Vendalite

P.O. Box 241,
Niagara-on-the-Lake, ON.
L0S 1J0
vendalite@yahoo.ca
www.vendalite.com

Presentation to the Ontario Ministry of the Environment

RE: Public consultation process for release of the Cap & Trade Initiative
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Focus: Commercialized use of wax candles in religious related institutions and the issue of carbon emissions.

For more than 2000 years individuals at time of deep contemplation and reflection in expressing their religious conviction light a candle to give thanks, and appreciation of thoughts and prayers.

In Catholic religious institutions, including Churches, Shrines, Mausoleums, Hospitals and Schools, individuals express such intent by lighting a candle before a statue. As this religious act has crossed all cultures it has evolved over time. The significance of such intents has diminished, but the practice is still never the less an important practice to many Catholics throughout the world, a population that makes up roughly 40% of the world population.

Vendalite, an Ontario based company, has successfully developed, manufactured and marketed a product for more than 35 years that provides an alternative in catholic religious institutions The product “electronic candle stands,” was developed to eliminate the need for wax candles in such institutions, thereby reducing a substantial amount of carbon.

With the support of the Ontario Government, the Federal Government and the foresight of various European nation's, the State of California and the Provinces of Quebec and British Columbia, Vendite through production of it's product “electronic candles” will eliminate carbon emissions detrimental to the health of citizens. The elimination of fire, soot, and smoke are reasons for the support of Fire Marshall's and Insurance providers in the production of this product. Wax candles as a petroleum-based products producing a significant carbon footprint. An increasing number of indoor air quality scientists* are sounding the alarm about the ability of candles to emit pollutants like benzene, styrene, toluene, acetone and particulate matter. Some core wicks on imported candles have even been found to be made of lead.

*Academic studies conducted on the emissions of lead and zinc from candles with metal-core wicks (Nriagu and Kim, 2000). For this study, the researchers purchased and tested candles (found in Michigan stores) that had metal-core wicks. Fourteen brands of candles manufactured in the US, Mexico, and China were found to contain lead. Emission rates from candles ranged from 0.52 to 327 :g-lead/hour, resulting in lead levels in air ranging from 0.02 to 13.1 :g/m 3. Another prominent study, van Alphen (1999), examined emissions and inhalation exposure-based risks for candles having lead wick cores. The mean emission rate was 770 :g-lead/hour, with a range of 450 to 1,130 :g-lead/hour. A candle burned for 3 hours at 1,000 :g-lead/hour in a 50 m 3 room with poor ventilation is estimated to yield a 24-hour lead concentration of 9.9 :g/m 3, and a peak concentration of 42.1 :g/m 3 . OSHA's 50 :g/m 3 PEL is not approached in this study, but again, EPA's outdoor ambient air standard of 1.5 :g/m 3 is exceeded. Sobel et al. (2000a) modeled lead emissions from candles containing lead wicks. After burning multiple candles in a contained room, 24-hour lead concentrations ranged from 15.2 to 54.0 :g/m 3 . The candle containing the least amount of lead produced lead concentrations of 30.6 :g/m 3 in 3 hours. The maximum concentration of 54 :g/m 3 is above the PEL standard of 50 :g/m 3 and EPA's outdoor ambient air quality standard of 1.5 :g/m 3.

The National Association of Home Builders (NAHB) has historically received an increased number of reports about black soot deposition. A prime suspect is the increased use of candles. The problem is so severe that North America's largest indoor air quality conference, held in Texas in 1999, featured a workshop that presented the latest research and case studies on the effects of black soot from candles.

Soot is a product of incomplete combustion of carbon-containing fuels, usually petroleum-based. The soot not only discolours walls and furniture, it can also contaminate ventilation systems. Although the problems resulting from burning candles can be minimized, the basic problem is that candle flames must contain soot or they will not be bright. Soot is the source of the bright white/yellow light that candles emit. A flame without soot will burn blue, like the flame from a gas stove. Since soot particles are typically very small, they can potentially penetrate the deepest areas of the lung. Researchers caution that the very young, the elderly and those with respiratory diseases like asthma should avoid exposure to candle soot.

