Chapter 4

Technological Feasibility of Alternatives to Burning

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Chapter 4: TECHNOLOGICAL FEASIBILITY OF ALTERNATIVES TO BURNING

District staff has conducted detailed research and identified several potentially feasible alternatives to open burning of agricultural materials. Some of the alternatives were previously identified during the 2005 and 2007 burn prohibition schedules. Potential alternatives for agricultural wood and agricultural non-wood materials were identified for each of the following groups: 1) vegetative and related material and 2) animal-related material.

The more common methods of disposing of agricultural material that cannot be open burned include the following:

- Some agricultural materials, like orchard removals, are primarily transported to biomass power plants for use as fuel.
- Chip or grind the material and transport it off-site for disposal or other renewable uses.
- Prunings and some field crop materials may be shredded in place, chipped onsite, or tilled into the soil.
- Some materials, such as rice straw, may be baled and sold for various commercial purposes, although the market for such product is much less than available supplies.

The potential alternatives to open burning of agricultural wood and agricultural non-wood materials are described below.

4.1 VEGETATIVE AND RELATED MATERIAL

Most alternatives to open burning agricultural wood materials and pruning materials require that the agricultural materials go through a chipping, grinding or shredding process. These processes are typically used to change the agricultural wood materials into a more manageable and useable size. Some of the benefits of chipping, grinding and shredding include faster decomposition of the materials, easier incorporation into the soil, easier to process and transport, and better combustion when used as fuel at biomass power plants.

Agricultural wood and pruning material that are to be chipped need to be as free of debris as possible to prevent damage to the chipping equipment and to increase its acceptability by potential end users such as biomass power plants and other processors. Orchard removal material is usually removed from the farm after the chipping process, as growers want a relatively clean field for planting a new crop. For pruning, growers may recycle the materials onsite or remove the material from the farm.

4.1.1 Biomass Power Plants

Biomass power plants in the SJVAB will generally accept agricultural, forestry, construction, and urban residues. The power plants burn the material in combustors to produce steam. The steam is then used to spin turbines to generate electricity.

Biomass power plants do not universally accept all agricultural material due to concerns that some materials may harm power plant machinery. Several issues have been noted concerning the types of material, such as citrus chips, that can be burned by the biomass power plants and the amount of agricultural materials that is accepted at the biomass power plants at any given time. Biomass power plant operators have indicated that these issues have been overcome over the past few years as the facilities involved have adapted in processing the ag materials to better suit the situations encountered.

Using the orchard removal materials for fuel at the biomass power plant is currently the most viable and cost effective alternative to open burning for growers due to available tax credits for biomass facilities and required agricultural offsets for some biomass power plants. However, reliance on biomass fuel as a primary alternative to burning is somewhat uncertain since there are no long-term federal or state funding commitments for the biomass facilities in the SJVAB. It is also relatively more affordable for the biomass power plants to accept urban waste than agricultural materials. Pruning materials are sometimes accepted by biomass power plants. The residents of a typical community are being charged more money to divert urban waste out of a landfill. Therefore, the urban waste is subsidized by the community in their waste payments and this provides the urban fuel to be processed at biomass plants at a more competitive price.

4.1.2 Land Application/Soil Incorporation

Applying agricultural materials to the soil is a common method of disposal of the materials. The pruning material from many tree crops and vineyards is usually gathered into windrows and shredded in place using grinders suitable for brush. The shredded material can either be left on the ground or be incorporated into the soil when the field is tilled. Over time, the material decomposes into the soil which adds valuable organic material to the soil and can lead to better water infiltration and soil quality. This practice is evolving as more growers and equipment manufacturers innovate and collaborate to make the process work for everyone.

Current practice does not work well for all crops, especially for pome (apple, pears, and quince) fruits with concerns over the spread of diseases and for nut crops which harvest the nuts from the ground. With the exception of the potential spread of diseases from pome fruits, other operators can usually minimize or prevent this problem for other crops by taking steps to better ensure that chipped pruning material has decomposed by the time that crops are harvested or that chipped pruning material is not placed in the area where the crop is to be harvested. The pruning material can be chipped into smaller pieces using upgraded technologies that can shred the material into finer quality. The cost of this equipment will be assessed later in this report to determine if it would be economically feasible.

4.1.3 Anaerobic Digestion

Anaerobic digestion is a biological process that decomposes organic matter with minimal or no oxygen level, which results in a liquid/solid stream (digestate) and biogas that contains mostly methane and carbon dioxide. This biological process can either be found or managed through some of the following: marshes, sediments, wetlands, the digestive tracts of ruminants and some insects, landfills, many wastewater treatment facilities, and animal feeding operations and dairies. The anaerobic digestion technology that is managed at a farm or facility could include several steps in the process, such as feedstock handling/storage, preprocessing, digester, collection and storage of the biogas, dewatering of the digestate, and handling/storage of the dewatered digestate.

