Appendix D: PLA Seed Grant Proposal Executive Summary

Potatoes to Plastics

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Executive Summary

This research project examined the resource and economic viability of Maine potatoes as a source for polylactic acid (PLA) to support InterfaceFABRIC's manufacturing requirements for use in their bio-based fabrics for commercial interiors. As part of this study, the following data was reviewed:

- the amount of acres currently harvested for potato production and the average number of acres in use;
- the average harvest yield of potatoes;
- the average price paid to growers per hundredweight (cwt) of potatoes;
- the raw materials costs associated with collecting, transporting and pre-processing waste potatoes for production of starch in preparation for PLA production;
- the availability of potato starch to meet the needs of InterfaceFABRIC; and
- the comparison of current cultivars of potato vs. one bred to use less fertilizer and fungicide (the Defender, a non-Genetically Modified Organism), both with approximately the same starch content.

The analysis of these data supports the conclusion that it is economically feasible for Maine potato growers to plant and harvest potatoes specifically for the purpose of providing a source of starch to manufacture PLA. It has also been determined that there would be little to no start-up costs to the potato growers themselves to provide potatoes for PLA using the potato cultivars (varieties) that are currently grown, in particular the Russet Burbank and/or Shepody potatoes. The planting, harvesting and pre-processing of these potatoes would be no different than what the growers are currently doing.

The analysis also shows that the cost of processing potatoes for PLA would be similar to that for a small capacity PLA facility that processes corn and the price which potato growers would receive for PLA potatoes would most likely be comparable to the average price paid to all growers for their potatoes. It also appears that the price of PLA from potatoes would be similar to that for PLA derived from corn. The analysis further confirms that the amount of PLA needed by InterfaceFABRIC (13 million pounds per year) could, in principle, be supplied solely by waste potatoes, made up of those left and examine the potential contribution of waste potatoes and processed starch to support a PLA facility and to examine the potential for new more cost effective and environmentally sustainable potato varieties which can be

Appendix E: Nanotechnology— An Emerging Category of Chemicals

Nanotechnology; An Emerging Category of Chemicals
June, 2007
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Professor of Toxicology and Molecular Epidemiology
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Nanotechnology is considered to be the next industrial revolution and to become a 1 trillion dollar industry within the next 10 years. The federal government is already investing $1 billion in nanotechnology development. Nanoparticles are currently in over 300 commercial products including sunscreen, stain-resistant clothing, tires, refrigerators, washing machines and sports equipment. They are in clinical trials for drug delivery in diseases such as pancreatic cancer, and the National Institutes of Health (NIH) has announced 4 new nanomedicine centers. The military is using nanomaterials to develop advances in electronics, munitions, propellants, fuels, nanocomposites, nano-controlled dielectrics and nanoscale photonics. We are at the beginning of the nanotechnology era.

Nanoparticles are defined as having at least one dimension less than 100 nm. They exist in the quantum scale, which means that they don't follow the laws of solids, liquids or gases. Instead, they follow the laws of quantum mechanics, which gives them their value. They exhibit mechanical, magnetic, electronic and color properties unachievable by these chemicals at larger sizes. However, the same properties that make these particles an exciting technology also make them daunting environmental health concerns. Simply put, it is unknown how these new properties will enhance, diminish or otherwise alter the toxicity of the compounds that they are made from because the toxicity of nanoparticles is uncertain and relatively unexplored.

Engineered nanoparticles clearly exhibit toxic effects as rodent studies have shown that inhaled nanoparticles accumulate in the nasal passage, lung and brain where they can cause lesions that interfere with oxygen absorption and cause suffocation due to immune system cells clumping around the nanotubes and blocking bronchial passages. Recently, it has been shown that lower doses also cause respiratory toxicity including proinflammatory and fibrotic responses. Cell culture studies confirm the toxicity of engineered nanoparticles reporting cytotoxicity, decreased cell viability and the production of proinflammatory agents. These cell culture studies indicate that size and particle composition can dramatically modify toxicity, with some sizes and forms being highly toxic and others nontoxic.

