Burning Issues
A project of Clean Air Revival, Inc.

BIOMASS BURNING:

WOOD, LEAVES, GRASS, FORESTS, CROPS and TRASH

Luke Curtis, MS, CIH- from Human Ecologist- Fall Issue 2002

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Biomass Burning is a problem of long standing. Huge amounts of air pollution are produced worldwide by the annual burning of 3 billion metric tons of biomass such as wood, leaves, trees, grass and trash (Abelson). Biomass burning represents the largest source of air pollution in many rural areas of the developed and developing world. Biomass burning is used create heat, to clear forests, to dispose of leaves, crop stubble, trash and wood. Globally, biomass burning is estimated to produce 40 percent of the carbon dioxide, 32 percent of the carbon monoxide, 20 percent of the particulates, and 50 percent of the highly carcinogenic poly-aromatic hydrocarbons produced by all sources (Levine).

The ill-health effects of biomass burning are well-established. Smoke from biomass burning is particularly dangerous since most of the particulates are smaller than 10 microns in size (PM10) and are easily able to travel deep into the lungs. Numerous studies have noted that increasing levels of PM10 (even if below the US EPA standard of 50 micrograms PM10 per cubic meter of air) can significantly increase levels of respiratory and heart problems (Morris, Schwela) [and are linked with a sudden death rate of approximately 5 percent at that level. *ed*]. About 95 percent of this burning is set by people, although lightning sometimes ignites fields and forests (Levine).

WOOD BURNING

The most significant form of biomass burning in the USA is wood burning. Wood is a renewable resource that has generally been in ample supply in most of the US, although some countries are suffering severe deforestation. Wood was the predominant heating/industrial fuel in 18th century, while in the late

19th and 20th Centuries [more efficient *ed.*] coal, oil, natural gas and propane have displaced many uses of wood fuel. However, the energy shortages of 1974 and 1978 have promoted increased use of wood burning. The EPA (EPA, 1986) in 1984 estimated that there were 11 million U.S. wood burning stoves, that they burned 43 million tons for woodstoves annually, that fireplaces burned an additional 11 million tons, and industry another two million.

Burning a kilogram (2.2lbs.) of wood in a new wood stove will produce about 130 grams of **carbon monoxide**, 51 grams of **hydrocarbons** (including up to 10 grams of carcinogenic benzene), 21 grams of**fine particulates**, and about 0.3 grams of the highly carcinogenic **poly cyclic organic hydrocarbons** (EPA, 1984, Larson, 1993). Wood burning also produces from 10 to 107 milligrams of highly carcinogenic **dioxins** per kilogram of fuel burning (Abelson). Wood burning is responsible for about 3 percent of the total suspended particulates, 6 percent of the total carbon monoxide, and 51 percent of the highly carcinogenic polycyclic organic matter produced by all US sources (EPA, 1986). Wood smoke is usually released near ground level in populated areas and thus is especially apt to hurt people. Wood burning pollution is often concentrated in certain areas of the country such as the Northwest, and at specific times, such as winter evenings. [Biomass smoke is generally heavier than air and tends to sink to the ground. It causes high concentrations of deadly particulate where ever it is burned, from a food cart in New York City to a neighbor or restaurant near you. *ed.*]

Compared to natural gas, our cleanest burning fuel, wood burned in stoves produces 1,100 times the carbon monoxide, 50 times the sulfur oxides and 1,687 times the potent carcinogen benzo(a)pyrene to produce the same amount of BTU heat energy (Cooper)! Another study showed that an old wood stove will produce 16,500 times the particulates per day as will a gas furnace. (McCrillis, 1990). [A new woodstove is 8,500 times dirtier and deteriorates in efficiency rapidly. A pellet stove is 2,500 dirtier than natural gas or propane. *ed.]*

Wood burning can greatly increase outdoor pollutant concentrations. For example, in Missoula, Montana about half the households burn wood as a primary form of heat (Cannon, Missoula Department of Health). Wood burning was responsible for 51 percent of Missoula's average total suspended particulate (TSP) level of 110 microgram/ cubic meter of air in 1980. This TSP level of 110 micrograms/ cubic meter was almost double the old EPA standard of 60 micrograms TSP/ cubic meter of air. During many cold winter days with much wood burning the TSP levels exceeded 500 micrograms/ cubic meter. In the San Francisco Bay area Mary Rozenberg (Rozenberg) found significantly

higher levels of carbon monoxide, particulates and carcinogenic polycyclic aromatic hydrocarbons on winter evenings when wood burning is most common . Other studies have noted that wood burning can produce a large percentage of total winter airborne particulates smaller than 2.5 microns in size (PM2.5). The percentage of PM2.5 produced by wood burning in winter has been estimated to be 45 percent in San Francisco, 40 percent in Los Angeles, 50 percent in the Grand Canyon, 72 percent in Boise, Idaho, 75 percent in Albuquerque, 85 percent in Petersville, Alambama and 95 percent in Raleigh, North Carolina (Rozenberg, 2002). [This affects indoor concentrations as well, with readings as high as 70 percent of outdoor levels. There is no protection from this pollution as it is so small it bypasses masks and air filters. ed.]

