



Placer County
AIR POLLUTION CONTROL DISTRICT

*Placer County Community Biomass Removal
Program*

Final Report Clean Air Grant Program - 2007

Placer County
California

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Placer County Community Biomass Box Program

Program Overview

Placer County implemented a “Biomass Box” program beginning in the spring of 2007 with partial funding of \$70,000 from a Placer County Air Pollution Control District (APCD) Clean Air Grant (contract number 25261), and \$10,000 of Placer County matching Funds. The program objective was and remains twofold: First, it encourages county residents to clear defensible space around their homes to improve fire safety and survivability. Secondly, it provides a means for collection (the “box”) and utilization of the resultant brush, tree limbs, natural debris, etc. (or as its called, “biomass”) for use as fuel for producing energy. Use of forest detritus in this manner is in marked contrast to the current practice of open burning on site.



Open burning of biomass

During this project we collected 3,361 green tons of material that was converted to 2052.6 MW of electrical energy (enough to power 228 homes for one year). Because this material was burned in a controlled facility instead of open burning the net air pollution reduction was 88.6 % or over 300 tons of pollutants.

Program Details

The first step of the program provided residents of urban forested areas with information, training, and assistance in clearing biomass and maintaining “defensible space” around homes and businesses. Clearing during spring, summer, and fall was encouraged in order to reduce the effects of wildfire, something most prevalent in the “fire season” which occurs annually from May to November.

Next, numerous “biomass boxes,” large 20’ to 40’ industrial containers, were placed throughout the participating communities for collection of biomass materials. Boxes were placed throughout the County from the Tahoe region in the east to the extreme western end of the County. Local fire agencies, homeowners associations and Fire Safe Councils organized and promoted the use of the boxes.



A typical 40’ biomass box

The Biomass Box Program complements other county fire prevention programs, including Defensible Space Inspections and Shaded Fuel Break Maintenance.

The County continues to try and meet the demand for this highly successful program throughout the region. A large percentage of the usage was in and around the Lake Tahoe region due to the proximity of the Angora and Washoe Fires in 2007. We allowed the North Tahoe Fire Protection District extra biomass boxes to keep up with the demand for slash removal beyond what their chipper program could handle. This resulted in reducing a six week waiting period (from a resident's request to actual arrival of chippers) during the height of fire season to two weeks.

Finally, our regional waste management partners -- Auburn Placer Disposal in the west end of the county, and Tahoe Truckee Sierra Disposal in the east end, were able to efficiently pick up the boxes, deliver them to a regional drop off station, grind the biomass into useable fuel that energy companies accept. This "chipped biomass" was then loaded onto larger trucks and hauled to one of two biomass utilization facilities (Rio Bravo Rocklin in the west and SPI Loyalton in the east).



Loading Biomass in a truck for transport to energy facilities

Problems Encountered / Services not Performed from Original Grant Application

No significant problems were encountered. The program was well received, residents were enthusiastic and grateful for the program, and it was, in all, a great success. Considerations for future efforts include:

- Providing additional assistance to the elderly/low income populace. Efforts to do just that are on-going.
- Advertising throughout the county. A majority of the funds were expended in the eastern end of the county as it had a higher participation rate, although material was collected from each of the five county districts.

Benefits to the Air District and Placer County from the Implementation of the Biomass Box Project

Placer County wishes to thank Bruce Springsteen of the PCAPCD for his assistance in all of the calculations regarding pollutants.

Under the Placer County Biomass Box program in the Year 2007, the following quantity of biomass was collected, processed, and transported for use as fuel to the biomass-to-energy facilities:

| | |
|---------------|--------|
| Green Tons | 3,361 |
| Bone Dry Tons | 1,849 |
| Cubic Yards | 18,488 |

Emissions reductions were determined for comparing:

- Biomass Box Program -- Emissions that occurred from the collection, processing, and transport of biomass for use as fuel at biomass power plants, and emissions from the biomass power plants.
- Baseline Avoided -- Emissions that would have occurred had the biomass been open burned in the field.

Emissions were determined for:

- CO (carbon monoxide)
- NO_x (nitrogen oxides)
- PM₁₀ (particulate matter, diameter less than 10 microns)
- NMOC (non-methane organic hydrocarbons)
- CH₄ (methane)
- CO₂ (carbon dioxide)

Table 1 and Table 2 summarize the emissions benefits from use of the Biomass Box Program. The "Appendix A" (attached) is background information with emissions factors that were used to make the emission comparisons.

