SB 620

RELATING TO THE ENVIRONMENT.
Requires food service businesses to provide customers with an option to use compostable or reusable food containers provided by the restaurant or food.
Requires signs to be posted informing customers that compostable food containers are available at no extra cost.
Requires violators to pay a fine for repeated violations

HAWAII FOOD INDUSTRY ASSOCIATION (HFIA)
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TO: COMMITTEE ON ENERGY AND ENVIRONMENT
Senator Mike Gabbard, Chair
Senator Russell E. Ruderman, Vice Chair

COMMITTEE ON COMMERCE AND CONSUMER PROTECTION
Senator Rosalyn H. Baker, Chair
Senator Brickwook Galuteria, Vice Chair

FROM: HAWAII FOOD INDUSTRY ASSOCIAITON
Lauren Zirbel, Executive Director

LOCATION: Conference Room 225

DATE: Thursday, February 7, 2013

TIME: 2:45 p.m.

RE: SB 619 AND SB 620 RELATING TO THE ENVIRONMENT

POSSITION: In Opposition.

The Hawaii Food Industry Association is comprised of two hundred member companies representing retailers, suppliers, producers and distributors of food and beverage related products in the State of Hawaii.

Chair & Committee Members:

These measures ignore the fact that despite burdening ALL food establishments in the State with a 30% increase in cost, these biodegradable products, under our current system of waste disposal will meet the same end as polystyrene. Both compostable and polystyrene options incinerate. Both compostable and polystyrene options will not biodegrade in modern landfills. Landfills are designed to protect the environment from the liquids and gases produced by reducing the exposure of garbage to air, water and sunlight – conditions essential for degradation. Without an investment in commercial composting facilities, this increased cost for food establishments and consumers will result in negligible

environmental benefits.

Not one county in Hawaii has a commercial composting facility where these products can be sent to compost. Oahu has HPOWER which can utilize the very high BTU value of polystyrene.

Most of the trash debris seen on beaches is the result of haphazard disposal of waste from all over the world and on the seas, which are brought here by currents. A ban condemning one product will not change this. Many products do not biodegrade which is why waste management is such a huge and important issue.

Hundreds of Kalihi jobs may be eliminated if the Legislature continues to threaten this locally produced, favorably priced, FDA approved product.

The market is creating it's own commercially viable and money generating solutions to the problem, solutions which don't put people out of work or force the market to act in premature ways, but instead generate jobs and profit for government and private enterprise. These solutions are especially promising given the need for energy sustainability, especially in Hawaii, and given the rising cost of fuel. Technology is now available and widely used in Japan to turn plastics into high grade Diesel oil.

While polystyrene is a petroleum byproduct, it is also a renewable resource. It is currently being recycled here in Kalihi on a small scale, and is becoming a major recyclable resource in schools on the Mainland. In fact, more that 57 million pounds of packaging were recycled in 2004. Also, in accordance with EPA priorities, polystyrene manufactures have placed precedence on source reduction and reuse as well as recycling, locally here in Hawaii as well as nationally.

Looking at this from a resource conservation prospective, source reduction is much more effective than recycling. According to Franklin Associates, in order for polystyrene packaging and disposables' recycling efforts to save as much energy as the 408 million pounds source reduced in 1997, a recycling rate of 51% would have to be achieved. On a side note, we invite all of the legislators to come visit KYD's recycling facility in Kalihi to see how they source reduce and streamlining production by reusing leftover production materials.

There are very real concerns associated with the manufacturing of biodegradable packaging, as the 2006 Smithsonian Magazine put forth, stating that biodegradable alternatives have considerable drawbacks that haven't been publicized...such as that the cultivation of corn uses more nitrogen fertilizer, more herbicides and more insecticides than any other U.S. crop; those practices contribute to soil erosion and water pollution when nitrogen runs off fields into streams and rivers. One must acknowledge the environmental trade-offs associated with the use of any packaging material and whether a mandate to use one particular type of container or product will have the desired result of reducing litter and/or marine debris.

All foodservice products – regardless of the material from which they are made – require the use of various natural resources i.e. energy, water, etc. A 2006 Life Cycle Inventory study by Franklin and Associates showed that polystyrene when compared to other food service

containers, is very efficient in terms of minimizing air emissions and energy used in the manufacturing process and in reducing the amount of waterborne waste generated during the manufacturing process.

This bill makes the false assumption that products that would replace polystyrene are somehow manufactured in a vacuum without the use of any raw materials, energy, or water, or fuel to deliver the product. This is especially important considering many bio-degradable options are produced in China where labor, quality and environmental standards are know to be well below the labor, quality and environmental standards practiced in plants which produce polystyrene here on the island of Oahu. Not to mention the carbon footprint shipping supplies from China creates when we have a more economically viable product produced right here in Hawaii providing a 100 jobs to the community.