Residential wood burning can increase average outdoor concentrations of the potent carcinogen benzo(a)pyrene by an average 8.8 nanograms (ng) per cubic meter (EPA, 1986). Occupational Physician Bertram Carnow (Carnow) estimated that for every 1 ng per cubic meter increase in benzo(a)pyrene there appears to be about a five percent increase in lung cancer.

A cord of wood is four feet by four feet by eight feet. A heavy wood stove user can burn eight cords in a winter. Joellen Lewtas (Lewtas) estimated that burning two cords of wood produces as many mutagenic particles as driving a car 130,000 miles at 20 miles per gallon! (Mutagenic means it causes mutations which often cause cancer.)

Wood burning not only increases pollution levels outdoors, it can greatly increase indoor pollution levels especially if the stoves/ fireplaces are not air-tight. [Even if they are air tight pollution re-enters the house. *ed*.]One study noted that wood burning can increase indoor pollution levels by as much as 7.5 PPM carbon monoxide and 480 micrograms/ cubic meter of total suspended particulates (TSP) (Traynor). Most wood smoke particles are less than 0.4 microns in diameter and can easily enter homes. Koenig (Koenig, 1993) found that indoor particulate levels in non-wood burning homes are about 70% as high as outdoor levels during heavy community wood burning periods. This suggests many of the burning particulates are able to penetrate into homes and indoor air.

Cooking over wood and charcoal grills was found to increase personal sample levels of particulates smaller than 2.5 microns in diamter (PM 2.5) by an average of 125 micrograms per cubic meter (Johnson).

ADVERSE HEALTH EFFECTS OF WOOD BURNING

Several studies have looked at the specific adverse health effects of wood burning. A Seattle area study (Koenig, 1990 & 1993) noted increases in asthma and other respiratory disease and declines in lung function among children exposed to woodsmoke.

Lung-function declines were especially great during wintertime wood burning periods and in children who lived in smoke trapping valleys. As much as 90 percent of the winter particulate levels were produced by wood burning. A study, in Santa Clara County, California, found significantly higher rates of hospital emergency room visits and significantly higher air levels of particulates (PM10) during the winter months. Residential wood burning was responsible for over 50 percent of winter particulates smaller than 10 microns (Lipsett). A Michigan study and a study with Navajo Indians both noted statistically significant increases in respiratory illnesses in children in homes with wood burning stoves (Hornicky, K Morris). Zelikoff (Zelikoff) found that rats suffered significantly lower rates of lung bacterial clearance and lung phagocytic (ie. microbe killing) activity when exposed to wood smoke at concentrations typically found indoors during residential wood burning periods.

David Fairley of the San Francisco Bay Area Air Quality Management District estimates that Bay area wood burning annually kills 200 and costs over $1 billion in medical expenses- even though only about 16 percent of the Bay population burns wood (Hall). It is estimated that wood smoke pollution is responsible worldwide for about 2.7 million premature deaths per year (World Health Organization).

A survey of gas and wood prices in Chicago in 2001 found than natural gas cost about the same as commercial wood on a BTU heat basis. On the other hand, natural gas can cause serious problems for a chemically sensitive person if it leaks out unburnt.

A number of states and communities have taken steps to reduce wood burning.

In 2001, the Berkeley, California city council banned new fireplaces, woodstoves and wood burning pizza ovens (Burress). Residential wood burning in the Puget Sound Area of Washington State and in Missoula, Montana is banned on high pollution days unless the house has no other source of heat. Medford, Oregon introduced a similar ban on wood burning on high pollution days and also required emission certification standards for wood burning stoves. Several legal judgements have ordered homeowners to stop using woodburning stoves because it poses a health threat to their neighbors

(Thomsen, McGrath). For more information on wood burning pollution please visit Mary Rozenberg's burning issues website at www.burningissues.org.

