

BIOMASS IS DIRTY BUSINESS

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references

We trust the U.S. Environmental Protection Agency, the EPA, to protect us from pollution and to know how much air pollution is released in America. But, for the emissions from burning biomass to produce electricity, our trust is misplaced.

Many people are unaware that burning biomass or even wood alone causes serious air pollution, and industry and government promote burning wood and other biomass as a viable method of producing more energy. Burning is heavily government subsidized. American Reinvestment and Recovery Act, New Markets Tax Credits, Clean Renewable Energy Bonds, USDA Biomass Crop Assistance Programs, including dollar-for-dollar subsidies of fuel costs, Department of Energy Economic Stimulus Act grants and rebates, together with tax credits for each kilowatt hour, can total a hundred million dollars and more per facility. But biomass is not the clean, green, energy savior of America, in part because methods used to determine the quantities of pollution, especially but not only Hazardous Air Pollutants, HAPs, emitted by individual biomass burners are not accurate, not by a long shot.

Burning biomass damages health because *all* smoke, visible and invisible, is harmful. (1)
Chronic exposure to air pollution contributes to the development of heart disease and stroke. Epidemiology demonstrates a consistent, increased risk of cardiovascular illness, including

cardiac and stroke deaths, from both short- and long-term exposure, and even tiny amounts of pollution can be hazardous. (2, 3)

Biomass includes everything biological in origin: crops, trees, animals, manure, sewage sludge, and construction and demolition debris inadvertently containing bits of copper wire and nails. A little copper increases dangerous dioxins emissions dramatically. Many construction and hardwood boards have been unidentifiably chemically treated against sapstain fungi. Clean wood, i.e., untreated wood not coated with glue, paint, etc., a biomass subset, can be contaminated with soil pollutants, with chlorine (another goad to dioxin formation) absorbed from winter road salt, or with pesticides. Energy crops can also be contaminated. (4, 5)

Chemically treated wood pallets were blamed for two recalls of pharmaceuticals, but pallets are considered clean wood fuel. Because trees absorb radioactive elements, wood ashes can exhibit 100 times the radioactivity which classifies nuclear facility refuse as radioactive waste, and ultrafine wood ash gets into our air. (6)

Energy crops, like switch grass and miscanthus, are *assumed*, without available proof, to match emissions with wood. But sugar cane waste certainly doesn't, and some fuel crops accumulate chlorine. Pollution can vary from one load of wood to another. Sewage sludge can contain all manner of chemicals, resulting in incalculable emissions.

A facility can't pollute unrestrained, though. Emissions limits exist, supposedly enforced through required operating permits. But for nearly all the HAPs, estimating and reporting are done as if emissions never vary, although they do, widely, source to source and even, over time,

from a single source. Pollution might skyrocket, but it's biomass and will be called clean and green.

HAPs from burning biomass include numerous metals, such as mercury and cadmium, plus toxic organic chemicals like dioxins, furans, and benzene, all health hazards. Permits to burn biomass are based upon the anticipated quantities of emissions. These are calculated from emissions factors.

An emission factor is a number which, multiplied times the amount of heat produced in burning a quantity of fuel, is presumed to yield the amount of a pollutant released by the combustion. Burn wood to produce ten million Btu, the formaldehyde emission factor, in pounds per million Btu, times ten, *attempts* to indicate the quantity of formaldehyde pollutant emitted.

(7)

Factors are averages, principally, of such emissions quantities reported to the EPA. Factors are published in the EPA's *AP-42, Compilation of Air Pollutant Emission Factors*. An alternative, private, and largely derivative publication, *NCASI TB 858*, is addressed later. AP-42 emissions factors are used nationwide not only in calculating potential emissions from proposed facilities, and so, determining the type of nearly every permit, but also, inappropriately, to determine the quantities of HAPs released from operating smokestacks.

HAPs emissions factors are not accurate for specific facilities burning biomass. The EPA knows this, repeatedly warns that factors should not be used to determine emissions from a specific source because factors are unlikely to provide accurate estimates, and yet allows their use, approves permits to burn based on them. (8, 9, 11) This means decisions regulating pollution

and affecting public health are based on unreliable information about past and future emissions. While government assures us to the contrary, we are exposed to unknown quantities of poisons.