Research has shown that wax candles and wax usually refers to a variety of organic substances that are solid at ambient temperature but become free-flowing liquids at slightly higher temperatures. The chemical composition of waxes is complex, but normal alkanes are always present in high proportion and molecular weight profiles tend to be wide. The main commercial source of wax is crude oil but not all crude oil refiners produce wax. Most commonly used wax in catholic institutions is Paraffin wax derived from petroleum. It is easy to recover and offesr a wide range of physical properties that can often be tailored by refining processes. Most producers offer two distinct types of petroleum waxes: paraffins, which are distinguished by large, well formed crystals; and microcrystallines, which are higher melting waxes with small, irregular crystals. Microcrystalline wax contains substantial proportions of branched and cyclic saturated hydrocarbons in addition to normal alkanes. Petroleum wax producers also characterize wax by degree of refinement; fully refined paraffin has oil content generally less than 0.5%, and fully-refined micro-crystalline less than 3%. "Slack wax," precursors to the fully refined versions in either case, would have oil content above 3%, and as high as 35% by weight. Paraffin wax produced from petroleum is essentially a pure mixture of normal and iso-alkanes without the esters, acids, etc. found in animal and vegetable-based waxes.

Synthetic waxes have entered the wax market in the past 50 years. Polyethylene waxes are low molecular weight polyethylenes (less than 10,000 Mn) having wax-like properties made by either high-pressure or low-pressure (Zeigler-type catalyst) polymerization. All such waxes have the same basic structure, but the various production processes yield products with distinctly different properties, and these have a major impact on the use of products. Products from one manufacturer may satisfy one particular application, while product from a similar process will not work well.

Alpha olefin waxes are synthetically derived from ethylene via a Ziegler-Natta catalyst. The process results in a Schulz-Flory distribution of alpha olefins ranging from C4 through C30+. These are distilled into the individual carbon fractions or carbon fraction blends. Due to the high melting points of the waxes, C20 and higher carbon numbers are fractionated into blends. Because of the linear double bond present in normal alpha olefins, these waxes can be functionalized or reacted to create other derivatives. They can also be used for their physical properties such as hardness and melting point. End uses for alpha olefin waxes include lube oil additives, PVC lubricants, candles, oilfield chemicals and personal care applications.

Animal-based waxes include lanolin from the wool of sheep; ambergris produced in the intestines of sperm whales; and tallow from beef fat. Beeswax has been traded for over 2,000 years and references to "wax" before the 19th century typically meant beeswax. Yellow beeswax is secreted by bees to build honeycombs; the empty comb is melted in boiling water to recover the wax. This type of wax has traditionally be used in religious institutions and urban myths suggest that it to be case today.

To understand the carbon cycle you need to understand burning (combustion) and breathing (respiration). Both result in carbon dioxide gas (CO_2) being released into the atmosphere. As a candle burns some of the wax “disappears”. If you weighed the candle before and after a burn, you would see a difference in how much it weighs. Candles use oxygen gas (O_2) to "burn" food and this generates energy and carbon dioxide gas (CO_2).

Candle and Oxygen Gas —> Energy and Carbon Dioxide Gas and Water

The chemical reaction is written as:
Wax ($C_{30}H_{64}$) + O_2 (g) —> energy + CO_2 (g) + H_2O (g)

North American wax consumption is estimated at approximately 3 billion pounds a year, split between two major markets, packaging materials and all others. Although packaging represents only 30% of the market, the world has historically viewed this segment as the entire wax business, and continues to today. Think of how wax was used thirty years ago, and how it is still being used - waxed paper, milk cartons, paper drinking cups, etc. Packaging was and still is one of the primary markets for wax. However, packaging uses for wax are currently forecast to continue to decline, while overall wax demand is

expected to grow in line with economic growth (currently 2-3% per annum).

This growth in demand is driven by a number of new uses for the material. Markets for wax are truly diverse, ranging from simple fuel in manufactured fire logs and candles, to practical applications such as adhesives, anti-oxidation agents in tires, and sizing in construction materials, to even more exotic uses in cosmetics and foods. Although, the largest single consumer of wax in North America remains the packaging area, followed by candles, and then building materials.