There are currently no commercial-scale solid waste digesters in operation in the United States even though anaerobic digesters have long been used to treat agricultural and municipal wastewater. Although, District staff has found that the anaerobic digestion technology will be installed in Emmetsburg, Iowa, in 2011, as part of a commercial scale cellulosic ethanol plant. The digestate would be used as a source to power the plant.

District staff is not aware of any facilities in the SJVAB that can process agricultural materials through anaerobic digesters on a commercial scale. In addition, it is not believed to be practical to require that growers install an anaerobic digester for the purpose of disposing the agricultural material. The agricultural materials that are subject to Rule 4103 are typically pruned or removed once a year or every few years for orchard removals. Based on these considerations, District staff will not conduct further analysis on anaerobic digesters as a viable technology in the SJVAB.

4.1.4 Composting

Composting is the process by which organic material is broken down aerobically to form a biologically stable organic substance suitable as a soil enhancer and plant fertilizer.

Agricultural material is one of the sources of organic material for composting operations. Other sources could include, but are not limited to, urban waste, biosolids, and manure. The District distinguishes the blend of organic material into two categories, composting and co-composting. Along with vegetative material, co-composting includes biosolids, manure, and/or poultry litter. The vegetative materials are a good source of nitrogen, whereas, chipped wood provides carbon to the mixture. As a result, compost and co-compost facilities sometimes accept agricultural materials either as feedstock or as amendment for the operation. Some compost and co-compost facilities also accept and store the material for other use such as fuel for biomass power plants or animal feed. Based on District's data, there are currently 19 composting and co-composting facilities in the SJVAB that might be able to accept and process the agricultural material.

Sources usually pay a tipping fee to compost operators to dispose of the material at the composting site. With competing materials from subsidized urban waste, disposal costs for agricultural materials could be higher and the accepted amount of agricultural materials could vary. This fee would be additional to other operational costs, such as chipping and transporting the material to the compost facility. These operational costs for the grower would be similar to the cost of chipping and transporting the material to the biomass power plants, which does not charge a fee for disposal. Based on discussion with the chipping operators, most of the agricultural materials that are chipped are transported to biomass power plants for use as fuel. Therefore, District staff plans to conduct the economic feasibility analysis on transporting the material to biomass power plants as a more cost effective alternative.

4.1.5 Landfill

Growers and chipping companies can take agricultural materials to local landfills for disposal. Not all landfills will accept these materials, particularly landfills designated for hazardous waste. Municipal solid waste landfills are allowed to receive putrescible waste, such as yard waste or any methane producing material. Agricultural materials accepted at these landfills may be disposed at the site but are primarily being used as alternative daily cover (ADC) to reduce odor and for vector control. State Assembly Bill AB 939 was passed in 1989 and mandated local jurisdictions to meet solid waste diversion goals of 25 percent by 1995 and 50 percent by 2000. Local agencies within California are required to comply with the mandated landfill diversion requirement every year.

There are four landfill facilities within the District that are currently accepting organic material, which could include materials from agricultural crops and orchard removals. Similar to compost facilities, landfills also charge tipping fees for the disposal. Due to the state mandated landfill diversion requirement and the small number of landfills that are allowed to accept organic material, it is not feasible to promote agricultural material going to the landfills. District staff has considered the information above and plans to conduct the economic feasibility analysis on transporting the material to biomass power plants as a more cost effective alternative.

4.1.6 Cellulosic Ethanol Production

Cellulosic ethanol, a key next-generation biofuel, can be made from switch grass, corn stover, forest waste, fast-growing trees, wood chips and other plant material.

Advanced biofuels are those that do not rely on the corn kernel starch. In contrast, the most common type of ethanol in the United States is corn ethanol which is produced from corn with only the grain being used. Corn ethanol is primarily used in the United States as an alternative to gasoline and petroleum (first-generation biofuel).

The production of cellulosic ethanol is still predominately in the demonstration plant phase of development. At this time, District staff is not aware of any commercial plant within the SJVAB that currently uses agricultural materials for the production of cellulosic ethanol.

4.1.7 Gasification for Liquid Fuels

There are emerging technologies that can convert agricultural materials, sewer sludge, wood, trash, and plastics into diesel or biofuel. In traditional gasification, oxygen is used, but the new technique uses hydrogen and steam at nearly 1,500 degrees F to break apart the feedstock into a gas made up of its molecular components. After gasification, the resulting gas then goes through additional steps that produce water, wax, and diesel fuel. Up to 85% of the feed material becomes usable liquid fuel at the end of the process.