Invalid, low estimates enable facilities to acquire federal Clean Air Act Minor-source of pollution permits, avoiding the Maximum Achievable [*pollution*] Control Technology required of Major sources. Smokestacks, instead of limiting pollution to the average level produced by the nation's cleanest similar burners, will have a fifty-fifty chance of spewing, literally, two or even ten thousand times the amounts in their permits. (8)

If invalid factors prove insufficient to eliminate need of a Major Source permit, a facility can simply promise to not reach the thresholds, and effectively acquire a Minor permit. The Potential To Emit doesn't matter. A corporation's promise is good enough for Uncle Sam and the states. Companies save money. We suffer adverse health effects from excessive, undocumented pollution, but cannot prove the connection. We suffer. We pay the medical bills. Industry profits. No one, whatever they say, knows how much pollution is actually getting into our air from any biomass burner. Here's why.

Most HAPs will never be actually measured. It is rare that more than a few are measured at all, rarer that HAPs, except carbon monoxide(CO), concentrations of which are moderated by air intake, and Hydrogen Chloride(HCl), often decreased with pollution controls, are frequently or continuously monitored. Only Continuous Emissions Monitoring of HAPs can yield accuracy because emissions can vary by orders of magnitude even at the same facility. CO, HCl, and Particulate Matter are used as surrogate measurements of most HAPs. No found published information justifies this. The EPA claims unpublished laboratory validation of CO use as a

surrogate for all HAPs in coal combustion, but, “The jury is still out in biomass/wood combustion.” (9)

Even the EPA’s most recent *AP-42* is inaccurate for biomass HAPs. Take the EPA’s word for it. “[E]missions calculated for a given facility using these factors are likely to differ from the actual emissions...In some cases...significantly. Only specific source measurement can determine the actual emissions...” (10) “[E]mission factors frequently may not provide adequate estimates of the average emissions for a specific source. ...some emission factors are derived from tests that may vary by an order of magnitude or more.” (11)

They vary by much, much, more. The quantities of carcinogen arsenic in 23 EPA reports, a large number in this business, varies by as much as a billion percent! (12) That means small facilities could release anywhere from $3 \frac{1}{2}$ millionths of a pound to half a ton of arsenic a year, with no practical way to know the actual amount. Seven factors derive from only solitary reports. Of elements based upon multiple reports, phosphorus varies the least at 183%. Cadmium spans a range of ten million. (12) Emissions calculated from factors which are averages of these ranges of quantities cannot possibly, reasonably, be considered accurate for a specific smokestack.

Even were smokestack gas analyzed frequently, HAPs could be incorrectly figured because: “...many hazardous or toxic compounds may be emitted in particulate form.” (13) Dioxins and furans are generally measured only as gases. They also occur adhered to volatile ash, and pollutants can form high in smoke streams, above usual sampling locations. (14)

The EPA, in rating them, acknowledges the inaccuracy of its emissions factors. Pollution test results used to develop factors are also rated. Only A-rated data gatherings are “performed by

a sound methodology and are reported in enough detail for adequate validation.” “D= Tests are based on a generally unacceptable method...” (15) Even top-rated *A factors* can't be adequately validated. Only 10 of 91 factors in one table of *AP-42* are A-rated. Forty-six are Ds. (16)

True, the EPA updates factors, but relying on information from state agencies. Individual sources of pollution generally use existing factors to calculate their emissions reported to states, which forward them to the EPA. Thus, factors are used to verify themselves. “Because insufficient data exist to determine the accuracy or validity of the emission factors...no estimates can be made of the error that results from using these factors to calculate toxic air emissions from any given facility.” (17)

Representative of the quality of data the EPA uses is a 1996 Louisiana report: “The inventory emissions represent actual emissions as determined through a variety of methods, including stack testing, mass balance, EPA emission factors, and engineering judgement.” (18) Emission factors and engineering judgement are not actual emissions, but calculations and guesses. Mass balance, measuring chemicals into and out of a process, cannot adequately be applied to most combustion HAPs because they form during the process.

Oregon's data in the National Emissions Inventory is “...determined from Title V application forms...” This is calculated data for burners not then yet built, based on factors and guesses, not measurements. (19)

Years of reports from state agencies underlie *AP-42* updates, but inquiry of fully 10% of the states reveals most reports are nothing but estimates based on the faulty emissions factors. “If an agency decides to estimate...by using emission factors in Section 3 and data on material

usage records, permit applications, or inspector records of facilities...it must be emphasized that these estimates can vary greatly from actual emissions..." (20) Yet, the AP-42 factors are used to *calculate* past emissions quantities used to update the AP-42 factors. Factors could hardly fail to verify themselves.

