

Senate President Myron Jackson

By e-mail

November 21, 2017

Dear Senator Jackson,

As health professionals with expertise in the links between air pollution and human health, we are writing to express our grave concern about and opposition to the proposed plan to dispose of wood debris on the Virgin Islands by burning them in air curtain incinerators. Burning of brush and wood on St. Croix, St. Thomas and St. John will increase air pollution and therefore the risk of associated health problems, including exacerbation of asthma in children and adults; increased severity of chronic obstructive pulmonary disease; and fatal myocardial infarction.

The alternative to burning—mulching and composting—is a far wiser choice on many levels. Mulching and composting add essential nutrients to the soils of the islands which will increase overall soil health. Mulching and composting avoid harmful exposures that pose health risks to people. And mulching and composting will save money for the Virgin Islands now and in the future by avoiding the unnecessary health care costs that will result from cardiac and respiratory illnesses produced by smoke exposure.

The authors of this letter include air pollution and wood smoke scientists who have published extensively. Several of us have led international, national and regional assessments of the impacts of air pollution, and wood smoke in particular, on human health. The authors include environmental and occupational health scientists and practicing pediatricians with particular expertise in asthma and neurodevelopment. Among us are long-term visitors to the Virgin Islands with strong connections to island residents and the beautiful environment on which the regional economy depends.

Below we summarize the relevant scientific/medical literature and our assessment of the exposure and health conditions in the Virgin Islands which form the basis for our concern. We cite over 30 peer reviewed articles; the references are attached.

Relevant Scientific Literature

Decades of research on air pollution have established that fine particulate air pollution, a mixture of solids and liquid droplets generated by combustion fuels including wood, is associated with significant health effects. These include shortened life expectancy, as well as increases in specific health conditions such as asthma attacks, heart attacks, stroke, chronic obstructive pulmonary disease, and a range of other conditions, including neurological impairments (Grandjean P et al 2014; Kioumourtzoglou, MA et al 2015). Air pollution and particulate matter specifically has been identified as a human carcinogen by the International Agency for Research on Cancer (Straif 2013). There is evidence that short-term exposure to particulate matter with the aerodynamic diameter of 2.5 microns or less--PM_{2.5}--is associated with stroke and heart failure as well as subclinical cardiovascular conditions such as systemic inflammation, increased blood coagulation, increased blood pressure, and increased vascular dysfunction (Brook RD et al, 2010). Numerous epidemiological studies examining the relationship

between increases in PM_{2.5} pollution and the most serious adverse health outcomes have not been able to identify a “no risk” level of PM 2.5 (i.e. a no threshold model) (Pope III AC and Dockery DW, 2006 and Book RD et al 2010). Fine particulates emitted into the outdoor ambient air pose an indoor as well as outdoor air quality hazard (Allen R et al 2003; Larson T et al 2004).

In addition to PM_{2.5} particles, wood smoke also contains ultra-fine particles with an aerodynamic diameter of less than 1 µm (Sippula O et al 2009). Both ultrafine and PM_{2.5} particles tend to deposit in the deep lung where they can penetrate into the blood stream and can have systemic biological effects. PM_{2.5} from wood biomass combustion can remain suspended in ambient air for longer periods of time, can be transported over long distances, and can penetrate more readily into indoor environments as compared to larger, coarser particles. (Wilson WE and Suh HH, al 1997)

Particulates are not the only pollutants of concern in emissions from wood burning. Wood smoke contains many other hazardous substances which are known contributors to acute and chronic illnesses, including asthma, cardiovascular disease, neurodevelopmental problems and cancer. These include Carbon Monoxide, and Polycyclic Aromatic Hydrocarbons (PAHs). Some studies of PAHs have found that wood combustion emits more carcinogenic PAHs per unit of fuel energy than several types of coal (Oanh et al. 1999 ; Truesdale RS and Cleland JG 1982). Emissions from wood burning can also include trace levels of heavy metals, such as arsenic, cadmium, and nickel which occur naturally in many types of wood (Washington State Department of Ecology 2003 ; Demirbas 2008). While metals are not a significant fraction of particulate pollution, one recent study of emissions from institutional and commercial wood biomass combustion units found that heavy metals and trace elements showed a tendency to concentrate in fine particles (Sippula et al. 2009). Burning “pressure-treated” wood is highly hazardous.