The actual dose range of nanomaterials to which the environment is likely to be exposed is currently uncertain as the technology is still very new. However, given the broad spectrum of applications and widespread use, exposure is expected to become common and frequent. For example, considering silver nanoparticles, exposure scenarios are numerous. One population that will certainly be exposed is workers who manufacture silver nanomaterials and who assemble these materials into products. These exposures are expected to be high, though mitigated by personal protective equipment and engineering controls. The nanomaterials are expected to be both agglomerated and monodispersed as the products are made, with the primary exposure route likely to be through inhalation, followed by dermal exposure, with oral ingestion being infrequent.

Another large population to be exposed will be the consumers and users of those products. Silver nanoparticles have a broad spectrum of commercial uses including toothpaste, clothing, washing machines, refrigerators and paints. Thus, consumers will be exposed orally through their direct use in toothpaste, dermally through their direct use in clothing and washing machines and by inhalation through exposure to paint and nanodusts. Given the history of lead in paint, oral exposure in very young children is likely as well.

A third exposure scenario is through an environmental route and will affect the public in general, whether or not they choose to use nanomaterials. Ultimately, these materials will enter the environment though air and water releases such as catalytic converter exhaust and paint chips released from vehicles, and water released from washing machines, among others. These air and water cycles will carry nanomaterials across the globe, in a manner such as that already documented for numerous other chemicals such as mercury. For silver nanoparticles, release into the general environment is direct and virtually assured.

For example, consider just one commercial product with silver or gold nanomaterials. Silver nanoparticles are currently in use in the 'WF300' series of washing machines made by Samsung. This series consists of 6 models each featuring "Silver Care" and currently on sale at your local Best Buy and Lowe's store. "Silver Care" is provided by two plates consisting of 99.9% pure silver nanoparticles and the interior is coated with silver nanoparticles. Samsung reports that in addition to silver ions, each load releases 4 million nanoparticles into the water that penetrate into the laundry. In cold water, the silver nanoparticles can sanitize and kill odor-causing bacteria and continue "shielding them out" by remaining in clothes "for about a month". Thus, the laundry can be cleaned in cold water instead of hot making the machine more energy efficient and since it is competitively priced (currently on sale for $899), it is likely to become a popular machine and to be imitated by other manufacturers.

There are approximately 85 million households with washing machines in the U.S. On average, these households wash 1.07 loads of laundry each day. Given Samsung's statement that each laundry load delivers 4 million nanoparticles, if their new exciting machine captures just 10% of the U.S. market (currently its global market share is 11%, but in the US it is about 4%), that would be 8.5 million households each doing 1.07 loads of laundry per day, each load delivering 4 million silver nanoparticles resulting in the release of about 36 trillion nanoparticles into the waste stream EACH DAY (or about 13 quadrillion per year) from just this one source. Of course this number only considers the potential U.S. market, and thus, the daily release of silver nanoparticles can be expected to be much higher when worldwide markets are considered since Samsung already has 15% of the Indian washing machine market and 47% of the Korean market (19-20). Moreover, these releases will rise dramatically if other manufacturers mimic this technology. The full exposure potential to silver nanoparticles will of course be still higher as this calculation only considers washing machines and excludes the numerous other consumer products containing silver nanoparticles, which will ultimately significantly contribute to any exposure scenario.

There are of course numerous types of nanomaterials. As we push forward, Maine should assume a leadership position and manage the safety of this novel new class of compounds and encourage and stimulate more measures and research to maximize their benefits and minimize their risk. In particular, we should build expertise in the design of more environmentally and health friendly nanomaterials or "green-nano" and in the evaluation of its toxic potential.

Appendix F: Letter from Maine to Federal OSHA

JOHN E. BALDACCI
GOVERNOR

May 18, 2007
Ms. Maureen O'Donnell, Industrial Hygienist
Directorate of Standards & Guidance
Room N3718, US Department of Labor
200 Constitution Ave., N.W.
Washington, DC 20210

Re: Docket No. H-022K, Global Harmonization System ANPRM

Dear Ms. O'Donnell:

These comments are submitted on behalf of the State of Maine's Governor's Task Force to Promote Safer Chemicals in Consumer Products, the Maine Department of Labor and the Maine Department of Environmental Protection.
While we recognize that the comment period of the September 12, 2006 Advance Notice of Proposed Rulemaking (ANPRM) has expired, we have communicated on the subject of this comment with Attorney Ian Moar, of the DOL Office of the Solicitor, and were encouraged to bring our thoughts to your attention earlier rather than later. These comments are responsive to the question to the public in the ANPRM regarding whether there are "any health or physical hazards that aren't covered in either the HCS or the GHS that should be added." (ANPRM, p. 17)

