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S 3625. New York State Healthy and Green Procurement Act

Final Report

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1 Executive Summary

With a procurement budget of $142 billion, New York State has decided to add a sustainability metric to the purchases it makes in order to improve the environment and the health of its citizens. The bill indicated specific examples of purchases that it aimed to improve such as procuring 30% post-consumer paper, however, based on the budget; we came up with additional areas that play a significant role in the procurement process. These four areas include the purchases of vehicles, paper, electronics, and building materials. The primary purpose of this analysis is scientific. Hence, the goal is to have a process that is easier on the environment than current methods of procurement. The categories listed above went through a lifecycle analysis, and the most environmentally significant stage of the assessment was further analyzed. By identifying the environmental and health issues of the stage, we came up with viable recommendations to alleviate these negative effects. Then, the science behind the recommendations explained the negative consequences that would be expected. To prove that these recommendations are more sustainable than previous practices, there are indicators of success that can measure and verify these claims.

2 Introduction

Currently, New York State procures commodities, services and technologies with limited consideration of the impact of these purchases on public health and the environment. The New York State Healthy and Green Procurement Act, introduced in February 13, 2011 by Senator Brad Hoylman, aims to make amendments and additions to existing laws including the state finance law, economic development law, and environmental conservation law, to incorporate environmental and human health issues to the procurement process of New York State.

This report examines the environmental issues related to the procurement of goods and services made by state government, and analyzes the key contents of the bill with a focus on the science of the problem and the proposed solutions. In order to understand the environmental science behind the purchases made by the state government, the report focuses on the problems and solutions of four key purchases of New York State–electronics, paper, building materials and vehicles. In addition, the report addresses the scientific indicators that could be used to measure the success of the proposed bill.

2.1 What is the Current Procurement Criteria of New York State?

Currently, New York State procures commodities, services and technologies with limited consideration of the impact of these purchases on public health and the environment. The traditional criteria focused on lowest price, best quality and efficiency. The current New York State procurement complies with multiple state regulations, including 13 New York State procurement guidelines, Procurement Lobbying Law, sales tax certification, vendor responsiveness and responsibility, Office of Information Technology Services (ITS) approval, as applicable, prevailing wage schedules, consultant disclosure, reference and compliance with Executive Law Article 15-A (M/WBE & EEO), workers' compensation insurance and disability benefits insurance, bidders' right to a debriefing, and green purchasing goals, policies, specifications and standards (New York State Procurement Council, 2014).

There are previous policies that require agencies to procure goods and services in a sustainable manner. The New York State has switched to procurement method with sustainability consideration starting with Executive Order 4 (New York State Department of Environmental

Conservation, 2015). Executive Order 4 proposes a state green procurement and sustainability program, and Executive Order No. 18 controls the state purchase of bottled water (New York State Department of Environmental Conservation, 2015). Executive Order 4 involves approximately 85 state agencies and other affected entities (New York State Department of Environmental Conservation, 2015). The Executive Order states that, "New York State agencies must procure commodities, services, and technology in accordance with Article 11 of the New York State Finance Law" (New York State Department of Environmental Conservation, 2015). Moreover, the Executive Order also establishes the Procurement Guidelines (New York State Department of Environmental Conservation, 2015). Before the introduction of the Green and Healthy Procurement Act, the requirements of existing policies for state agencies include (New York State Department of Environmental Conservation, 2015):

- "Conserve, improve and protect natural resources and the environment;
- Prevent water, air and land pollution;
- Enhance the health, safety and welfare of State residents and their overall economic and social well-being;
- Promote cost effective methods to reduce energy and resource consumption;
- Reduce greenhouse gas emission;
- Reduce or eliminate the use of hazardous substances and the generation of hazardous substances, pollution and waste at the source;
- Reduce the generation of solid waste, reusing materials, and recycling materials that cannot be reused;
- State agencies should consider environmental attributes and green performance standards as part of their overall assessment of the agency's need for goods or services."

2.2 What is the New York State Green Procurement Act?

Introduced by Senator Hoylman on February 13, 2015, the New York Healthy and Green Procurement Act is an Act to establish in New York State a new procurement process of goods

and services that takes into account the impacts on public health and the environment ensuring at the same time the economic growth of New York State.
This new procurement process aims for the best value and quality of procurement process in New York State avoiding the purchase of commodities, services, and technologies with toxic substances, and minimizing adverse environmental impacts whenever feasible.

Thereunto, the Act proposes amendments to the state finance law, economic development law and environmental conservation law, includes health and environment expertise in the membership of the State Procurement Council, and addresses to the Office of General Services the authority to develop guidelines for healthy and green procurement.