The FDA, Health Canada and Environment Canada concluded extensive studies that styrene is "non-toxic" and that styrene "does not constitute a danger to human life and health" and "does not constitute a danger to the environment on which human life depends."

For all of these reasons we would ask that this bill be held.

Thank you so much for your time.

American Chemistry Council

February 6, 2013

To: The Honorable Mike Gabbard, Chair
Members of the Senate Committee on Energy and Environment

The Honorable Rosalyn H. Baker, Chair
Members of the Senate Committee on Commerce and Consumer Protection

From: Tim Shestek
Senior Director, State Affairs

Re: **SB 620 – OPPOSE**

The American Chemistry Council (ACC) must respectfully oppose SB 620. ACC and its members certainly support efforts to reduce litter and marine debris. However, SB 620 appears to be drafted under the false assumption that alternatives to polystyrene food service containers are environmentally preferable.

All packaging leaves an environmental footprint regardless of the material type. It takes energy and raw materials to produce, transport, and recover or dispose of any material. So it is important to measure all of these impacts throughout the entire lifecycle of a product. Consider the following:

- Polystyrene cups weigh anywhere from two to five times less than comparable paper packaging products which means fewer air emissions when transporting products.
- A polystyrene hot beverage cup requires about 50% LESS energy to produce than a similar plastic-coated paperboard cup with a corrugated cup sleeve.
- Studies conducted for Seattle Public Utilities (SPU) showed that banning polystyrene foam food take-out containers would dramatically increase environmental impacts by doubling the greenhouse gas emissions, energy use, and waste associated with the use of alternative products.

It does not make environmental sense to encourage the use of products that essentially result in higher greenhouse gas emissions, more trucks on the road, and more fuel being used.

In addition, focusing one a single material type (e.g. polystyrene) does not reduce litter. The city of San Francisco banned polystyrene containers but according to a 2008 litter audit conducted for the city, paper cup litter increased after the ban was enacted.

Furthermore, encouraging restaurants to use compostable products as replacements for polystyrene products will likely result in higher operating costs for food establishments. Polystyrene containers are 2-3 times more affordable than replacement products, which in some cases do not perform as well, especially for very hot and cold food and beverages.

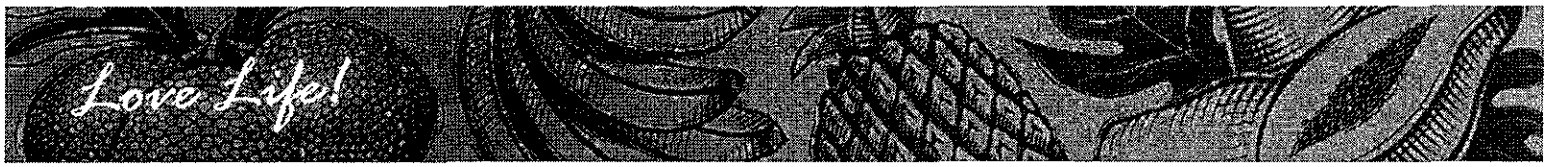
The committee should also know that "bio based" or "degradable containers" only "degrade" in a controlled composting environment – essentially a large industrial facility where temperatures can exceed 140 degrees for several days.

Consumer access to these facilities is very limited and these containers do not degrade if littered alongside the road, deposited into a trash can, nor will they degrade if they make their way into a storm drain or other water body.

ACC and its members take seriously the issue of litter and marine debris. To that end, ACC is working domestically and internationally with government officials, retailers, anti-litter groups and consumers to devise solutions to prevent marine debris.

Some of our more recent activity includes helping develop new and innovative recycling programs nationwide; promoting industry-wide practices to contain plastic pellets; partnering with governments and conservationists to encourage recycling and discourage litter; working to educate children on the link between litter and marine health; working with the National Oceanic and Atmospheric Administration to advance scientific understanding of marine debris; and continuing to innovate and develop smaller, lighter packaging. More information about our activities to help reduce marine debris can be found at: http://www.marinedebrissolutions.com/default.aspx

Thank you in advance for considering our views. If you have any questions or comments, please do not hesitate to contact me at 916-448-2581 or via email at Tim_Shestek@americanchemistry.com . You may also contact ACC's Hawaii based representatives Red Morris or John Radcliffe at 808-531-4551.



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Wednesday, February 06, 2013

RE: S.B. 620 Mandatory Option to Provide Compostable Disposable Containers

Chairman, Vice Chair, Committee Members

Thank you for the opportunity to submit comments on this bill.

We laud the attempt to create less dependence on petro chemical products and to reduce the amount of trash going to our landfills.