Candles: one of the oldest uses of wax is still vital. No longer used for primary illumination, candles are the fastest growing segment of the wax market with new decorative and therapeutic uses.

U.S. wax production grew at a compound rate of about 3.1% per annum from 1982 to 1998, when the impact of industry consolidation and new base oil technology became significant. The production peak in 1996 is exaggerated due to product definition issues, but the trend line is true. Between 1998 and 2002, annual wax production fell from 2,480 MM# to 1900 MM#, about 23% as several small base oil plants shut down and another large one converted from MEK dewaxing process to wax hydroisomerization technology in order to manufacture higher quality Group II base oils.

Wax imports have grown steadily throughout this period, about 6.1% per annum according to Energy Information Agency (EIA) reporting, while wax exports grew at an annual rate of 9.1%. In 1953, there were 67 base oil plants in the U.S., about half of them producing some type of wax. Today, there are eight U.S. wax producers.

The estimated total sales of candles in 1999 varied between $968 million and $2.3 billion, while imports were $486 million. Vendalite's product has the potential of eliminating tens of thousands of tons of carbon from the environment.

In North America, eight companies currently manufacture finished or semi-refined waxes at nine locations in North America; not all companies produce both semi-refined and fully refined waxes.
Product distribution is about 40/60 between finished and semi-refined, though this can be misleading because semi-refined is sold as feedstock to fully-refined producers, as well as being sold into end-use markets. A typical wax producer in North America produces wax concurrently with base oils at an integrated solvent dewaxing/deoiling unit, although there are also "stand-alone" deoiling plants producing finished wax from purchased feedstocks. An average finished wax plant produces about 1,000 barrels a day of product, or 100 MM pounds a year. About half of U.S. wax manufacturers produce low oil content, finished waxes, and the rest simply recover slack wax from their operations (although one producer sells residual material from waxy crude without further processing). Curiously, no integrated Canadian refiner or Caribbean plants produce finished wax. North American producers operate only solvent deoiling processes. There

are other technologies available for deoiling, including sweating and fractional crystallization; the latter process is the only practical alternate for large scale production. After deoiling, product wax is typically finished by hydrogenation or clay treating to decolorize it and assure FDA compliance where required. With the exception of 2000, wax imports stayed within 1,000 barrels per day of exports from 1999 – 2005. This ratio began to change in 2006 with the tariff on parrifin wax candles imported from the People's Republic of China. However, in subsequent years, the delta narrowed as imports, particularly from Southeast Asia, entered the U.S. market.

Given the current state of flux in the North American lubricants business, there are three strategic concerns for its wax co-products: attrition of base oil manufacturing facilities, the rising trend of imports and the advent of new process technologies, specifically Gas-to-Liquids (GTL) and Coal-to-Liquids technologies capable of co-producing premium waxes along with sulfur free fuels and premium lubricants.

Base oil refinery attrition is the factor with the most influence on wax production in the past twenty years. A historical view of North American paraffinic base oil manufacture shows a clear trend to consolidation. This consolidation is bad news for the wax buyer since bigger plants have installed hydroisomerization technology that converts wax to base oil and eliminates wax as a co-product. To the extent that increasing demand for low volatility, high VI stocks for engine oil drives investment in lubricants, there may be further conversion of existing capacity to isomerization with resultant decrease in wax manufacturing. NPRA estimates that approximately 25% of finished wax capacity could be considered "at risk" for such conversion, and about the same proportion of semi-finished wax. This represents approximately 500 MM pounds per year of wax products, roughly twice the present import amount. However, many current wax manufacturers are independent operators and not major international integrated companies. These players are considered less likely to move to the new technology than the integrated majors. The two major integrated companies among wax producers have already committed themselves to technology choices, one reducing its capacity by a hydroisomerization conversion, and the other maintaining its wax capacity by developing alternate processing for its base oil products. Given that the capacity of one production plant is dedicated to the "export gap" defined previously, it is believed that further rationalization, if it occurs, will not seriously affect supply, and that supply shortages can be made up by imports. The other side of the supply question is how much can domestic supply be expanded? Given the relatively high cost of building process units and the low price of import waxes, it is unlikely that there would be grassroots construction of a wax deoiling plant. However, one can expect to see the usual "capacity creep" through debottlenecking, but no grassroots construction.