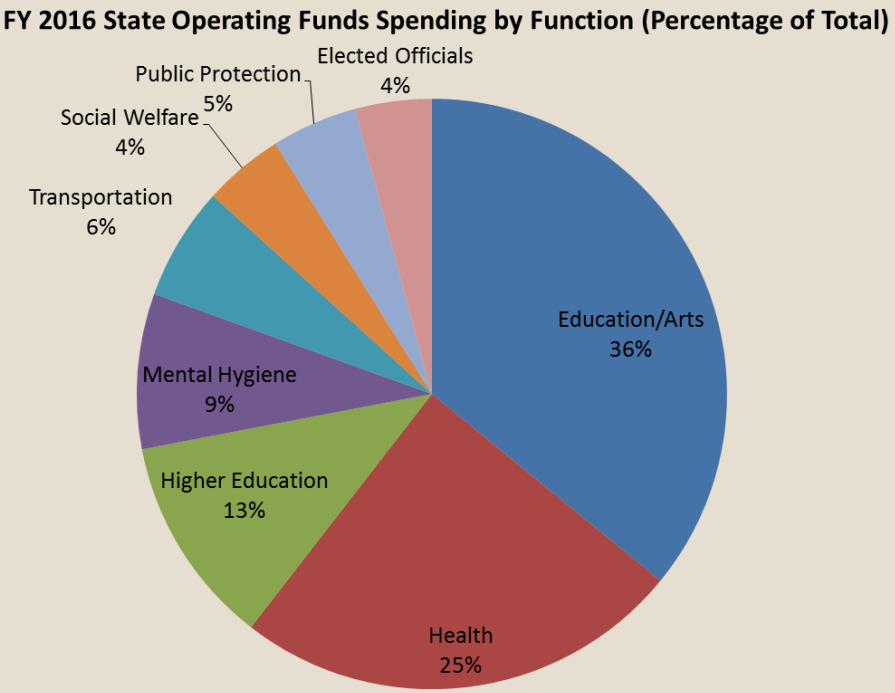
Finally, the New York Healthy and Green Procurement Act requires annual reports to be made to the Legislature and Governor regarding the status of green and healthy considerations in the procurement process including recommendations for programs or policies towards waste minimization and the use of healthy and green commodities, services and technologies within the state.

3 What are the Major Purchases of New York State?

New York State's budget is divided into eight main spending categories: Education/Arts, Health, Higher Education, Mental Hygiene, Transportation, Social Welfare, Public Protection, Elected Officials and Other.

Embedded within these categories, are the purchases for commodities, goods and services: Professional Services, Information Technology, Computers and Communication, General Commodities, Supplies, Equipment - Acquisitions, Leases and Rentals, Equipment - Repairs and Maintenance.

Within these subcategories are additional purchase breakdowns. We primarily focused on the subcategories that relate to the procurement of electronics, papers, vehicles and building materials.



Source: Enacted Budget Financial Plan for FY 2016

3.1 New York State Budget

The New York State Budget for fiscal 2016 is $142 billion. Of this total, approximately $6.5 billion is spent on commodities, goods and services each year (New York Senate, 2015). New York State, as a major consumer of goods and services, can support green procurement which directly benefits the environment and public health as well as providing for more durable and less embodied energy products.

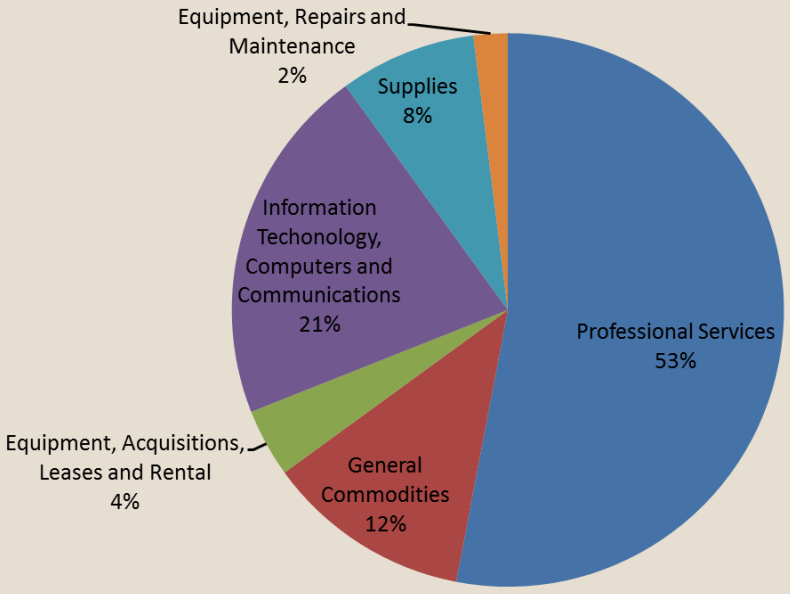
FY 2016 All Funds Spending (billion $)				
Criteria	**FY2015**	**FY2016**	**Change**	**Percent**
All Funds w/o Extraordinary Federal Aid or Settlement Proceeds	$137.7	$141.6	$3.9	2.8%
All Funds w Extraordinary Federal Aid and Settlement Proceeds	$143.0	$150.0	$7.0	4.9%

Source: NY State Senate Majority, Finance Committee, Counsel Staff Analysis of FY 2016 Executive Budget.