Agricultural wood materials can be used as a solid fuel by being burned in a combustion device or it can undergo processing to convert it into a gas or liquid fuel. Operators could choose to purchase a system given adequate space, but many of these vendors are located outside of California. For most of these situations, the agricultural wood materials are usually chipped on the farm site and then transported to the processing facility. District staff is not aware of these types of facilities currently in operation in the SJVAB, which would indicate that these technologies are not current alternatives to burning.

4.1.8 Pyrolysis

A new biofuel derived from wood chips through a pyrolysis process has been developed. The process involves heating wood chips and small pellets in the absence of oxygen and high temperature (pyrolysis). About a third of the dry wood becomes charcoal and the rest becomes a gas. The gas then undergoes a chemical process where it is converted into liquid bio-oil. According to researchers, the new method offers environmental benefits and could reduce industrial costs of alternative fuel for conventional diesel engines. The technique is still in the early stage; therefore, use of wood chips for this process would not be a viable alternative source in the SJVAB at this time.

4.1.9 Mulch

Soil Stabilization / Dust Control
A project in Northern California gauged the use of wood chips as an alternative source for soil erosion and stability to roads and parking areas. The Road Stabilization and Improvement Demonstration Project demonstrated that the use of wood chippings not only provides stabilization and erosion control on light duty, low-use roads, parking, and access areas, but is also cost-effective when compared to the use of other road materials.

The project found that using wood chips for road use was a feasible alternative to expensive materials such as rock or shale. Other benefits resulting from the project include added value to the chipped materials, improved site and off-site water quality, improved stability, usability, and mud free road and area conditions. The project addresses the successful use of wood chippings for soil stabilization or dust control as potential alternatives. District staff is not aware of a feasible market in the SJVAB that could accept and process all of the agricultural material for use as dust control but this alternative would be considered as a similar alternative to soil incorporation and a possible option, given that the materials serve as beneficial use. Typically, operators apply the chipped material onto surfaces for nutrient value and may apply the extra material on road surfaces. In other cases, not all roads are in need of chipped materials.

Hydraulic Mulch
Agricultural material can be shredded into wood fiber and used as hydraulic mulch by Caltrans or others. Hydraulic mulch is a mixture of shredded wood fiber or a hydraulic matrix and a stabilizing emulsion or tackifier. The mixture is

typically applied to disturbed areas requiring temporary protection until permanent vegetation is established or disturbed areas that must be re-disturbed following an extended period of inactivity (Caltrans Storm Water Quality Handbooks, Section 3, Hydraulic Mulch SS-3). Caltrans uses hydraulic mulch as one of the alternatives to temporarily protect exposed soil from erosion by rain or wind. However, the wood fiber hydraulic mulches are generally short-lived, lasting only a part of a growing season, which operators may have to take into account for long-term projects. In addition, for the wood fiber hydraulic mulches to be effective, the material requires a drying time of 24-hours (Standard Specifications Sections 20-2.08).

Wood chips to be used as hydraulic mulch are required to be cleaned and free of salt and deleterious materials such as clods, coarse objects, sticks, rocks, and weeds. Such requirements may minimize efficiency during processing of the agricultural materials, and increase costs from separating the material or diverting different parts of the material to various locations for alternative use. Use of hydraulic fiber mulch has increased over the years as it has proven to be a cleaner alternative to hay or straw mulches, however, staff is not aware of agricultural material being used for the hydraulic mulch process on a market scale. Therefore, staff will not pursue this option as a feasible alternative for open burning of agricultural material.

Wood Mulch

Agricultural materials could also be recycled as wood mulch. Wood mulching can be used in landscape projects or for erosion control and may be a mixture of shredded wood mulch, bark, and compost. The material is primarily used to reduce erosion by protecting bare soil from rainfall impact, increasing infiltration, and reducing runoff. Caltrans found that wood mulching can be used as temporary soil stabilization for disturbed areas awaiting revegetation and permanent cover or as a temporary, non-vegetative ground cover on slopes (Caltrans Storm Water Quality Handbooks – Section 3, Wood Mulching SS-8). As part of wood mulching, the greeneries from the agricultural materials may also be used for similar purposes and composted as necessary to kill weed seeds. However, there are limitations to using wood mulch, such as introduction to unwanted species, possible sheet erosion because the material cannot withstand concentrated flows, and the green materials may bring in unwanted weeds and plant materials. In addition to these considerations, staff is not aware of most agricultural material being used for this process on a market scale. Therefore, staff will not pursue this option as a feasible alternative to open burning of agricultural material.

4.1.10 Hand Crews for Removal of Materials

Some operators have considered using hand crews to remove materials, such as weeds, as a potential alternative for open burning. The labor-intensive removal of individual weeds is often characterized with unreasonable costs and safety issues. Additionally, hand removal of weeds is technically unfeasible due to the magnitude of weed abatement. Technological development is needed to reduce the burning of weed abatement material.