Imports are a growing part of the North American wax picture. China has large production volumes of waxy crude and a fairly large processing capability, and is a ready source of wax to meet the needs of the North American and other markets.
The third strategic influence on wax is the potential new supply that could be introduced

by large-scale Gas-to-Liquid (GTL) operations, based on Fischer- Tropsch (FT) synthesis. There are presently a number of GTL projects announced to build large-scale commercial units, although not all have wax plants. The technology of producing wax by FT synthesis has been proven for many years and there are presently two FT-based plants operating in South Africa and Malaysia. GTL could multiply the supply of these waxes many times. A basic GTL plant uses FT to synthesize a wide-boiling paraffinic "gas oil" that is then refined into finished products. The main interest in GTL is to produce environmentally friendly fuels, in which case the FT product is hydrocracked and dewaxed: expected fuels yield would be about 50 - 80% from such a feedstock. The remaining material can be processed for ultra-high VI lube base oil or wax. A world-scale GTL plant thus has the capability to produce a large volume of wax. However a proliferation of GTL plants would depend on many factors, including the vagaries of crude and natural gas markets.

With the past and current changes to the wax market described above, one may expect in the future to see the same evolution that has taken place for the past 2,000 years. Smart operators will continue to find new ways to take advantage of the special properties of this unique material, and smart producers will continue to find ingenious and efficient methods to meet their customers' requirements.

On the political front the leaders of the G7 plan to "end extreme poverty and hunger" by phasing out 85% of the world's energy supply including 98% of the energy used to transport people and goods, including food.

The Pope, spiritual leader of the Catholic Church, in a bold move suggests that the Earth looks like "an immense pile of filth" and encourages a move to passive energy use.

The Keeling curve of CO2 concentration in the Earth's atmosphere since 1959 is the supposed smoking gun of catastrophic climate change. We presume CO2 was at 280 ppm at the beginning of the Industrial Revolution Most of the rise from 280 to 400 ppm is caused by human CO2 emissions.

Ontario's emissions in 1990 were 177 megatonnes (Mt) of GHG, so the province intends to reduce emissions to 150 Mt annually by 2020.

Current Ontario emissions are about 165 Mt annually, meaning the province's goal is to reduce them by about 15 Mt annually by 2020.

As an alternative to such hazards, Vendalite initiated a"green" based program in consultation with it's clients to deliver an electronic candle product through the developmental support of a Community College. In itself, new research took Vendalite out of 30 year era of incandescent bulbs and MOS chips to one of LED technology.

The result is an electronic candle delivery system that reduces by 97% the energy costs compared to earlier versions of the product. For further information please review our website www.vendalite.com.

Under cap-and-trade, the government sets a gradually decreasing annual limit on GHG emissions from the burning and use of fossil fuels. The government imposes caps on carbon emissions, and gradually lowers the caps over time. Big businesses as non-exempt industries must obtain permits to emit greenhouse gases. Those that become more efficient and use less than their quota, can sell the rest of the permits or credits to non-exempt industries— that's the trade part of cap-and-trade. Each credit entitles the bearer to emit one tonne of carbon dioxide or its equivalent.

If it truly the intent of the Government of Ontario incentives can and will be induced to free the Church from burning wax candles for parishioners to express their intentions. Vendalite is positioned to obtain and trade permits or credits thereby utilizing the quotas and selling it's permit or credits to those who may use them to offset caps on carbon emissions. In this manner, Vendalite as a representative of an energy efficient company that reduce emissions over time will have extra credits to sell to inefficient, non-exempt companies that don't have enough credits to cover their emissions.

If the Ontario Government is proposing that all industrial and institutional sectors will have an assistance factor of 100% in the first compliance system period of 2017 to 2020 as reported, and that it will give free credits to industries which, in its determination, reduced emissions voluntarily, before 2017. Vendalite respectfully requests participation in this program.

Derek Insley, M.A.
President