"The government has the capacity to directly fund key elements of the transition to a sustainable economy through a variety of programs and tools, specifically investments in scientific research and development and direct spending through sustainable public procurement policies and programs" (Cohen, 2015). Of the approximately $6.5 billion spent for commodities and services, the sub categories under the category of commodities, goods and services break down as the following:

- Professional Services - $3,432,540,844 : 53%
- Information Technology, Computers and Communication - $1,355,776,327 : 21%
- General Commodities - $784,326,657 : 12%
- Supplies - $519,547,661 - 8%
- Equipment - Acquisitions, Leases and Rentals - $272,708,722 - 4%
- Equipment - Repairs and Maintenance - $147,870,469 - We primarily focused on the subcategories that relate to the procurement of electronics, papers, vehicles and building materials.

Expenditures for Commodities and Services New York State Overall Agency Spending



Source: New York State Office of the State Comptroller. Directory of Frequently Purchased Commodities and Services by New York State Agencies, FY 2013-14.

3.2 Selected Categories

Our primary focus is on the subcategories that relate to the procurement of electronics, papers, vehicles and building materials. Electronics represent about 14% of the $6.5 million budget. Paper represents about 9.2%, and vehicles represent about 17.9% (includes fuel costs) (Annual Information Statement, 2015). Building materials are more difficult to estimate due to their procurement is spread among several categories including new construction (capital costs) and repairs and renovations.

Vehicle and Paper

General Commodities: Vehicle Fuel and Paper Products			
Category	**Spending by Category**	**Subcategory**	**Spending by Subcategory**
Vehicle Fuel	78,412,102	Compressed Natural Gas (CNG)	608,598
		Diesel	26,376,531
		Gasoline	51,388,047
		Hydrogen	33,995
		Motor Vehicle Propane	4,931
Books/Magazines	87,489,737	Reference Book/Magazine/ Map/Subscription Materials	87,489,737
Total Vehicle and Paper Related Spending			**165,901,839**
Total General Commodities Spending			**784,326,657**

Source: New York State Office of the State Comptroller. Directory of Frequently Purchased Commodities and Services by New York State Agencies, FY 2013-14.

Paper

General Commodities: Supplies			
Category	**Spending by Category**	**Subcategory**	**Spending by Subcategory**
Office	59,291,175	Office Supplies	59,291,175
Total Paper Related Spending			**59,291,175**
Total Supplies Spending			**519,547,661**

Source: New York State Office of the State Comptroller. Directory of Frequently Purchased Commodities and Services by New York State Agencies, FY 2013-14.

Buildings & Vehicles

Equipment - Repairs and Maintenance			
Category	**Spending by Category**	**Subcategory**	**Spending by Subcategory**
Building & Grounds	52,168,571	Building & Grounds Equipment	52,168,571
Vehicle, Heavy Machinery & Transportation	50,151,893	Aviation	3,347,679
		Heavy Machinery	4,534,993
		Marine	401,002
		Railway	220
		Vehicles	41,867,999
Total Building Materials and Vehicle Related Spending			**102,320,464**
Total Machinery Repairs and Maintenance			**147,870,469**

Source: New York State Office of the State Comptroller. Directory of Frequently Purchased Commodities and Services by New York State Agencies, FY 2013-14.

Buildings & Vehicles

Equipment - Acquisition, Leases, and Rentals			
Category	**Spending by Category**	**Subcategory**	**Spending by Subcategory**
Heavy Machinery, Aviation, Marine & Railway	62,068,308	Aviation Acquisition	4,131
		Heavy Machinery Acquisition	59,970,993
		Marine Acquisition	2,093,284
		Railway Acquisition	-100
Building & Grounds	10,265,226	Building & Grounds Equipment Acquisition	10,265,226
Motor Vehicle - Lease & Acquisition	38,219,226	Motor Vehicle Lease	2,613,000
		Vehicle Acquisition	35,606,226
Total Vehicle, Building, and Paper Spending			**110,552,760**
Total Equipment Acquisitions, Leases, And Rentals			**272,708,722**

Source: New York State Office of the State Comptroller. Directory of Frequently Purchased Commodities and Services by New York State Agencies, FY 2013-14.

Electronics

Information Technology, Computers and Communications			
Category	**Spending by Category**	**Subcategory**	**Spending by Subcategory**
Communication Equipment & Peripherals	20,635,462	IP Phones	6,185,782
		Mobile Phones	189,139
		Personal Data Assistant	121,779
		Public Safety Radios	9,511,853
		Telephones	699,512
		Unclassified Pers Comm Devices/Parts	3,927,397
Computer Parts & Peripherals	89,735,651	Computer Accessories	3,952,047
		Computer Servers	13,002,700
		Desktop Computers	41,874,669
		IT Mainframe Printer	679,091
		IT Network Capable Printer	2,741,157
		IT Personal Printer	1,228,474
		Media Storage Devices	473,886
		Multifunction Printing Devices	3,691,867
		Notebook Computers	8,915,408
		Parts and Peripherals	9,830,511
		PC Lease	2,693,650
		Printer Lease	9,511
		Server Lease	10,717
		Specialty Printers	512,760
		Thin Client Computers	119,203
Total Electronics Related Spending			**110,371,113**
Total Information Technology Spending			**1,355,776,327**

Source: New York State Office of the State Comptroller. Directory of Frequently Purchased Commodities and Services by New York State Agencies, FY 2013-14.