BURNING OF LEAVES, GRASS, AND TRASH

The second most significant form of biomass burning in the U.S. is the burning of leaves, grass, and trash. This smoke is particularly hazardous since it is released at ground level in populated areas. Burning a ton of leaves will produce about 117 pounds of carbon monoxide, 41 pounds of particulates (most of them smaller than 10 microns and easily absorbed in the lungs), and at least seven highly carcinogenic polycyclic aromatic hydrocarbons (Battelle, Friedman). A 1975 Des Moines study found that one-third of the air measurements during the leaf-burning month of October exceeded U.S.EPA standards for particulates and carbon monoxide, but none of the air measurements in nonburning August exceeded these standards. This study was instrumental in getting a leaf-burning ban in DesMoines in1977. [In addition, vegetation and trees are burned in urban areas to make way for housing. Forests and undergrowth vegetation are burned to remove fire hazard. *ed.*]

A number of studies have demonstrated adverse health effects from leaf burning. Jim VanDeBerg (VanDeBerg) director of Iowa Lutheran Hospital in Des Moines, reported that October 1975 respiratory admissions were 60 - or more than twice the monthly 1975 average of 28 admissions. Following the 1977 Des Moines leaf burning ban, the October 1977-1989 respiratory admissions at Iowa Lutheran Hospital were no greater than the annual average. The Des Moines leaf burning ban can therefore be projected to cut October respiratory admissions by at least half.

A detailed study of the effects of leaf burning on respiratory function was conducted in Beloit, Wisconsin in 1989 (From, 1992). Seven asthmatics on their usual asthma medication were asked to walk one mile during a Monday afternoon leaf burning period. Five of the seven asthmatics had a significant drop in lung function following leaf smoke exposure, with two asthmatics suffering a drop in FEV1 (forced expiratory volume at one second) of 20 percent or greater. The effects of the leaf smoke might have been even greater had the seven asthmatics not been on their usual asthma medication and/or the test had been conducted on a Saturday- when leaf burning rates are typically at their highest. Another study reported that 36 out of 60 asthmatics (60 percent) reported worsened asthma upon exposure to leaf smoke (Shim and Williams). In addition, burning poison ivy/ poison sumac leaves can release dangerous

quantities of the toxin urishiol, which can cause life threatening respiratory reactions and cause a rash over 100 percent of the body (Brill).

Stubble from wheat, corn, rice and other crops is often burned away in the fields. A 10-year study in Butte County, California noted that hospital asthma admissions were 29 percent higher than average on days when large quantities of rice stubble was been burned (Jacobs). A five-year study in a rice growing area of Japan reported that the average number of childhood asthma hospital visits were more than double during the rice burning months of September and October as compared to the rest of the year (Torigoe). Average airborne particulate concentrations were also more than double during September and October as compared to the rest of the year. In addition, an adult asthmatic volunteer in this study suffered a 41 percent drop in peak expiratory flow after being exposed to rice burning smoke for 20 minutes (Torigoe). A southern Lousiana study found that hospital respiratory admissions were increased by about 50 percent during the October-November sugarcane-burning season (Boopathy).

In many communities, residents often burn trash and grass clippings. This trash burning can produce significant amounts of carbon monoxide, particulates, heavy metals, and toxic chemicals such as dioxins and poly aromatic hydrocarbons. A North Carolina study found that burning a kilogram of mixed household waste produced from 10 to 6000 nanograms of highly carcinogenic dioxins (Gullett).

The burning of leaves/grass/trash is also a major fire hazard, especially if these fires are left unattended (as they frequently are). For example, East Moline, Illinois (population 20,000) averages three house fires annually caused by leaf burning (Long).

The states of California, Ohio, New York, New Hampshire, Delaware, District of Columbia, Massachusetts and Rhode Island completely ban burning or allow it only by permit. The right of states to pass anti burning legislation over the objections of local communities was affirmed on August 2, 1971, in Nassau County (New York) Superior Court, Case 323 N.Y.S. 2d504, Judge Betram Harnett presiding. In this case, the New York Appellant court rejected a suit from the town of Old Westbury to allow an exemption from New York's statewide ban on leaf burning. The court concluded "The court is not persuaded by the argument that Nassau County's air is already befouled and a small additional amount would not cause any additional damage. The same logic, if applied elsewhere, would result in total dismemberment of all applicable air

quality regulations, since all the sources of air pollution appear independently small."

In addition, many towns and counties have banned leaf burning where state law does not prohibit it. Many communities have had leaf burning bans and/or communities leaf pickup services for many decades. For example, Tenafly, New Jersey has had a community leaf pickup service and leaf burning ban since 1956 (Van Vorst).

In many communities, however, leaf burning has become a contentious issue, and many anti-leaf burning groups and some pro-burning groups have been formed.

A case in point is South Bend, a community of about 150,000 people in northern Indiana. Richard Miller, a retired South Bend steel worker, suffered respiratory distress during a heavy leaf burning period in 1985 (Duda) and had been hospitalized at a cost of $90,000. Upon his hospital discharge, he formed a "ban the burn" committee with alderwoman Loretta Duda. They enlisted help from physicians, nurses, and the local media for their campaign. They collected several thousand petitions against burning, including several hundred from elementary teachers who were tired of seeing their students miss school due to fall asthma attacks. A TV debate on the issue was held between Duda and another alderwoman who favored continued burning.