Numerous studies show that exposure to wood smoke causes a range of acute and chronic health problems, including harms to respiratory health in both children and adults, among them aggravation of asthma and of chronic obstructive pulmonary disease, bronchitis, and decreased lung function (Naeher et al, 2007; Boman BC, 2003). Two recent reviews add to the growing evidence of **cardiovascular impacts** of wood smoke exposure (Reid CE, Brauer M et al, 2015; Sigsgaard T et al 2015). One study documents a clear link between exposure to wood smoke and increased hospitalizations for heart attacks (Weichenthal S et al 2017). **Studies have also identified additional health risks for young children, notably an increased risk of bronchiolitis**—the leading cause of hospitalizations for children under one year old—among those exposed to the highest levels of wood smoke compared to those exposed to the lowest levels (Karr CJ et al 2009).

The scientific literature also establishes that individuals already burdened by significant environmental, social and economic stressors are more likely to be adversely affected by exposure to air pollution (Pope and Dockery 2006 ; Brook et al. 2010 ; Johnson PR and Graham JJ, 2005; Landrigan 1998). While not all of these populations have been studied with respect to wood smoke exposure, there is evidence as noted above that children as well as people with existing respiratory illness are particularly susceptible to the adverse effects of wood smoke (Naeher et al 2007).

Exposure and Health Considerations in the Virgin Islands

The level of risk to people's health from wood burning depends on factors related to the conditions of burning, and factors related to people. Several of these increase the likelihood that the proposed wood burning will harm the health of people in the Virgin Islands.

First, air curtain incinerators do not allow for high-temperature nor complete or efficient burning, which increases emissions of hazardous compounds. (Johansson et al 2004) Yet regardless of the method, burning wood debris left over from the hurricanes in the VI would generate higher hazard emissions because of physical and chemical properties of the wood. These include **moisture content (Bignal KL et al 2008; Atkins A et al 2010), the variability in size and composition of wood debris, and the large amount of bark and roots, all of which contribute to incomplete combustion, higher levels of emissions and higher toxicity of particles.** (Demirbas 2008 ; Beauchemin PA and Tampier M, 2008). In addition, some of the wood has likely been in contact with seawater, in which case dioxin emissions are possible (Lavric ED et al, 2004). Finally, **burning brush and wood from poisonous trees**, such as the Machineel, found in the Virgin Islands, can cause severe irritation of the eyes and skin (Brittanica Editors, accessed 2017) and likely the lungs as well (NIOSH accessed 2017).

On all three Virgin Islands, people of all ages from young infants to the very old live, work and play near where the burning will take place, increasing the risk of health problems. The percentage of pollution that is inhaled relative to the overall volume of emissions—known as the “intake fraction”—is higher the closer populations are to the source. The intake fraction can also increase when respiration rates are higher than normal, such as when people are exercising (Hoppin P and Jacobs M, 2012). Workers directly involved in the burning would be at particular risk for health problems (Youssef H et al 2014; Hoppin P and Jacobs M, 2013).

The health risks from wood burning also need to be considered in the context of the high vulnerability and susceptibility of people on the Islands at this time.

People in the Virgin Islands suffer disproportionately from a range of health conditions (Callwood et al 2012) **which make them more likely to be affected by lower levels of pollutant concentrations.** In addition, some sub-populations are inherently more susceptible to health effects because of their age or condition—in particular pregnant women, infants, children and the elderly.

