# Memorandum

**To:** Competitive Power Ventures **Date:** January 5, 2014

**From:** Chris Long, Sc.D., DABT

**Subject:** CPV Towantic Energy Center Exposure Comparisons

Both fine particulate matter ($PM_{2.5}$) and nitrogen dioxide ($NO_2$) are ubiquitous in indoor and outdoor air due to a number of common indoor and outdoor sources, including motor vehicle exhaust, road dust and debris, gas appliances, cooking activities, wood-burning, candles, and smoking. Below, we provide comparisons for both $PM_{2.5}$ and $NO_2$ to provide perspective on the significance of modeled maximum annual-average air quality increments for the Towantic Energy Center relative to typical $PM_{2.5}$ and $NO_2$ exposures from other everyday activities. Importantly, these comparisons utilize modeled maximum annual-average air quality increments for the Towantic Energy Center that represent worst-case exposure conditions since they not only are based on maximum-impact scenarios for the Towantic Energy Center, but they also assume that someone is present outdoors at the location of maximum impact 24 hours a day, 7 days a week, 365 days a year.

What these comparisons tell us is that doing any one of these common activities throughout the year adds the same to our $PM_{2.5}$ or $NO_2$ exposure as the modeled maximum annual-average air quality increments for the Towantic Energy Center. Because all of us engage in a variety of these activities, the total duration of each separate one need be much less than what is given below for the total spectrum to add up to the equivalent of the worst-case exposures associated with the Towantic Energy Center; moreover, activity durations will also be smaller for more typical exposures associated with the Towantic Energy Center. In other words, even if we do not engage in one or more of these activities or we do so for lesser periods of time than assumed below, the sum of our $PM_{2.5}$ and $NO_2$ exposures from these and other everyday activities will well-exceed even a worst-case year-round exposure to $PM_{2.5}$ and $NO_2$ associated with the Towantic Energy Center emissions. Even with the use of modeled maximum annual-average air quality increments for the Towantic Energy Center representative of worst-case exposure conditions, these comparisons illustrate how $PM_{2.5}$ and $NO_2$ exposures will continue to be dominated by the everyday contributions from a variety of common sources and personal activities.

## $PM_{2.5}$ Comparisons

A year of breathing air at the 0.12 $\mu g/m^3$ modeled maximum annual-average $PM_{2.5}$ increment is equivalent to –

- about 25 minutes a week driving/riding in a car on an urban highway (for a year); or
- about 25 minutes a week of cooking using a gas range/oven in the home (for a year); or
- about 25 minutes a month wok cooking (for a year); or
- about 2 times mowing the lawn for 30 minutes each time; or

- 1 visit to indoor food courts every other week for a year (assuming a 30-minute duration per visit); or
- about 5 days inside a house with a clean-burning woodstove; or
- about 1 ½ days inside a house with a traditional woodstove; or
- about 45 minutes a week burning candles in the home (for a year); or
- about 20 hours at Mohegan Sun gambling inside a main casino room that allows smoking; or
- 6 trips into New York City to see sporting events, Broadway shows, *etc.* (assuming 3 hours of driving and 4 hours in NYC per visit); or
- about 60 minutes inside a Korean-style barbecue restaurant; or
- about 20 hours riding the subway in New York City.

## $NO_2$ Comparisons

A year of breathing air at the 1.4 $\mu g/m^3$ modeled maximum annual-average $NO_2$ increment is equivalent to –

- about 26 minutes a day driving/riding in a car (for a year); or
- about 40 minutes a week of cooking using a gas range/oven in the home (for a year); or
- about 20 minutes a week of oven-cleaning for a gas appliance (for a year); or
- about 5 times using an unvented natural gas fireplace (assuming a 4-hour duration each time); or
- attending about 16 hockey games (assuming a 2-hour duration per game); or
- 39 trips into New York City to see sporting events, broadway shows, *etc.* (assuming 3 hours of driving and 4 hours in NYC per visit); or
- 3 times a week for about 10 minutes each time being inside an underground parking garage just meeting the ASHRAE one-hour $NO_2$ guideline of 250 ppb (for a year).

# Science and Strategies for Health and the Environment

Gradient is an environmental and risk sciences consulting firm renowned for our specialties in Toxicology, Epidemiology, Risk Assessment, Product Safety, Contaminant Fate and Transport, and Environmental/Forensic Chemistry.

Since 1985, Gradient has employed sound science to assist national and global clients with resolving their complex environmental and human health challenges. Our Scientists are nationally recognized experts and active contributors to the advancement of knowledge for science solutions. Focusing on rigorous, high-end science and creative problem solving, our engagements are led by teams with top credentials and unparalleled client focus.

Certified as a Women's Business Enterprise by the Center for Women and Enterprise, a regional partner of the Women's Business Enterprise National Council (WBENC), Gradient's team of experts specialize in Toxicology, Epidemiology, Risk Assessment, Product Safety, Contaminant Fate and Transport, and Environmental/Forensic Chemistry. Our open and communicative culture, paired with a commitment to leading edge science, translates to unrivaled service to our clients and their complex challenges in environment and human health issues.