A 1988 South Bend city council vote failed to ban leaf burning by one vote. Later that year, a seven- year- old child nearly died of an asthma attack during a burning period. Moved by the near death of the child, the alderwoman who debated Duda then dramatically changed her vote and a leaf ban and leaf pick up service was instituted for South Bend in 1989. Their leaf collection service has gone smoothly, with few complaints and costs less than $3 per resident per year (Duda).

The Americans with Disabilities Act (ADA) has also been successfully employed to ban leaf burning. Anita and Thomas Kacmarynski filed an ADA complaint that the leaf burning allowed in their home town of Mallard, Iowa was endangering the life of their five-year old daughter Heather who suffers from asthma and congestive heart disease. On November 8, 1996, Judge Mark Bennett, US District Court, North District of Iowa, handed down a precedent setting case in which he found that Mallard was discriminating against Heather by allowing burning to continue (CASE #C95-3048-MWB), and ordered a total burning ban in Mallard. The court rejected a motion by Mallard to allow a "compromise" of continued burning during limited days of the year, since

Heather could still suffer a fatal asthma attack during these limited burning times. (For more information on this case- please visit www.iowacleanair.com or call Blake Parker 515-955-2193, the lawyer who successfully prosecuted this ADA complaint [current as of October, 2002. *ed.*].

What can be done with leaves not being burned? Leaves may be easily composted by throwing them in an open pile, where they will decompose easily in a year or less. Using special composting pits and adding other nutrients and microbes may speed up decomposition or produce a richer compost- but these interventions are not absolutely necessary. Leaf compost is excellent for enriching gardens, mulching or filling in low spots. The leaves from large wooded properties can be picked up easily and quickly with large and powerful leaf vacuum/shredder/baggers available for under $600. Many towns also have community leaf pick up and composting services. Mandated leaf composting is a triple victory: less air pollution, less fire risk and production of rich soil.

OTHER BIOMASS BURNING

Many third- world nations use wood, straw, dung, leaves or other materials for heating and food cooking. Such uses of biomass for cooking can have serious adverse health effects. A Mexican case-control study noted that the use of wood burning stoves greatly increased the risk of both chronic bronchitis and chronic airway obstruction (Perez-Padilla).

Worldwide, huge amounts of biomass are burned in tropical rain forests in South America, Africa and Malaysia/Indonesia to make room for agricultural crops. The stubble of tropical crops is also often burned to form a "slash and burn" agriculture which depletes the soil rapidly and forces farmers to abandon fields after several years of burning. During the summer and early fall, South America is regularly covered by thick clouds of smoke covering as much as 2.5 million square miles (The USA is about 3.5 million square miles-LC) (Schemo). Such smoke is often so thick that airports and roads have to be closed since the visibility is so poor (Schemo). A study in a rural Brazilian Amazon village reported average air particulates smaller than 10 microns (PM10) of 191 micrograms per cubic meter of air were reported during a weeklong agricultural burning period(Reinhardt). (This compares to the USA annual PM10 standard of 50 micrograms per cubic meter- LC). Another study in a Southern Brazilian sugarcane growing area reported that total air particulates were significantly higher during sugarcane burning periods and that the number of patients requiring inhalation therapy also increased significantly during sugarcane burning periods (Arbex).

Over the past 10 years, huge areas of Indonesian and Malaysian rainforests have been burned to make room for farming operations. The smoke from these huge fires has traveled for hundreds of miles to Singapore and the Philippines and has covered over two million square miles (Emmanuel). A Singapore study reported that hospital outpatient asthma admissions were 30 percent higher during periods of heavy rainforest burning. The smoke came mainly from the Indonesian provinces of Sumatra and Kalimantan which lie 300 to 500 miles from Singapore! (Emmanuel) A second study in Malaysia (Awang) studied air quality during heavy rainforest burning periods of 1997. In September 1997, all 28 Malaysian air quality stations recorded air concentrations of particulates smaller than 10 microns (PM10) above 150 micrograms per cubic meter. In the Hospital Kuala Lumpur, hospital respiratory admissions were 912 in June 1997, but rose more than 5-fold to over 5,000 in during the heavy forest burning month of September, 1997 (Awang). Efforts are underway to promote more environmentally sound policies in tropical rainforest areas, such as carefully managed tree farming and no-burn agricultural practices (Uhl).

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RESOURCES

- For information on the case that led to the Mallard, Iowa leaf burning ban, please visit www.iowacleanair.com or call Blake Parker, (515) 955-2193, the lawyer who successfully prosecuted this ADA complaint.
- For information on filing an ADA complaint, please contact the U.S. Office of Interior, Office for Equal Opportunity, 1849 C Street NW, Washington, DC 20240; E. Melodee Stith, (202) 208-5693.

Burning Issues
Box 1045
Point Arena CA 95468
Tel: 707-882-3601
Email: **[pm10mary at mcn dot org]**
URL:http://burningissues.org