Health hazards abound during this hurricane recovery period. Exposure to diesel from generators; mold from infiltration of water into damaged buildings; high levels of dirt and dust indoors and outdoors; stress caused by the immediate experience of the storms and the hardships that have ensued, including lack of basic services and loss of livelihoods as well as poor economic prospects going forward—all these are risk factors for acute and chronic health conditions. Interactions among these risk factors can increase the risk of both disease exacerbation and onset; for example, the combined exposures of vehicle emissions and psychosocial stress can have a multiplicative impact on lung function in children exposed to both (Wright 2011). **It would be irresponsible to intentionally introduce additional environmental exposures to the people of the Virgin Islands at this time**, especially when non-polluting alternatives exist.

In conclusion, the robust scientific literature on the health hazards of wood smoke and the current conditions in the Virgin Islands—including the range of environmental and social risk factors to which people are currently exposed—provide the basis for our professional opinion that burning wood debris from the hurricanes poses unnecessary risks to human health. We strongly recommend that you do everything in your power to prevent burning of wood and brush debris, either in air curtain incinerators or otherwise.

We understand that public policy decisions often require trade-offs. In this case, we believe that a decision to burn virgin wood debris is unacceptable, both because of the risks we describe, and because of the feasibility of the much safer alternative of mulching and composting. To the extent that costs are central in the debate, we urge that you consider the increased health care costs associated with acute and chronic health impacts, as well as the long-term economic benefits of the Virgin Islands serving as a beacon for the region, indeed for the globe, in demonstrating policies and practices that both protect human health and establish sustainable infrastructure for the future.

Sincerely,

Polly Hoppin, ScD, Research Professor, University of Massachusetts Lowell and Program Director, Environmental Health, Lowell Center for Sustainable Production (Also Convenor, Northeast Regional Initiative on Wood Biomass and Health)*

Nicholas A. Ashford, PhD., JD, Professor of Technology and Policy and Director, MIT Technology & Law Program

Michael Brauer, ScD, The University of British Columbia (also National Academy of Medicine (U.S): Standing Committee on the Medical and Epidemiological Aspects of Air Pollution on U.S. Government Employees and their Families (2017 -); World Health Organization, Guideline Development Group: WHO Global Air Quality Guidelines (2016 -); Global Burden of Disease. Member, Core Analytic Team. (2013-))

Catherine Chapman, MD, practicing pediatric neurologist, Boston Children's Hospital

Richard Clapp, D.Sc, Professor Emeritus, Department of Environmental Health, Boston University School of Public Health

David Kriebel, ScD, Professor, University of Massachusetts Lowell

Philip J Landrigan, MD, MSc, FAAP. Dean for Global Health, and Professor of Preventive Medicine and Pediatrics, Icahn School of Medicine at Mount Sinai (Also Co-Chairman, The Lancet Commission on Pollution and Health)

Shari Nethersole, MD, practicing pediatrician and Executive Director for Community Health, Boston Children's Hospital

Jerome Paulson, MD, FAAP, Emeritus Professor of Pediatrics, George Washington School of Medicine and Health Sciences; Emeritus Professor of Environmental and Occupational Health, George Washington School of Public Health

Kathleen Rest, PhD, MPA Former Acting Director of National Institute of Occupational Safety and Health, and Current Executive Director, Union of Concerned Scientists

Madeleine Scammell, D.Sc., Associate Professor of Environmental Health, Boston University School of Public Health

Perry Elizabeth Sheffield, MD, MPH, Assistant Professor, Departments of Pediatrics and Environmental Medicine, and Public Health Deputy Director, Federal Region 2 Pediatric Environmental Specialty Unit, Icahn School of Medicine at Mt. Sinai

Ted Schettler, MD, MPH, Science Director, Science and Environmental Health Network

*Please address correspondence to Dr. Hoppin: Polly_Hoppin@uml.edu or 617 417-4340.

Please also note that we sent this letter to Governor Mapp as well. This letter to Senator Jackson includes additional co-signers. Our letter to Governor Mapp included cc's to the following people:

Michelle Davis, Health Commissioner

Dawn Henry, Commissioner, Dept. of Planning and Natural Resources

Roger Merritt, Executive Director, VI Waste Management Authority

Nelson Petty, Commissioner, Dept. of Public Works

Carlos Robles, Agriculture Commissioner

REFERENCES for Letter from Hoppin et al opposing burning of wood debris in the USVI

Allen R, Larson T, Sheppard L, et al. Use of real-time light scattering data to estimate the contribution of infiltrated and indoor-generated particles to indoor air. *Environ Sci Technol* 2003;37(16):3484-92.