Gradient provides cutting edge risk sciences consulting services that advance science, help governments develop sound risk policies, and answer the most difficult health effects questions. Through scientific excellence and common sense, we help our clients develop solutions to their challenges that are cost effective while ensuring safe environments.

# Christopher M. Long, Sc.D., DABT

## Principal Scientist, Air Quality & Environmental Health

clong@gradientcorp.com

Dr. Long is an expert in the area of exposure and risk assessment, with particular expertise in indoor and outdoor air pollution, inhalation toxicology, air pollution epidemiology, air sampling and measurement, and air modeling. He has assessed exposures and health risks associated with airborne particulates such as diesel exhaust particulates, carbon black, coal ash, ambient sulfates and nitrates, asbestos, ambient ultrafines, engineered nanoparticles, lead and other trace elements, and bioaerosols, as well as with numerous gaseous criteria and hazardous air pollutants. Dr. Long's practice area includes evaluating product safety, with specific interests in airborne exposures and engineered nanoparticles, and he is a technical editor of Gradient's nanotechnology newsletter, *EH&S Nano News*. Dr. Long also has a particular interest in the historical evolution of air pollution science and regulation.

Dr. Long has prepared approximately 40 technical papers and presentations in the general areas of indoor and outdoor air pollution and exposure assessment. He is a member of the International Society of Exposure Science, the Air and Waste Management Association, and the American Chemical Society.

## Representative Projects

**Air Toxics Health Risk Characterization**: At the request of the New Mexico Environment Department (NMED), prepared a community acute health risk assessment associated with inhalation exposures to over 80 air toxics using air monitoring and modeling data.

**Air Quality Impacts at a Confined Animal Feeding Operation (CAFO)**: Conducted air sampling and performed air dispersion modeling analysis to characterize the air quality impacts of hydrogen sulfide ($H_2S$) gas emissions at a large Midwestern hog farm.

**Coal Ash Risk Assessment and Public Communications**: For a utility company, prepared a multipathway human health risk assessment evaluating potential exposures of nearby residents to a coal ash disposal site. Prepared a white paper on coal ash for public dissemination.

**Commercial Printer Product Safety Evaluation**: Designed a comprehensive measurement program to assess potential exposures associated with the use of a commercially available printer. Assessed toxicological significance of indoor air and surface wipe measurements.

**Indoor/Outdoor $PM_{2.5}$ Sampling and Exposure Assessment**: Designed and implemented an indoor/outdoor $PM_{2.5}$ sampling program in residential homes near a large industrial facility to investigate source contributions to individual particulate matter exposures.

**Human Health Risk Assessment for a Biomass-burning Power Plant**: Prepared a human health risk assessment to support the permitting process for a biomass burning power plant. Assessed potential cancer and non-cancer risks from inhalation of criteria air pollutants and air toxics in stack and fugitive emissions from the plant and also evaluated potential health risks associated with mercury deposition and accumulation in fish.

## Areas of Expertise

- Inhalation Risk Assessment
- Exposure Assessment
- Indoor/Outdoor Air Pollution
- Air Sampling, Measurement, & Modeling
- Nanotechnology

## Education

Sc.D., Environmental Health, Harvard School of Public Health

M.S., Environmental Engineering, Massachusetts Institute of Technology

A.B., Chemistry and Environmental Studies, Bowdoin College

Diplomate, American Board of Toxicology

## Selected Publications

**Long, CM**; Sax, SN; Lewis, AS. 2012. "Potential indoor air exposures and health risks from mercury off-gassing of coal combustion products (CCPs) used in building materials." *Coal Combustion and Gasification Products* 4:68-74.

Hesterberg, TW; **Long, CM**; Bunn, WB; Lapin, CA; McClellan, RO; Valberg, PA. 2012. "Health effects research and regulation of diesel exhaust: An historical overview focused on lung cancer risk." *Inhal. Toxicol.* 24(S1):1-45.

Valberg, PA; **Long, CM**. 2012. "Do brain cancer rates correlate with ambient exposure levels of criteria air pollutants or hazardous air pollutants (HAPs)?" *Air Qual. Atmos. Health* 5:115-123.

Hesterberg, TW; **Long, CM**; Lapin, CA; Hamade, AK; Valberg, PA. 2010. "Diesel exhaust particulate (DEP) and nanoparticle (NP) exposures: What do DEP human clinical studies tell us about potential human health hazards of nanoparticles?" *Inhal. Toxicol.* 22:679-694.

Valberg, PA; **Long, CM**; Sax, SN. 2006. "Integrating studies on carcinogenic risk of carbon black: Epidemiology, animal exposures, and mechanism of action." *J. Occup. Environ. Med.* 48(12):1291-1307.