Total Spending Targeted (Paper, Vehicles, Electronics, Buildings)	**548,437,351**

According to the Office of General Services for the State of New York, "more than 90% of reporting agencies consulted the green procurement specifications when making purchases in FY 13-14, but most did not report purchases of green products other than recycled paper." The office is hoping that as the program matures, New York State's green procurement program will

increase as the users, vendors and state agencies alike, become familiar with specification s regarding green purchases and the associated procedures. It is the office's goal to streamline the process as well as encourage additional green contracts.

Because of the manner in which the budget categories are divided, it is difficult to track green purchases. Tracking the purchase of recycled paper has been easier and the program to date overall is more successful than that of the other categories. In the FY 2012 - 2013, overall green purchasing by state agencies was $113.2. In the following fiscal year, FY 2013-2014, it amounted to $11.2. Expenditures were for 30% or more post-consumer recycled content copy paper, 100% recycled janitorial paper, re-refined oil, and green computers. The figure for FY 12-13 is considerable higher due to an expenditure of $100.8 million spent for the purchase of EPEAT Gold “Plus 7” computers, saving the State $94 million (New York Senate, 2015).

4 What are the Environmental Problems, Science, Proposed Solutions and Controversies of the Purchases?

4.1 Paper

According to the Environmental Paper Network waste from paper accounts for more than one-third of municipal solid waste. Municipal landfills are responsible for 34% of all human-related methane emissions and paper waste certainly does not improve this statistic. Unsustainable management of forests results in deforestation, which exacerbates the global carbon capture cycle. Aside from the carbon capture cycles, logging contributes to soil erosion, habitat loss, and destruction of biodiversity. The manufacture of papers consumes huge amounts of water, energy (mostly fossil fuels), and chemical bleaches. Paper today ends up in all forms of media and is distributed for use in a variety of ways, as cardboard, newspaper, printing, copy paper, and others.

The beginning of the cycle involves virgin wood from forests cut down and segmented into smaller pieces. From here the wood segments are sent to the Pulping Mill. Scraps from lumber mills are also transported to the mills as recycled by-products (Gullichsen, 2000).

Wood segments are either debarked or shredded into chips to be ground or sent through a thermomechanical refiner. A thermomechanical refiner sandwiches wood chips between two disks known as a disk refiner, under high temperature and pressure (PrintWiki, n.d.). The higher temperatures and pressures soften the lignin to separate the fibers. White liquor, a strongly alkaline solution mainly of sodium hydroxide and sodium sulfide, is used in the first stage of the Kraft process in which lignin is separated from cellulose fiber for the production of pulp (Biermann, 1993).

About a third of all paper recovered in the US is exported overseas to be recycled back into reusable paper products. The remaining paper waste is either sent to a landfill, burned, or sent back into the recycling process. Every year, about 50% of the paper Americans use is recovered for recycling and other uses. A second source of material is recycled fiber. Each year, more paper is recycled and its fibers are reused. The paper is de-inked, cleaned and fine screened, and sent back into the pulp mill to undergo the process again of creating new pulp for redistribution (Tappi, 2001).

Landfills and incineration plants are unwanted ends of paper waste. Incinerators are straightforward burn waste and release CO2 into the atmosphere. In landfills, paper degrades slowly but once it does it can contribute to the release of methane, a potent greenhouse gas (Environment America, 2007).

The main bleaching process involves chlorine to make white pulp (Biermann, 1993). Chlorine, used as a chemical weapon, is highly toxic and corrosive. Exposure to relatively low levels of chlorine can be fatal. Similarly, chlorine dioxide causes shortness of breath, bronchitis, and emphysema. In the event of an accidental or deliberate release, chlorine and chlorine dioxide present serious hazards. This process is chemically intensive and can involve anywhere from 200 to 2,000 chemical inputs. In the United States, 16 pulp and paper mills still use chlorine and 58 use chlorine dioxide in their processing or store it on-site. These 74 facilities use and store almost 4 million pounds of chlorine and chlorine dioxide, endangering 5.7 million people living in 23 different states (Environment America, 2007).

The by-product of pulp making is called black liquor. Black liquor is an aqueous solution of lignin residues, hemicellulose, and inorganic chemicals used in the process. Approximately 7 tons of black liquor is produced for one ton of pulp. Black liquor comprises 15% solids by

weight of which 10% are organic chemicals and 5% are inorganic chemicals (Gullichsen, 2000). Originally, Black liquor was discharged into waterways but now recovery processes prevent discharge of 99.5% (Weyerhauser, 2014). Total reduced sulfur gases such as hydrogen sulfide and dimethyl sulfide are skin and eye irritants and lead to damage of skin tissue (Weyerhauser, 2014).

Deforestation is a serious problem limiting the critical role of trees, especially older trees and naturally occurring forests, to capture and store CO2 through carbon sequestration that is being released into the atmosphere. Forests store nearly 300 billion tons of carbon, roughly 30 times the annual amount of emissions created by burning fossil fuels (Stephenson, 2014). Studies have discovered that older, larger trees have greater rates of carbon uptake than younger trees. Selective logging usually cuts down larger trees for paper production that has direct effects on atmospheric carbon concentrations as well as habitat loss for forest dwelling species (Sillett 2010, Ryan 1997). Procuring paper from only recycled sources will prevent logging of old growth forests and protect these trees from further destruction.

