.0449	0.0141	0.0065	\$769	0.0459	0.1101	0.1007	\$369			
16	0.0908	0.1242	0.1072	\$400	0.0448	0.0141	0.0065	\$769	0.0460	0.1101	0.1007	\$369			
18	0.0907	0.1242	0.1072	\$400	0.0448	0.0141	0.0065	\$769	0.0459	0.1101	0.1007	\$369			
20	0.0907	0.1242	0.1072	\$400	0.0447	0.0141	0.0065	\$769	0.0460	0.1101	0.1007	\$369			

Basis:

30 BDT/acre for citrus

4 BDT/acre for roots

Roots are burned in burning case

Roots are transported to composting operation for grinding case

Grind & haul cost includes \$244 for root composting

**Table 6-6
Per Acre Emissions and Costs Using District Data
Open Burning versus Grind and Haul for Vineyards/Kiwis**

Cost Basis: Chipper Contractor Quotations Jan 2010

Orchard Removal Size	Open Burning			Grind & Haul			Difference			
	Emissions Tons per Acre			Emissions Tons per Acre			Emissions Reduction Tons per Acre			
	NO _x	PM _{2.5}	VOC	NO _x	PM _{2.5}	VOC	NO _x	PM _{2.5}	VOC	
1	0.0210	0.0220	0.0190	0.0305	0.0030	0.0020	0.0000	0.0190	0.0170	\$4,575
2	0.0193	0.0220	0.0190	0.0233	0.0028	0.0018	0.0000	0.0192	0.0172	\$2,650
3	0.0185	0.0220	0.0190	0.0210	0.0027	0.0017	0.0000	0.0193	0.0173	\$2,008
4	0.0183	0.0220	0.0190	0.0199	0.0026	0.0016	0.0000	0.0194	0.0174	\$1,688
5	0.0180	0.0220	0.0190	0.0195	0.0026	0.0016	0.0000	0.0194	0.0174	\$1,495
6	0.0179	0.0220	0.0190	0.0190	0.0026	0.0016	0.0000	0.0194	0.0174	\$1,345
7	0.0176	0.0219	0.0190	0.0186	0.0026	0.0016	0.0000	0.0193	0.0174	\$1,226
8	0.0178	0.0219	0.0189	0.0183	0.0026	0.0016	0.0000	0.0193	0.0173	\$1,137
9	0.0177	0.0219	0.0189	0.0181	0.0026	0.0016	0.0000	0.0193	0.0173	\$1,068
10	0.0177	0.0220	0.0190	0.0182	0.0026	0.0016	0.0000	0.0194	0.0174	\$1,012
12	0.0176	0.0220	0.0190	0.0178	0.0026	0.0016	0.0000	0.0194	0.0174	\$929
14	0.0175	0.0220	0.0190	0.0176	0.0026	0.0016	0.0000	0.0194	0.0174	\$869
15	0.0175	0.0220	0.0190	0.0176	0.0026	0.0016	0.0000	0.0194	0.0174	\$845
16	0.0175	0.0219	0.0190	0.0176	0.0026	0.0016	0.0000	0.0193	0.0174	\$825
18	0.0175	0.0219	0.0189	0.0175	0.0026	0.0016	0.0000	0.0193	0.0173	\$790
20	0.0175	0.0220	0.0190	0.0175	0.0026	0.0016	0.0000	0.0194	0.0174	\$762

* Grind and haul cost includes \$650 per acre for removal of wire and stakes
\$75 per acre for composting roots

Basis

- 5 BDT/acre for Vineyard
- 1 BDT/acre for roots
- Roots are burned in burning case
- Roots are transported to composting operation for grinding case

Prunings

For the alternative of grinding orchard prunings for conversion to biomass fuel, the District evaluated the emissions as follows based on one (1) bone-dry ton per acre of prunings and a 20 acre orchard plot size:

Table 6-7 Emissions Comparison Open Burning versus Grinding for Biomass Fuel										
Tons per acre	Acres	Burn - lbs/acre			Grind/Biomass - lb/acre			Emission Reduction for Chipping - lb/acre		
		PM _{2.5}	NO _x	VOC	PM _{2.5}	NO _x	VOC	PM _{2.5}	NO _x	VOC
1	20	7.9	7.7	6.4	1.1	7.6	0.6	6.8	0.1	5.8

For the alternative of chipping orchard prunings for land incorporation, emissions estimates are as follows based on one (1) bone dry ton of prunings per acre:

Table 6-8 Emissions Comparison Open Burning versus Shredding for Land Incorporation										
Tons per acre	Acres	Burn - lbs/acre			Chip/Land Incorporate lb/acre			Emission Reduction for Chipping - lb/acre		
		PM _{2.5}	NO _x	VOC	PM _{2.5}	NO _x	VOC	PM _{2.5}	NO _x	VOC
1	20	7.9	7.7	6.4	0.2	6.2	0.4	7.7	1.5	6.0

Per the above tables, shredding the pruning materials provides the greatest reduction in emissions relative to open burning. Based on the greater emission reductions and reliability of cost data, the District will base further analysis only on the alternative method of shredding the materials in place. As previously mentioned, shredding operations may vary between \$30 and \$60 per acre depending on the availability of custom shredder and the amount of pruning material, while burning costs \$22 per acre. District staff has used the higher costs of shredding as a conservative estimate and determined the incremental cost of shredding to be \$38 per acre.

6.4 ADDITIONAL IMPACTS (COST AND AVAILABILITY) OF NEW ARB REGULATIONS ON TRUCKS AND EQUIPMENT

Agricultural representatives note that the costs for the upcoming off-road equipment (Tier 3), which needs to be replaced by 2012, need to be considered. The factors in the previous rulemaking analysis did not include trucks, Heavy Duty Rules, and AB32 (new colors on tractors, turning off AC units). It has been suggested that District staff analyze what has changed for the line items for '20 acres or less' in the 2007 analysis.

Agricultural representatives do not believe there has been any decrease in costs and that the new costs will increase for chippers because of the equipment replacements. The additional components of the "Off-Road" rule and the amount (\$26/ton instead of \$28/ton) the biomass power plants are now paying for the material could also impact the cost analysis. The District's costs analysis above are based on the most current and best available information from the chipping operator and agricultural industry. District staff will reevaluate any significant impact to the industry as necessary.

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