S.B. 620 mandates the providing of compostable disposable containers in addition to polystyrene disposable containers. There currently is no facility on Oahu, or in Hawaii, that is able to commercially collect, process, and compost such containers. As such, the compostable containers will go into the regular trash and continue to fill up the landfills and will not compost in that situation.

Many compostable disposable containers are made from corn. There is a world food shortage and food prices are going up causing financial hardship in poorer nations, the use of corn for packaging is a contributing factor to increasing food costs.

Additionally, much if not all of the corn used in compostable disposable packaging is most likely GMO corn.

In our view, while S.B. 619 is laudable in its intentions, in practical application it falls short.

Perhaps the bill should be amended to:

1. Take effect once a commercially viable process for composting the disposable containers is established in Hawaii
2. Exclude GMO corn compostable containers, and other containers made from food sources, from the definition of compostable containers to be published be the Department of Health

Respectfully submitted.

Mark Fergusson
Chief Executive Officer
808 254-511
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Testimony before the:
SENATE COMMITTEE ON ENERGY & ENVIRONMENT
Thursday, February 7, 2013 – 2:45 P.M. – State Capitol Room 225

Aloha Chair Gabbard, and Members of the Committee:

I am writing in support of SB619 and 620, which proposes to ban the use of polystyrene foam (styrofoam) food service-ware products in the State of Hawaii.

The amount of Styrofoam being used and thrown away every year is astounding, given the harmful health and environmental impacts of using and disposing it. According to EPA 2005 report, about 910 thousand tons of Styrofoam in the form of disposable cups, plates, trays etc are landfilled, or approximately 91 billion units every year.

Even though the adverse health effects of Styrofoam due to leaching are well documented by studies completed back in 1972[1] and 1976[2] Styrofoam is still widely used in restaurants, cafeterias and schools, These studies show that leaching from Styrofoam may lead to benzene and styrene exposure. Benzene, a known carcinogen, has been determined to cause leukemia, skin scaling, plastic anemia and possibly even death.[3] Styrene, acknowledged as a possible carcinogen, is linked to chromosomal and lymphatic abnormalities and neurotoxic effects.[4] Why is styrene still being allowed to be ingested and absorbed into the bloodstreams of so many Americans on a daily basis?

In addition the environmental effects of Styrofoam are as bad as the health effects:

- **Styrofoam does not biodegrade.** It is composed of a-biotic material that does not break down easily in natural environments.
- **Styrofoam pollutes our landfills, waterways, groundwater and the ocean.** It breaks into small pieces and gets ingested by marine animals, birds and fish.
- **Styrofoam is derived from petroleum** – a non-renewable resource.
- **Styrofoam is not easily recyclable**. Most cities do not offer curbside pickup and, cost of **recycling styrofoam makes it prohibitive for recyclers to recycle it.**
- **Styrofoam is hazardous to incinerate**. Studies show that incinerating Styrofoam results in emissions of over 90 hazardous substances. These chemicals cause health problems to residents nearby.
- **Styrofoam is difficult to reuse. The material is flimsy and begins to break up after just 2 or 3 uses.**

Numerous parents and voters have urged legislators to ban the use of Styrofoam trays, plates and cups in schools. Please vote to ban the use of expanded polystyrene

[1] K. Figge, "Migration of Additives from Plastic Films into Edible Oils and Fat Stimulants," Food Cosmet Toxicol, December 10, 1972, Vol. 6, pages 815 828.

[2] B.J. Dowty, J.L. Laseter, and J. Storet, "Ther Transplacental Migration and Accumulation in Blood of Volatile Organic Constituents," Pediatric Research, Vol. 10, pages 696-701, 1976.

[3] Agency for Toxic Substances & Disease Registry. Department of Health and Human Services. "ToxFAQs for Benzene" August 2007. <- http://www.atsdr.cdc.gov/tfacts3.html ->

[4] Agency for Toxic Substances & Disease Registry. Department of Health and Human Services. "ToxFAQs for Benzene" August 2007. <- http://www.atsdr.cdc.gov/tfacts53.html ->

As a long term way of dealing with our trash, composting is an excellent part of the equation. See below from page 64 of the Big Island resolution.