Atkins A, Bignal KL, Zhou JL, et al. Profiles of polycyclic aromatic hydrocarbons and polychlorinated biphenyls from the combustion of biomass pellets. *Chemosphere* 2010;78:1385-1392.

Beauchemin PA, Tampier M. Emissions from Wood-fired Combustion Equipment. Envirochem Services, Inc., Prepared for British Columbia, Ministry of Environment, Environmental Management Branch. June 30, 2008.

Bignal KL, Langridge S, Zhou JL. Release of polycyclic aromatic hydrocarbons, carbon monoxide and particulate matter from biomass combustion in a wood-fired boiler under varying boiler conditions. *Atmos Environ* 2008;42:8863-8871.

Boman BC, Forsberg AB, Jarvholm BG. Adverse health effects from ambient air pollution in relation to residential wood combustion in modern society. *Scand J Work Environ Health* 2003;29(4):251-60.

Brook RD, Rajagopalan S, Pope III AC, et al. Particulate matter air pollution and cardiovascular disease: an update to the scientific statement from the American Heart Association. *Circulation* 2010;121:2331-2378.

Callwood T, Campbell D, Gary F, Radelet M. Health and Health Care in the U.S. Virgin Islands: Challenges and Perceptions *ABNF J.* 2012 Winter; 23(1): 4–7

Committee to Study the Public Health and Environmental Benefits of Requiring Stationary and Mobile Sources that Burn Virgin Petroleum Products or Cool to Comply with the Requirements of the Air Toxic Control Act. June 18, 2003.

Demirbas A. Hazardous emissions from combustion of biomass. *Energy Sources, Part A* 2008;30:170-178

Editors of the Encyclopedia Britannica. Machineel Plant. *Encyclopedia Britannica*. Accessed November 19, 2017 at <https://www.britannica.com/plant/manchineel>

Grandjean, P and Landrigan, PJ. Neurobehavioural effects of developmental toxicity. *Lancet Neurol.* 2014; 13: 330–338

Hoppin P, Jacobs M. Wood Biomass for Heat and Power: Addressing Public Health Impacts. Symposium Summary. University of Massachusetts Lowell, Lowell Center for Sustainable Production. October 2012.

Hoppin, P, Jacobs, M. Public Health Protection in Wood Biomass Decision-Making. Chapter in Eds. Jacobson M and Ciolkosz, Eds., *Wood-Based Energy in the Northern Forests*. New York: Springer Press, 2013.

Johansson LS, Leckner B, Gustavsson L, et al. Emission characteristics of modern and old-type residential boilers fired with wood logs and wood pellets. *Atmos Environ* 2004;38(4):183-195).

Johnson PR, Graham JJ. Fine particulate matter national ambient air quality standards: public health impact on populations in the northeastern United States. *Environ Health Perspect* 2005; 113 (9): 1140-7

Karr CJ, Demers PA, Koehoorn MW, et al. Influence of ambient air pollutant sources on clinical encounters for infant bronchiolitis. *Am J Respir Crit Care Med* 2009;180(10):995-1001.

Kioumourtzoglou, MA, Schwartz, JD, Weisskopf, MG et al. Long-term PM_{2.5} exposure and neurological hospital admissions in the northeastern United States. *Environ Health Perspect.* 2015; 124: 23–29

Landrigan PJ. Environmental hazards for children in USA. *Int J Occup Med Environ Health* 1998;11(2): 189-94

Landrigan PJ, Air pollution and health. *The Lancet* 2017; 2(1), e-4-e5. Available at: [http://www.thelancet.com/journals/lanpub/article/PIIS2468-2667\(16\)30023-8/fulltext](http://www.thelancet.com/journals/lanpub/article/PIIS2468-2667(16)30023-8/fulltext). Accessed November, 2017

Larson T, Gould T, Simpson C, et al. Source apportionment of indoor, outdoor, and personal PM_{2.5} in Seattle, Washington, using positive matrix factorization. *J Air Waste Manag Assoc* 2004;54(9):1175-87.