Pulping is the initial stage and the source of most of the pollution generated by paper industries due to chlorine (Environment America, 2007). More specificity, there is a need to define exactly what is meant by one hundred percent chlorine free in order to provide solutions intended to address issues of large paper wastage, efficiency of resource use and also removal of toxins from goods purchased by the State. Paper can be totally chlorine free (no chlorine or chlorine derivatives used), elementally chlorine free (no chlorine gas used but chlorine derivatives used), process chlorine free or secondarily chlorine free (recycled paper that is produced with no chlorine or chlorine derivatives however the paper used in the first instance could have been made with chlorine or a chlorine derivative) (NRDC, 2006). Because there are three different definitions for chlorine free, it is critical that we determine chlorine free for the purposes of this analysis. Elemental Chlorine Free (ETF) reduces the use of chlorine but does not eliminate it. Totally Chlorine Free, (TCF), uses only non-chlorine bleaching processes, including oxygen, peroxide and ozone bleaching systems eliminating dioxins and chlorinated toxic pollutants. Processed Chlorine Free, (OCF), follows the same process as TCF only using recycled paper that was processed through the TCF process (Alliance for Environmental Technology, 1994). Paper companies that use Elemental Chlorine Free often note that dioxin is still “non detectable” in

their wastewater although advanced testing methods have detected this compound (Tarkpea, 1999).

By purchasing chlorine free paper, the absorbable organic halides such as dioxins and furans can be reduced or eliminated. One method to ensure success is ozone bleaching. Ozone bleaching involves one of the strongest oxidizing agents (ozone) reacting with unsaturated lignin materials at doses of around 0.5% to 1% and thoroughly mixing together to produce whitened pulp (Praxair, 1998). Ozone bleaching nevertheless brings scientific issues and trade-offs to the environment (Environment America, 2007). While once seen as a possible permanent solution, ozone is now used as a component part of the bleaching sequence working with chlorine dioxide, as a partial replacement (Air Liquide, 2007).

The bill mandates all paper purchased by state agencies to come from 100% post consumer recycled paper. Additionally, xerographic paper with at least thirty percent post consumer waste recycled content should be used. All printing and copying in state agencies should be done on both sides of the paper (double-sided). Using paper with post recycled contents means that this paper was produced using less energy and fewer toxins. The effectiveness of purchasing post consumer recycled content paper is just as important as consumer use in decreasing the volume of paper that otherwise might end up in a landfill. One ton of new paper recycled conserves 463 gallons of oil, 4100 kWh energy, prevents 60 lbs air pollution, saves 3 cubic yards of landfill space, reduces 850 lbs of CO2 emissions, saves 7000 gallons of water and 17 trees (NYSDEC – Stop). One issue regarding recycled paper is that it begins to degrade after six cycles and can no longer be used. The decrease of energy consumption and the reduction of green house gas emission are the major benefits of purchasing post consumer recycled content paper. However, only clean recovered paper can be recycled, and any contaminants such as food, metal, or other trash means the paper must be transferred to a landfill or incinerator (Zimring, 2012). Paper recycling requires the highest energy consumption among all recyclable materials. Every 100,000 dry lbs of recovered paper in a pulper creates 35,000 dry lbs of ink, fiber and other materials, which will either be burned, composed, or sent to the landfill (Tappi, 2001).

Costs and benefits come into play in order to determine feasibility. For waste management costs run $50-$150 per ton for recycling while trash pickup and disposal at a landfill costs around $70-$200 (Zimring, 2012). In order to keep recycling cost effective, the former values must remain

lower than the latter otherwise the program would be economically unfeasible; most large metro areas offer the best chance for success. Recycling paper also requires high energy usage compared to other materials 45% of original energy required to make the original paper–one of the highest energy requirements of all recyclable materials. This would be one of the first recycling programs to be discontinued if costs reductions are needed.

4.2 Vehicle

Fossil-fuel powered vehicles emit airborne particulate matter and pollutants including, carbon monoxide, nitrogen oxides, and hydrocarbons through its tailpipe when fuel is burned through its internal combustion engine, and these particulate matter and pollutants are public health problems as they can aggravate respiratory systems by damaging lung tissues. The tailpipe emissions from fossil-fuel powered vehicles can cause environmental problems such as acid rain, smog and CO2 emissions, which is a form of greenhouse gas emission--a significant driver of climate change (Tweed, 2012).

The following table illustrates the polluting chemicals produced by fossil-fuel powered vehicles through its tailpipe:

Greenhouse Gas	Abbreviation	Global Warming Potential	Source in Vehicle
Carbon Dioxide	CO2	1	Tailpipe
Methane	CH4	25	Tailpipe
Nitrous Oxide	N2O	298	Tailpipe

Table 1: Pollutants emitted from fossil fuel powered vehicles. Data sourced from Climate Change Connection.