Arkansas stated, "For their emissions inventory reports, most facilities report boiler HAP emissions by multiplying fuel usage by either a standard emission factor like AP-42 or an industry-specific emission factor." The majority of Nebraska's HAPs data, typically, is from emissions factors. (21) Connecticut's emissions data are generally estimated. (22)

Indiana assumes that, if HCl is below a permit's limit –and it will be with pollution controls operating– it is impossible other HAPs would exceed limits. HAPs could be wrong by a million percent; Indiana will never know. (23)

Half of one table of EPA emission factors are confidence rated D, questionable validity. Few actual measurements are made of HAPs. (24) When they are, accuracy can be questionable, and their relevance to emissions from other facilities is always doubtful.

The anthracene factor in *AP-42, Second Edition*, is 4.4millionth lb/ton of fuel. The reference for this is one of EPA's more credible, but it reports on only one facility. Combustion conditions varied. The document concludes, "Differences in relative emissions rates...between firing a dry wood fuel and a wet...were not discernable."

Anthracene varied by 400%, dry wood to wet, naphthalene by 900%. These appear *readily* discernable. Other emissions variations of 2235% were ascribed to differing amounts of combustion air. Combustion air varies, facility to facility, too. Many reports are from only one

test at one facility, and are not nearly as rigorous as *this*. Biomass HCl emissions ranged through 1.8 *million* percent in one report.

From this large a range of results, averages were calculated. Only after high and low actual results were lopped off, these averages, combined with others perhaps as good, perhaps not, generated a final average, the emission factor. (25) Because actual emissions can be far, far different than calculations, relying on factors without frequent, even continuous, actual measurements to confirm estimates is irresponsible.

The EPA mandated actual emissions tests at numerous facilities. The results show that of the HAPs, only 8 metals, dioxins, furans, plus HCl and CO were tested. In viewing more than 10% of the tens of thousands of data, no complete array of HAPs tests was seen. Most data covered no more than a few days. Some is dated 2002, long before the mandate, and emissions vary widely even from the same source. This is the most recent known attempt to update EPA emissions factors. (26)

The EPA's WebFIRE (Factor Information REtrieval software) site claims it "...provides fast and complete access to the Agency's air emissions factors information." "Emission factors...were originally taken from...XATEF. ...XATEF...contained emission factors [*all that were available October 1990*] for toxic air pollutants..."

Supposedly, poorly documented emission factors have been deleted or updated as data became available. Laudable, that, but the data won't withstand scrutiny because states rely upon facility reports generated from factors and because relatively few HAPs concentrations are measured.

EPA searched and made use of various studies and publications to develop factors. *AP-42, fifth edition* used XATEF. However, "Use of these factors as source-specific permit limits and/or as emission...determinations is not recommended by EPA. ...**approximately half of the subject sources will have emission rates greater than the emission factor...**"(27) How much greater cannot be determined. (16) Despite this, the EPA states, "When source specific data are not available, emission factors can be used to estimate emissions. (28) Allowing use of admittedly unreliable factors for critical pollution control decisions endangers public and environmental health.

Location & Estimating Air Emissions (L&E) documents were used in making XATEF, and, therefore, *AP-42* factors. In numerous L&Es, "The reader is strongly cautioned against using the emissions information contained in this document to try to develop an exact assessment of emissions from any particular facility." (29)

The 1994 toluene L&E doesn't mention wood combustion, yet *AP-42* lists its emission factor for toluene. *AP-42*, section 1.6 cites two toluene data references. Neither could be located within or outside the EPA.

Benzene factors are tied to more tests than most HAPs', but its L&E factors for wood/biomass are all rated D or E. One of three data references listed is FIRE. EPA emission factors were used to develop EPA emission factors! (30) Formaldehyde's L&E's only reference for wood or biomass combustion is an emissions study of residential fireplaces. (31)

Elsewhere, EPA states, "The emission estimating tools...should be used with discretion."
(32) "The emission factors are not intended to provide exact estimates of releases of air toxics from specific facilities." (33)

In spite of these and more warnings, emissions from specific smokestacks, both operating and proposed, are routinely calculated from factors. Permits to pollute are based upon estimates made with factors the EPA clearly states are *not* accurate for specific facilities. The smokestack approved for your neighborhood could be spewing a hundred or a million times more poison than its owner and regulators even suspect. Verification of the HAPs quantities released will, in the vast majority of cases, be calculated by multiplying fuel burned times emissions factors which should not be used.