Lavric ED, Konnov AA, De Ruyck J. Dioxin levels in wood combustion: a review. *Biomass and Bioenergy* 2004; 26: 115–145. Available at: http://www.academia.edu/17193834/Dioxin_levels_in_wood_combustion_a_review

Naeher LP, Brauer M, Lipsett M, et al. Woodsmoke health effects: a review. *Inhal Toxicol* 2007;19(1):67-106.

National Institute of Occupational Safety and Health (NIOSH). *Fast Facts: Protecting Yourself from Poisonous Plants*. Accessed November 20, 2017 at <https://www.cdc.gov/niosh/docs/2010-118/pdfs/2010-118.pdf>

Noonan CW, Ward TJ, Navidi W, et al. A rural community intervention targeting biomass combustion sources: effects on air quality and reporting of children's respiratory outcomes. *Occup Environ Med* 2012;69(5):354-60.

Oanh NTK, Reutergardh LB, Dung NT. Emission of polycyclic aromatic hydrocarbons and particulate matter from domestic combustion of selected fuels. *Environ Sci Technol* 1999;33:2703-2709.

Pope III AC, Dockery DW. Health effects of fine particulate air pollutions: lines that connect. *J Air Waste Manag Assoc* 2006;56:709-742.

Reid CE, Brauer M, Johnston FH, Jerrett M, Balme JR, Elliott CT. Critical review of health impacts of wildfire smoke exposure. *Environ Health Perspect.* 2016 Sep;124(9):1334-43. doi: 10.1289/ehp.1409277. Epub 2016 Apr 15. Review.

Sippula O, Hokkinen J, Puustinen H, et al. Particle emissions from small wood-fired district heating units. *Energy and Fuels* 2009;23:2974-2982.

Sigsgaard T, Forsberg B, Annesi-Maesano I, Blomberg A, Bølling A, Boman C, Bønløkke J, Brauer M, Bruce N, Héroux ME, Hirvonen MR, Kelly F, Künzli N, Lundbäck B, Moshhammer H, Noonan C, Pagels J, Sallsten G, Sculier JP, Brunekreef B. Health impacts of anthropogenic biomass burning in the developed world. *Eur Respir J.* 2015 Dec;46(6):1577-88. doi: 10.1183/13993003.01865-2014.

Straif K, Cohen A, Samet J. Air Pollution and Cancer. International Agency for Research on Cancer. *IARC Scientific Publication No 161*. 2013

Truesdale RS, Cleland JG. Residential stove emissions from coal and other alternate fuels combustion. *Specialty conference on Residential Wood and Coal Combustion. Air Pollution Control Association, Louisville, KY* 1982:115-128.

Washington State Department of Ecology. *Hog Fuel Boiler RACT Determination*. April 2003.

Weichenthal S, Kulka R, Lavigne E, van Rijswijk D, Brauer M, Villeneuve PJ, Stieb D, Joseph L, Burnett RT. Biomass Burning as a Source of Ambient Fine Particulate Air Pollution and Acute Myocardial Infarction. *Epidemiology.* 2017 May;28(3):329-337. doi: 10.1097/EDE.0000000000000636

Wilson WE, Suh HH. Fine particles and coarse particles: concentration relationships relevant to epidemiologic studies. *J Air Waste Manag Assoc* 1997;47(1238-1249).

Wright RJ. Psychological Stress: A Social Pollutant That May Enhance Environmental Risk *Am J Respir Crit Care Med*. 2011 Oct 1; 184(7): 752–754.

Youssof H, Liousse C, Roblou L, Assamoi EM, Salonon R, Maesano C, Banerjee S, Annesi-Maesano I. Non-Accidental Health Impacts of Wildfire Smoke *Int J Environ Res Public Health*. 2014 Nov; 11(11): 11772–11804.