Our Task Force was established by Executive Order dated February 22, 2006, to investigate the adequacy of existing federal and state laws and regulations regarding chemical safety, and to recommend state action to improve the safety of chemicals in consumer products. For background, you may review the Executive Order at www.maine.gov/tools/whatsnew/index.php?topic=Gov_Executive_Orders&id=21193&v=Article and our Interim Report at www.maine.gov/dep/oc/saferchemintrpt.htm. You will note that the Interim Report addresses many inadequacies of the federal Toxic Substances Control Act, and comments on some weaknesses of existing MSDS disclosure requirements. A focus of the Executive Order is concern regarding persistent bioaccumulative toxics (PBTs), such as mercury, and brominated flame retardants.

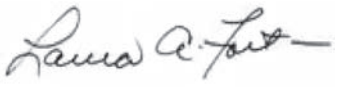
Our concern is related to the assumption made in the September 12, 2006 ANPRM that proposed revisions of OSHA regulations in response to the Global Harmonization System (GHS) would NOT incorporate ecological or environmental fate disclosures, such as persistence and bioaccumulative potential, in the Hazard Communication Standard (MSDS). The comparison chart at Appendix A to OSHA's Guide to The Globally Harmonized System of Classification and Labeling of Chemicals makes it clear that while the GHS, as well as the ISO Safety Data Sheet for Chemical Products, and the ANSI MSDS Preparation z400.0-2004, all require disclosure of "ecological information" including persistence and bioaccumulative potential, the OSHA HCS has "no present requirements" for such disclosure. The ANPRM acknowledges this discrepancy, and does not propose to redress it in proposed rulemaking: "....the GHS safety data sheet format includes a section that addresses environmental information. OSHA would not require inclusion of environmental information for SDSs used in workplaces." (ANPRM p. 9). The ANPRM goes on to note (p. 16) that "OSHA does not preclude such [environmental] information being on a safety data sheet, but will not review or enforce such provisions," for the purported reason that such disclosures are "outside OSHA's jurisdiction to regulate."

In connection with your agency's work on proposed rulemaking to conform OSHA HCS regulations to GHS regulations, we urge you to carefully reexamine the legal conclusion that OSHA does not have jurisdiction to require disclosure of scientific evidence that a chemical persists and bioaccumulates. We suggest that this conclusion be reassessed in view of the ample evidence developed in studies conducted by the Centers of Disease Control, the Environmental Working Group, and others, that certain chemicals are present in the blood, tissue, hair, and cord blood, of human beings, including, of course, workers. These chemicals are a result of a variety of environmental exposures including workplace exposures; they persist for long periods of time in human beings, and are passed on to fetuses in the uterus, with potentially serious toxicological effects. We believe that the fact that many workers carry with them an existing "body burden" of these chemicals is highly material information when assessing the risks of workplace exposures of these same chemicals. The fact that a chemical bioconcentrates implies a long half-life in the body, including the body of workers. That could have implications for the way in which the chemical is handled in the workplace. Given the toxicological perspective that the "dose makes the poison," the fact that workers may already have a body burden of PBTs that they are handling, or of related chemicals with similar toxicological endpoints, may well put the worker at greater health risk. Because PBTs have been found in high quantities in breast milk and to pass through the placenta to affect fetal development, they are of particular concern to female workers and the health of future generations of America's workers. Finally, both male and female workers need to be concerned about bringing these persistent chemicals back to their vehicles and homes on their shoes, clothing, hair and bodies.

The perspective that environmental fate has no relevance to workplace exposures ignores the best of current science; it also defeats the admirable goal of consistency in international and national worker safety and environmental requirements, a goal that OSHA has been a leader in advocating.

Sincerely,

David P. Littell, Commissioner
Dept. of Environmental Protection



Laura A. Fortman, Commissioner
Department of Labor

cc: Karin Tilberg, Office of the Governor, State of Maine
Ian Moar, DOL Office of the Solicitor
Ginger Jordan-Hillier, MeDEP