Questionable data underlie pollution limits, too. The 1999 National Emissions Inventory apportioned emissions to counties based on population and industrial employment *estimates* –not even real, available, job data nor smokestack-specific emissions. NEI is used for the National Emissions Standards for Hazardous Air Pollutants, NESHAP, standards used for the Maximum Achievable Control Technology program, i.e., for determining achievable pollution reductions.

The National Council for Air and Stream Improvement, publisher of alternative emissions factors, restricts membership to wood products and industrial forestry firms. Ostensibly an independent organization, member contributions finance NCASI, each year's contribution determined individually by each member. This, somehow, assures the organization is unbiased! Some permits are based upon *NCASI TB* (Technical Bulletin) 858 factors generating emissions

estimates lower than *AP-42* factors would generate, enabling polluters to sneak under Major Source thresholds.

A variety of combustors and cellulose fuels provided data for *NCASI*'s section treating biomass. This seems impressive, but a little digging eliminated all respect. Table A-19 cites *AP-42*, section 1.6, for 85% of its entries. This must be *AP-42* factors since section 1.6 contains relatively little data for HAPs.

NCASI states "Forty of the 47 boilers...data were summarized in electronic spreadsheet files supporting...*AP-42*..." and indicates EPA data contains information from burning "biomass other than virgin wood residues (e.g., agricultural waste, treated wood, etc.)..." But, "The EPA re-analyzed the test reports and found that three test reports should be deleted because the wood residue contained agricultural, urban and flakeboard waste which is not consistent [*ic*] with the typical wood residue used for these boilers." (34) *NCASI* appears incorrect.

NCASI continues: "...[S]ince the data available in the electronic spreadsheet files supporting the background document (EPA 2001b) received by *NCASI* were all reported as number entries and did not indicate whether any of the data were actually NDs [*Not-Detected*] reported at ½ the detection limit, the averages presented here could be considered somewhat upwardly biased..." (35)

"EPA 2001b" is not a background document, but, rather, is *EPA Requirements for Quality Assurance Project Plans QAR-5*, and contains no air emissions data at all. No other found documents referencing EPA2001b contained such data. "EPA 2001a" did not appear anywhere in research of *AP-42*'s section on wood residue combustion. An emissions data reference used

frequently in developing the relevant *AP-42* section contains this: “Dashes indicate compound was not found to have concentration above the detection limits of 0.05µg/dscm for Test 1 results and 0.04µg/dscm for Test 2 results...” *NCASI*'s research appears less than thorough.

NCASI's Table A-19 indicates many facilities tested had pollution limiting devices in place, but not whether sampling occurred downstream from devices. If downstream, factors would be less accurate for determining a facility's full potential emissions. Further, *averages* of emissions measurements are listed. The range of pollutant concentrations is frequently such as Not Detected to 0.0015 pounds, averaged to one half of this. Sometimes reported emissions differed by 100,000,000 percent. Two Hundred and fifty percent is typical. Emissions from a facility near you totaling twice the estimated permit-listed amount should be reason for alarm.

In generating *NCASI* factors for which numerous data were submitted, averages of the averages of emissions were calculated, but first, the highest and lowest, outlier figures were stricken from the list as nonrepresentative. EPA's factor development had already done this once.

(37)

For the pollutant cymen-p, *NCASI* rejected data ranging from Not Detected to 2.6 thousandths lb/MillionBtu because they exceeded expectations. *NCASI* accepted 2.6 *millionths*. No other real data were used for the factor, nor were justifications of the expectations given.

With page 6, *NCASI TB 858* describes its statistical manipulation of data which varied numerically from 1.5 to 35Billion. Occam's Razor suggests a simple average is sufficient. *NCASI* developed a vastly smaller factor.

The majority of *NCASI* Table A-19 factors are supported by an average of 2.7 reports. With even that data twice weight-shifted to the center, the final factor is unlikely to represent potential emissions. Enough said about *NCASI*.

Estimating and reporting, and, therefore, limiting biomass Hazardous Air Pollutants form a circle of confirmation of emissions factors by using the factors, themselves, to calculate emissions for which the EPA warns factors shouldn't be used. *AP-42* background documents, National Emissions Inventory, Toxic Release Inventory –wherever you look for the basis of factors, warnings against estimating a source's emissions by using factors appear.

The odds of calculated emissions from burning biomass being wrong are 2 in 3: low, matching-a-factor, and high. Even Russian Roulette offers better odds. But public health decisions are based upon HAPs data. Biomass is heavily governmentally subsidized based on it being clean energy, and health costs of incorrect emissions factors are severe. Biomass burners hold a gun on us, the trigger pulled every day. The gun, government wrongly assures us, is unloaded and safe.

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