4.1.11 Overseas Shipment of Raisin Trays

In the past, some growers have shipped reusable materials, such as raisin trays, overseas to be recycled. However, the alternative is no longer available for these materials.

4.1.12 Water Decomposition for Rice Stubble (Straw)

In recent years, water decomposition has become more prevalent than burning rice fields stemming with the passing of the Connelly-Areias-Chandler Rice Straw Burning Reduction Act of 1991. The Act mandated the reduction of burned rice acres over a ten year period besides that which is done for disease control. Currently, rice farmers are restricted to burn no more than 25% of planted acres, or up to 125,000 acres basinwide, and have moved more to flooding rice fields to improve the rate of decomposition.

Rice farmers flail mow the rice stubble into about 4-inch sections and stubble disk it, to ensure it has contacted with the soil four to five inches deep. It is then flooded as soon as possible to keep the clods covered. Flooding the fields during the winter helps with blast and speeds decomposition, as well as providing some fertilizer benefits.

Water availability and costs for winter water are a concern but can be offset by other practices. Some disadvantages of water decomposition arise with certain weather conditions but extra precaution is taken, such as managing the water flow and battening down the hatches, to prevent damage to the rice patties. Water decomposition is a common alternative to burning and is required in areas that limit the amount of acreage that can be burned.

4.1.13 Baling Rice Stubble (Straw)

As discussed above, alternatives to burning rice fields have been sought, especially with the passing of the Connelly-Areias-Chandler Rice Straw Burning Reduction Act of 1991. Baling rice straw was a highly anticipated option when the Act was passed but has declined in viability. It is estimated that only about 3-5%

of farmers use rice straw off-field. Baling rice straw is utilized even less due to a diminished market need and cost of production. Soil incorporation and flooding rice fields are more feasible and viable alternatives while potential uses are still being explored.

4.2 ANIMAL-RELATED MATERIAL

4.2.1 Burial

Burial seems to be most suitable for small amounts of material. Burial requires care in site selection because as carcasses decompose, they release materials that can pollute ground water, particularly if large volumes are buried. Advantages of burial are the low cost (if the operator owns the necessary equipment) and biosecurity (no trucks coming to the farm to pick up carcasses).

4.2.2 Incineration

Field incineration is only appropriate for deceased animals in those instances where the spread of disease is a concern. Decisions on how to dispose of diseased animals are deferred to local agricultural commissioners.

4.2.3 Rendering

Rendering provides a much needed service to the animal industries in the SJVAB and is subject to certain government food safety and environmental regulations. There are six rendering plants in the SJVAB. Five of the plants are independent operations and collect animals from other sites. The sixth plant is an integrated plant and operates in conjunction with its affiliated animal slaughter and meat processing plants.

In most rendering systems, raw materials are ground to a uniform size and placed in continuous cookers or in batch cookers, which evaporate moisture and free fat from protein and bone. A series of conveyers, presses, and a centrifuge continue the process of separating fat from solids. The finished fat (e.g., tallow, lard, yellow grease) goes into separate tanks, and the solid protein (e.g., meat and bone meal (MBM) and poultry meal) is pressed into cake for processing into feed. Other rendering systems are used, including those that recover protein solids from slaughterhouse blood or that process used restaurant grease.

The five independent rendering plants provide pick up and delivery for their customers. The plants do not allow public drive-up delivery in order to better control traffic at the plant and the quality of the animals processed. The pick up and delivery service is not available to any operator that has animals available for several reasons. A key reason is the traveling expense which may make it impractical to pick up small numbers of carcasses.

Rendering companies have certain regulatory and operational restrictions regarding the condition of the carcasses they process. In addition to complying with regulations governing diseased animals, rendering companies will generally not accept carcasses that do not remain intact when handled. Depending upon the end product of the rendering process, there may be other restrictions on carcass quality and condition. Although this alternative is available, District staff does not consider rendering to be a viable or feasible alternative. District staff considers burial and incineration (for deceased animals with diseases) to be viable alternatives, which are current practices for the industry.

4.2.4 Sterilization

For bee hives of diseased colonies that must be destroyed, disease experts recommend that the frames and combs be burned in a pit and the ashes covered. The heavy woodenware (supers, tops and bottoms, etc.) may be sterilized by scraping them clean (the scrapings should be burned) and scorching the inside surfaces. The scorching can be done with a propane torch with particular attention being paid to cracks and corners. If large quantities of supers are to be scorched they may be stacked and painted inside with kerosene and lit. To sterilize large quantities of equipment, operators could set up a barrel with a boiling lye solution. The woodenware should be immersed in the solution and boiled until clean. Frames may also be sterilized in this manner.