As it is illustrated in the global warming potential exhibit shown above, CO2 has been the leading chemical greenhouse gas emission pollutant, which is emitted from burning fossil fuel. CO2 counts for 95%-99% of the total greenhouse gas emissions from a passenger vehicle (EPA, 2014).

In the United States, greenhouse gas emissions from transportation accounted for about 27% of total greenhouse gas emissions, making it the second largest contributor of greenhouse gas emissions in the United States after the electricity sector (EPA[1], 2015).

In addition to the aforementioned pollutants that are released from fossil-fuel based vehicles, secondary pollutant such as ozone is another environmental and public health concern. Ozone is created when hydrocarbons react with oxides of nitrogen, and is a common component of smog. Motor vehicles are the single largest contributor of ground-level ozone, and it is prevalent in many urban areas. Excess ozone can become a public health concern as it causes coughing, wheezing and shortness of breath, and can bring on permanent lung damage.

The team proposes increasing the procurement and use of hybrid and electric vehicles because it would lower the demand for petroleum consumption. Helmars and Marx (2012) assert that electric vehicles are essential to "phasing out dependence on oil" and decreasing future emissions and energy usage. Electric and hybrid vehicles are already a staple in many European countries for its notable environmental and health benefits--New York State should adopt similar procurements policies to realize the same benefits.

Furthermore, this procurement policy strategy would align with the Bill's expressed intent to reduce the consumption of petroleum. It would directly contribute towards reducing greenhouse gas emissions, which is a leading driver of climate change, and by procuring more electric vehicles, the emission of volatile organic compounds, hydrocarbons, carbon monoxide, ozone, lead, and various oxides of nitrogen and air pollution would become reduced, if not eliminated (Zehner, 2013).

Although the proposed solution of procuring hybrid and electric vehicles would lead to lowered levels of gasoline consumption and therefore reduce associated environmental and public health problems, scientific controversies still exist behind this solution. Procuring hybrid vehicles is controversial because they combine both a gasoline engine with an electric motor, and because of this, maintenance of hybrid vehicles would become more costly and complex in comparison to standard gasoline powered vehicles or electric vehicles that contain either a gas engine or an electric engine (DeMorro, 2014). Furthermore, study shows that more energy is required in the manufacturing process of hybrid vehicles, consequently emitting more greenhouse gas into the environment in comparison to conventional gasoline powered vehicles (UCLA, 2012).

Another environmental concern with procuring electric vehicles is that it contains rare earth metals inside the motors--a fixed magnet technology. The mining of the rare earth metals, namely of neodymium and dysprosium, that is required to produce the fixed-magnet motors poses a an environmental threat especially in the future because the demand of these metals is expected to increase up to 2600% over the next 25 years (Chandler, 2012).

Finally, contrary to popular belief, electric vehicles are not 100% clean-fuel based because although electric vehicles release no tailpipe emissions, they rely on electricity which comes from a mix of generation sources—the mix includes nuclear, natural gas, petroleum, and coal power plants. Collectively, these sources are not from a 100% renewable natural resource; rather, a greater percentage of the fuel source is derived from fossil-fuel (US EIA, 2015).

4.3 Building Materials

Buildings are great consumers of resources and materials. Building on sensitive or undeveloped land sites can have an adverse effect on habitats, biodiversity and increase transportation and infrastructure costs. Air quality, both indoors and out is affected by the emission of noxious gases and contaminants that can be emitted from materials, finishes, construction methods, green cleaning practices, tobacco smoke, landscape practices, vehicular access and mechanical, electrical and plumbing systems. These can also directly affect water quality. Waste that is not recycled or reused adds to existing landfills. Buildings currently consume 73% of all electricity in the U.S., making energy efficiency and energy generation of critical concern (USGBC, 2015).

PVC is a white sold plastic that is used in a wide range of building materials (e.g. piping, flooring) and many consumer goods. It is primarily made from vinyl chloride (colorless organic gas with a sweet odor, slightly soluble in water, flammable) which is considered a human carcinogen (EPA, 2013). “Acute (short-term) exposure to high levels of vinyl chloride in air has resulted in central nervous system effects, such as dizziness, drowsiness, and headaches in humans. Chronic (long-term) exposure to vinyl chloride through inhalation and oral exposure in humans has resulted in liver damage. Cancer is a major concern from exposure to vinyl chloride via inhalation, as vinyl chloride exposure has been shown to increase the risk of a rare form of liver cancer in humans. EPA has classified vinyl chloride as a Group A, human carcinogen” (EPA, 2013).

PVCs are widely used because they are relatively inexpensive and easy to work with. Versatile uses in construction of buildings include, as piping, floorings, sidings and doors and windows, etc. Many alternatives exist for materials that can be used instead of PVCs. With respect to piping, cast iron and steel are alternatives. Floorings solutions that are more environmentally friendly include linoleum and ceramic tiles. Proposed green siding solutions are recycled or reclaimed or FSC (Forest Stewardship Council) certified sustainably harvested wood, OSB (oriented strand board), brick, polypropylene (Healthy Building, 2006). Window and door solutions that are widely considered sustainable materials are recycled or reclaimed or FSC (Forest Stewardship Council) certified sustainably harvested wood and aluminum (Healthy Building, 2006).