Table 1. Criteria Pollutant Emission Reductions, Placer County Biomass Bin Collection, Year 2007

| | PM10 | CO | NMOC | CH4 | NOx |
|-------------------------------|-----------------------|--------------------|--------------------|-------------------|--------------------------|
| Baseline | | | | | |
| In-Forest Open Pile Burn (lb) | 50,422 | 504,218 | 50,422 | 10,084 | 13,446 |
| Biomass Box Program (lb) | | | | | |
| TOTAL | 1,007 | 18,744 | 345 | 983 | 5,367 |
| SPI Loyalton Boiler | 636 | 17,303 | 323 | 969 | 4,621 |
| Transport | 12 | 1,185 | 15 | 15 | 503 |
| Chipping | 359 | 257 | 8 | | 243 |
| Reduction (tons) | 24.7 | 242.7 | 25.0 | 4.6 | 4.0 |
| Reduction (%) | 98.0% | 96.3% | 99.3% | 90.2% | 60.1% |
| | Volume cubic yards | Weight wet tons | Weight dry tons | Moisture %/100 | Density yd3 / wet ton |
| | 18,488 | 3,361 | 1,849 | 0.45 | 5.5 |

Table 2. CO2 Emissions, Placer County Biomass Box Program, Year 2007

| | | |
|--|------------|--|
| Total Biomass Moved to SPI Loyalton | | |
| Green Tons | 3,361 | |
| BDT | 1,849 | |
| BDT/load | 12.5 | |
| | | |
| Heating Value (Btu/lb, dry) | 8,700 | |
| | | |
| Total Energy from Tahoe Bin Biomass (MMBtu) | 32,173 | |
| Loyalton Boiler Firing Rate (MMBtu/hr) | 300 | |
| | | |
| Equiv. Boiler Operating Time on Biomass | | |
| hr | 107 | |
| days | 4.5 | |
| | | |
| Loyalton Boiler Efficiency (%) | 22 | heat rate : 16,145 Btu / kWhe |
| Electricity Production from Biomass (MWhe) | 2052.6 | |
| | | |
| CO2 | | |
| avoided from displaced grid electricity (tons) | 884 | 861 lb CO2/Mwhe, ARB AB32 Scoping Plan |
| chipping and transport (tons) | 56 | |
| net reduction (tons) | 828 | |
| | | |
| <u>Transport CO2</u> | | |
| miles/trip | 100.0 | |
| BDT/trip | 12.5 | |
| # trips | 148.0 | |
| miles | 14,800.0 | |
| chip van mpg | 6.0 | |
| gallons fuel used | 2,466.7 | |
| kg CO2/gal fuel (ARB Scoping Plan) | 10.0 | |
| kg CO2 | 24,666.7 | |
| lb/CO2 | 54,331.9 | |
| tons CO2 | 27.2 | |
| | | |
| <u>Chipping CO2</u> | | |
| gal fuel/dry ton biomass | 1.4 | |
| total gas fuel | 2,588.6 | |
| tons CO2 | 28.5 | |

Program Summary

The value of the APCD funding to the health and well-being of the citizens of Placer County can be in part judged by the amount of biomass material not burned in the open lessening the amount of pollution released into the atmosphere. More importantly, the program provides a landmark opportunity for providing an economically self-sustaining solution to the problem of reducing the effects of over forestation in a healthy manner. Placer County appreciates the Air Pollution Control District's support, through this grant and supporting guidance, that will allow the biomass box program to continue to grow.

Appendix A

Open Pile Burning of Sierra Nevada Forest Material – Air Pollutant Emissions Factors

| | PM10 lb/wet ton | CO lb/wet ton | NMOC lb/wet ton | CH4 lb/wet ton | NOx lb/wet ton | SOx lb/wet ton |
|--|--------------------|------------------|--------------------|-------------------|-------------------|-------------------|
| EPA Emissions Factors for Open Burning (1) | 4 - 17 | 90 - 195 | 4 - 19 | 2 - 9 | | |
| EPA Emissions Factors for Prescribed Burning Piles (2) | 8 - 14 | 56 - 230 | 8 - 15 | 4 - 12 | | |
| U.C. Davis Lab Scale Study (3) | 9 - 11 | 65 - 85 | 6 - 11 | 2 - 3 | 3 - 4.5 | 0.14 |
| Emission Factor Used for this Study | 15 | 150 | 15 | 3 | 4 | 0.1 |

Sources:

- (1) U.S. EPA, Compilation of Air Pollutant Emission Factors, AP-42, Section 2.5, Open Burning, October 1992.
- (2) U.S. EPA, Compilation of Air Pollutant Emission Factors, AP-42, Section 13.1, Prescribed Burning, October 1996.
- (3) B. Jenkins, et al., Atmospheric Pollutant Emission Factors from Open Burning of Agricultural and Forest Biomass by Wind Tunnel Simulations, CARB Report No. A932-196, April 1996

Boilers Burning Biomass – Air Pollutant Emission Factors

| | PM10 | | | NOx | | | SO2 | | | CO | | | NMOC | | | CH4 |
|-----------------------|-------|----------|------------|-------|----------|------------|-------|----------|------------|-------|----------|------------|-------|----------|------------|------------|
| | lb/hr | lb/MMBtu | lb/dry ton | lb/hr | lb/MMBtu | lb/dry ton | lb/hr | lb/MMBtu | lb/dry ton | lb/hr | lb/MMBtu | lb/dry ton | lb/hr | lb/MMBtu | lb/dry ton | lb/dry ton |
| Rio Bravo Rocklin (1) | 4.50 | 0.0115 | 0.205 | 31.8 | 0.083 | 1.48 | 4.1 | 0.011 | 0.196 | 0.04 | 0.0001 | 0.0018 | 1.38 | 0.0036 | 0.064 | 0.192 |
| | | 0.0115 | | | 0.081 | | | 0.010 | | | 0.0001 | | | 0.0035 | | |
| SPI Lincoln (2) | 5.25 | 0.0179 | 0.319 | 35.0 | 0.120 | 2.13 | 0.3 | 0.001 | 0.018 | 50.00 | 0.1708 | 3.0408 | 1.18 | 0.0040 | 0.071 | 0.214 |
| SPI Loyalton (3) (4) | 3.30 | 0.0193 | 0.344 | 24.0 | 0.140 | 2.50 | 0.3 | 0.002 | 0.031 | 89.76 | 0.5258 | 9.3588 | 1.68 | 0.0098 | 0.175 | 0.524 |

- (1) From June 2007 Source Test of Rio Bravo Rocklin Circulating Fluidized Bed Boiler, burning urban wood waste and agricultural biomass wastes
- (2) From June 2007 Source Test of Sierra Pacific Industry Lincoln McBurney Grate Fired Boiler, burning mill wood wastes and agricultural biomass wastes
- (3) From August 2007 Source Test of Sierra Pacific Industry Loyalton Riley Grate Fired Boiler, burning urban wood wastes, mill residues and in-forest biomass wastes
- (4) Loyalton PM10 is based on 16 year average due to 2007 being extremely low (0.47 pph) and not representative of normal.

Chip Van Biomass Transport -- Air Pollutant Emission Factors

| | PM10 g/mile | NOx g/mile | CO g/mile | NMOC g/mile | CH4 g/mile | PM10 lb/mile | NOx lb/mile | CO lb/mile | NMOC lb/mile | CH4 lb/mile |
|--------------|----------------|---------------|--------------|----------------|---------------|-----------------|----------------|---------------|-----------------|----------------|
| Chip Van (1) | 0.4 | 17 | 40 | 0.5 | 0.5 | 0.000881 | 0.037445 | 0.088106 | 0.001101 | 0.001101 |

(1) Carl Moyer Program Guidelines, Diesel Heavy Duty Vehicles, November 2005

| | Transport Distance miles one-way | Biomass Moved wet tons | Number Van Trips | Total Trans Dist. miles |
|-------------------|--|------------------------------|---------------------|-------------------------------|
| Tahoe - Loyalton | 50 | 3361 | 134.5 | 13446 |
| Chip Van Capacity | 12.5 BDT/load 25 wet tons/load | | | |

Emissions from Transporting Forest Biomass to Boiler

| | PM10 lb | NOx lb | CO lb | NMOC lb | CH4 lb |
|------------------|------------|-----------|----------|------------|-----------|
| Tahoe - Loyalton | 11.85 | 503.48 | 1184.65 | 14.81 | 14.81 |

Emissions from Chip Van Travel Over Dirt Road

| | PM10 g/mile traveled |
|------------------|-------------------------|
| Unpaved Road (1) | 2.1 |

(1) California Air Resources Board, Emission Inventory, Section 7.10, Unpaved Road Dust (Non-Farm Roads)

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| | PM10 g/mile | NOx g/mile | CO g/mile | NMOC g/mile | CH4 g/mile | PM10 lb/mile | NOx lb/mile | CO lb/mile | NMOC lb/mile | CH4 lb/mile |
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| Unpaved Road (1) | 2.1 |

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Biomass Chipping

| | |
|------------------------------|--|
| Tub Grinder | Brushbusters, 600 HP tub grinder |
| Grinder Biomass Process Rate | 75 green tons/hr 37.5 dry tons/hr 50 biomass moisture, % |
| Engine size | 650 HP |
| Production rate/HP | 0.1154 wet tons/hr-HP |

Emissions from Engine

| Engine Emission Factor (1) | NOx g/HP-hr | VOC g/HP-hr | PM10 g/HP-hr | CO g/HP-hr | NOx lb/hr |
|----------------------------|----------------|----------------|-----------------|---------------|--------------|
| Tier I, 300-750 HP | 5.93 | 0.38 | 0.12 | 5 | 8.5 |
| Tier II, 300-750 HP | 3.79 | 0.12 | 0.088 | 4 | 5.4 |
| Tier III, 300-750 HP | 2.32 | 0.12 | 0.088 | 3 | 3.3 |

(1) Carl Moyer Program Guidelines, Agricultural Engines, Off-Road Diesel, Table B-12, November 2005

| | NOx lb/wet ton | VOC lb/wet ton | PM10 lb/wet ton | CO lb/wet ton |
|---------|-------------------|-------------------|--------------------|------------------|
| Tier II | 0.0723 | 0.0023 | 0.0017 | 0.0764 |

Emissions from Chipper

| Uncontrolled (1) | Controlled (2) |
|----------------------|----------------------|
| PM10 lb/green ton | PM10 lb/green ton |
| 0.35 | 0.105 |

(1) EPA, AP-42, Log Sawing, Chapter 12

(2) PM control efficiency of 70% with water spray

(3) EPA, AP-42, Log Debarking, Chapter 12, 0.024 lb PM/ton