The bill recommends avoiding the use of polyvinyl chloride, (PVC). This is far reaching considering its broad use as a building material, particularly in piping and flooring. Alternatives for piping include cast iron, copper, steel, concrete vitrified clay, and HDPE (high density polyethylene) (Healthy Building, 2006) . HDPE, a plastic based product, has come under scrutiny as potentially being hazardous (Yang, 2011). PVC is toxic from production, use to disposal (Sommerlatt, 2013). Most PVC ends up in landfill waste with less than 1% being recycled (Healthy Building, 2006). Avoiding PVC reduces exposure to air toxins emitted during production or through incineration releasing dioxins, an EPA identified human carcinogen, and hydrogen chloride gases. Eliminating, not avoiding, PVC for potable water is critical as PVC has been found to leach phthalates and other contaminants into the water supply (EPA, 2012). This applies to eliminating the use of vinyl flooring as it has been found to release phthalate plasticizers which may be endocrine disruptor suspects.(Akingbemi, 2004) Children under the age of three are the most susceptible causing hormonal imbalances. (Akingbemi, 2004). Linoleum is a replacement that is made from flaxseed which is a renewable material. More durable than oil-based products with a long life expectancy, it is biodegradable and releases no harmful toxins. Siding, windows and doors are better constructed from certified sustainably harvested wood Forest Stewardship Council (FSC).

The use of PVC alternative piping (cast iron, cooper, steel, concrete vitrified clay, high density polyethylene) reduces exposure to air and water toxins. However, break failure, structural failure, longitudinal cracking are the associated serious durability issues. The Steel and iron extraction and manufacturing processes require high-energy use that increases CO2 emissions. While tin based soldering of pipes generates environmental problems (Friends of the Earth, 2012), the increase of copper in the environment is exerting evolutionary pressure on disease.

While linoleum is a flooring alternative to reduce exposure to air toxins such as dioxins and vinyl chloride, it also generates adverse impacts on the environment. At the end of its life cycle, most linoleum goes to landfills or incinerators. The use of nitrogen based pesticides (Gorree, 2000) and fertilizers to grow flaxseed contributes to global warming and acidification. Trichloroethane is a solvent used during production that releases volatile organic compounds (Gorree, 2000).

4.4 Electronic Waste

There are two major issues of concern regarding electronics. These are the amount of energy they use and the hazardous materials they contain. Energy consumption by electrical and electronic devices is higher than for any other type of appliance. Depending on the source of raw materials used to produce the energy, the environmental damages from high energy-use can be significant. The EPA estimates that greenhouse gas emissions from electricity demand have increased by 11% since 1990 and consume an abundance of fossil fuels (EPA[2], 2015).

While the Bill does not directly address electronic waste, it does state its intention to increase energy efficiency by utilizing and reducing pollution while improving human health and protecting the environment. Lead, mercury, beryllium, cadmium, and chromium are toxic materials used in the production of electronics. These elements, when released into the environment, can cause soil and air pollution, and put workers at risk of exposure during the extraction, production and disposal phases (New York State Department of Environmental Conservation, 2014).

The electronics industry was designed around the melting point and physical properties of lead. Lead is ideal for soldering. For decades lead–tin solder has been used to attach electronic components to printed wiring boards. Lead is not a problem when contained in electronic equipment. However, when electronic components are deposited in landfills, lead leaches into the groundwater supply and contaminates drinking water. (Electronics TakeBack Coallition, n.d.) The risk is compounded in countries that receive massive imports of electronic waste. Eighty percent of recycled electronics in the U.S. are sent to China, Nigeria, India, Pakistan, and Vietnam. Unprotected workers, including children, strip recyclables out of electronic components in a cottage industry of sorts (Electronics TakeBack Coallition, n.d.). Thus, the team opted to procure lead free and Energy Star designated electronics. Energy Star computers use

30%-65% less energy than computers without this designation. The reduction of energy directly impacts the reduction of greenhouse gas emissions. If all of the computers in the U.S. were Energy Star labeled, it would equal reducing the greenhouse gas emissions of over 1.4 million vehicles (EPA[2], 2015). Potential alternatives to lead include a combination of tin, bismuth, silver, copper that melt at low temperatures and share the properties of lead.

Lead has serious effects on humans. Lead exposures above the 600 ppm (EPA standard) cause biochemical changes that affect human physiology at the neurological level, the nervous, cardiovascular and immune systems (Bostick, 2015). In particular, research shows lead exposure by children has resulted in impaired neurodevelopment, learning and behavioral problems. Research done by the EPA on neurocognitive effects in children showed evidence of a direct correlation between increased blood lead concentrations and IQ change. An increase of 1 ug/dL in average blood lead concentration was associated with a decrease of 0.5 IQ points (EPA, 2007).

Scientific issues, controversies and trade-offs are associated with seeking to utilize lead free electronics. Firstly, we need to carefully distinguish between lead-free assembly versus lead-based assembly because lead-free assembly is not better for the environment but even worse. Lead free solder such as tin, silver and copper has global warming, acidification and human toxicity potential. The additional tin mining required to produce high-purity tin alloys, plus the mining of other precious metals required to alloy with tin in substitution for lead is a poor trade for the use of existing lead, much of which comes from recycled products (Titus, 2011). Increased solder-reflow temperatures will put heat-sensitive components such as SAC solder (95.5% tin, 3.9% silver, 0.6% copper) at risk because many of the components being made could not withstand the higher temperatures (Black, 2005).

A scientific controversy related to purchasing Energy Star electronics is that when compared to certain low-use applications or in locations with very low rates of electricity, EnergyStar qualified products are not cost-effective (Foster, 2013). Additionally, Energy Star's reported energy savings are unreliable and some of the benefits are not verified (Foster, 2013). Environmental News Service has also advised that Energy Star electronics lack quality review of its data, heavily dependent on estimates, forecasting and unverified third party reporting.

5 Indicators for Measuring the Success of the Solutions

Performance indicators play an important role in tracking progress towards achieving a program's desired goals. These enable stakeholders to reassess and redesign prior solutions when and where needed. In order to determine the appropriate performance indicators, the following success factors were been created by the team for each problem purchase:

Success Factors

Vehicles: The burning of fossil fuels is a leading cause of greenhouse gas emissions and vehicles are a leading contributor. The team proposes that New York State procure more electric vehicles as a solution. Thus, a success factor to ensure that the goal is being met would be a:

- Reduction in greenhouse gas emissions and airborne particulate matter from fuel combustion

Paper: Paper has been traditionally produced using a toxic bleaching agent named chlorine. Chlorine causes adverse health and environmental impacts; therefore, the team advises the State to procure only chlorine-free paper. A success factor to ensure that the goal is being met would be a:

- Reduction in Chlorine and dioxin emissions from paper consumption

Building Materials: Materials made from PVC can produce toxic chemicals during its production, use and disposal. The team recommended procuring non-PVC-based piping and linoleum-based flooring. A success factor to ensure that the goal is being met would be a:

- Reduction in toxic pollutants

Electronics: Electronic equipment used by the members of the State consists of products such as computers, servers, lighting, heating and cooling systems. These electronics consume vast amounts of electricity and contributes to greenhouse gas emissions. In order to conserve and minimize the energy consumed, the team suggests purchasing electronics that are Energy Star-labeled. These devices generally use 20-30% less electricity in comparison to devices that do not carry the label (Tugent, 2008). A success factor to ensure that the goal is being met would be a:

- Reduction in greenhouse gas emissions

Additionally, another concern regarding electronic equipment is that some of the equipment contains heavy metals and hazardous chemicals such as lead (Pb). This is both an environmental

and public health concern when it is released into the environment and causes soil, water and air pollution. Therefore, the team advises purchasing lead-free electronics. A success factor to ensure that the goal is being met would be a:

- Reduction in toxic pollutants

Performance Indicators

The following performance indicators will allow stakeholders involved in the analysis of the policy to track its progress and or success of the policy and ensure that the goals of the policy are being met:

Category	Success Indicators
Vehicles	Measure carbon dioxide (CO2) emissions Measure atmospheric Average Particulate Matter Concentration
Paper	Measure chlorine (Cl2) content from point source Measure dioxins (TCDD) exposure; water contamination
Building Materials	Measure Phthalates (DEHP) exposure Measure Dioxin (TCDD) exposure
Electronics	Measure electricity usage (MWh, kWh) Measure Lead (Pb) exposure

Table: Success Indicators for four procurement categories

6 Conclusion

New York State is one of the first governments in the United States to attempt to use human health and the environment as a standard in the procurement of technologies, goods and services. Throughout our analysis, we critically discussed and clarified what green procurement means. This entailed dissecting the lifecycle of paper, electronics, building materials and vehicles to better understand the negative effects associated with procurement of these items. Most products exhibit cradle to grave cycles with harmful impacts on the environment and human health through emissions of pollutants, damage to ecosystems, and other hazards. Preventing waste from entering landfills by promoting recycling of discarded items and reintroducing old materials from the waste stream into the production line, creates an end use market while providing environmental, human health, and economic benefits. The Healthy and Green Procurement Act provides a framework for product-specific stewardship. This stewardship presents criteria requiring agencies to fully analyze the best available actions and consistently purchase the most sustainable goods. Frameworks like the Procurement Act will force citizens to rethink where to

get their daily services from. Additionally, such an Act means state agencies and authorities will be leading by leading by example and clearly demonstrating a commitment to a more sustainable way of life. This can also incentivize businesses to adopt more green practices to attract the State and the more selective customer.

In order to combat forest degradation, ecosystem loss, rising pollution, public health problems, and waste accumulation; examining consumer actions which foster these problems is essential. The Healthy and Green Procurement Act is the first critical step at examining our consumer actions and curtailing our harmful procurement. Thus, we have resolved that the traditional procurement methodology is defective and a new one is required if we are to successful address the increasing threats of the 21st century as a healthier and more environmentally conscious society.

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