> WHEREAS Hiawai Legislature enacted Act 8 SSLH 2005 which provided for the development of a sustainability plan to address the vital needs of Hiawai through the year 2050 Diverting all organics from the landfill for land application mulching composting or digestion can help the Hiawai achieve several key benchmarks in the plan including Benchmark 4 Increase recycling reuse and waste reduction strategies Benchmark 5 Develop a more diverse and resilient economy Benchmark 6 Develop a sustainability ethic and Benchmark 7 Increase production and consumption of local foods and products particularly agricultural products
>
> WHEREAS the quickest and cheapest way to immediately reduce our community greenhouse gas emissions and improve the health of soils on the island is to get compostable organics out of landfills and back into our soils through composting and anaerobic digestion technologies
>
> THEREFORE we agree to phase these materials out of our landfills by 2012 and to redirect these materials back to our soils as useful soil amendments Staff would establish a plan on how to best accomplish this and how to work with local agencies to encourage the use of compostable organics to sustain the health of our soils

Marine Ingestion

Polystyrene Spherules in Coastal Waters

Edward J. Carpenter [1], Susan J. Anderson [1], George R. Harvey [1], Helen P. Miklas [1], and Bradford B. Peck [1]

[1] Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543

Polystyrene spherules averaging 0.5 millimeter in diameter (range 0.1 to 2 millimeters) are abundant in the coastal waters of southern New England...White, opaque spherules are selectively consumed by 8 species of fish out of 14 species examined...Ingestion of the plastic may lead to intestinal blockage in smaller fish.

Harmful marine debris such as plastic bags, rubber, balloons and confectionery wrappers is frequently ingested by marine species, which confuse them with prey species. Most marine species feed non-

selectively and may consume marine debris, particularly ones accumulated in the vicinity of food items. This debris usually causes a physical blockage in the digestive system, leading to internal injuries and pain. Turtles frequently ingest plastic bags, confusing them with jellyfish which is common prey for all turtles. Research indicates at least 56 species of sea birds confuse fish eggs and crustaceans with polystyrene balls and plastic buoys, and so consume the debris. Eventual starvation may occur. Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris.

Advice to the Minister for Environment and Heritage from the Threatened Species Scientific Committee on a public nomination of a Key Threatening Process under the ***Environment Protection and Biodiversity Conservation Act 1999***

In June 2006, the United Nations reported that there are, on average, around 46,000 pieces of plastic litter per square mile of ocean worldwide. Causing the death of over 100,000 marine mammals and turtles and one million seabirds each year as a result of eating or getting entangled with plastic debris.

Recycling

More than 15 mil tons of polystyrene (aka Styrofoam) is produced each year, but less than 1% is recycled. Styrofoam can not be practically recycled, it can not be composted, and it is never biodegradable.

Health

From the US Navy (Sept. 2007): Naval Medical Center San Diego Nutrition Management Department is taking the lead Sept. 20 to protect its patrons and the environment. Balboa Café, the name given to the hospital galley, will systematically replace polystyrene (Styrofoam) take-out containers with more environmentally friendly products. The full conversion will include 14 items with plans to phase in the remaining 12 by the end of the year.

The first items to be introduced are a compostable paper cup and a hinged, three compartment container made from sugar cane. These two items were chosen for the initial kick-off due to their high volume use. Hite said studies have shown the use of Styrofoam, which was initially developed during World War II as flexible electrical insulation, can have a long-term impact on health. In a 1986 U.S. Environmental Protection Agency Human Tissue Survey, styrene was found in 100 percent of all human fat tissues sampled.

"Styrofoam containers lose weight as styrene is absorbed into the food and drink held in the containers," said Hite. Styrene is unwittingly consumed and stored in human fatty tissue where it accumulates. Several factors determine the impact of styrene on an individual such as frequency of use and personal physiological factors. Those more sensitive to styrene build up may experience fatigue, nervousness, difficulty sleeping, blood abnormalities and carcinogenic effects.

About half of the galley patrons manage their time with take out. That hectic pace motivated Laeske to want to help educate galley customers on the harmful effects of Styrofoam. For example, microwaving food in Styrofoam is particularly dangerous.

Environmental Control Department, Directorate General for Royal Commission at Yanbu, P.O. Box 30031 Yanbu Al-Sinaiyah, Kingdom of Saudi Arabia. maqbool_60@yahoo.com

Bottled water may not be safer, or healthier, than tap water. The present studies have proved that styrene and some other aromatic compounds leach continuously from polystyrene (PS) bottles used

locally for packaging. Water samples in contact with PS were extracted by a preconcentration technique called as "purge and trap" and analyzed by gas chromatograph-mass spectrometer (GC/MS). Eleven aromatic compounds were identified in these studies. Maximum concentration of styrene in PS bottles was 29.5 microg/L. Apart from **styrene, ethyl benzene, toluene and benzene** were also quantified but their concentrations were much less than WHO guide line values. All other compounds were in traces. Quality of plastic and storage time were the major factor in leaching of styrene. Concentration of styrene was increased to 69.53 microg/L after one-year storage. **In Styrofoam and PS cups studies, hot water was found to be contaminated with styrene and other aromatic compounds**. It was observed that temperature played a major role in the leaching of styrene monomer from Styrofoam cups. Paper cups were found to be safe for hot drinks.

United States Environmental Protection Agency (7407)	Pollution Prevention and Toxics	November 1994 EPA 749-F-95-019

OPPT Chemical Fact Sheets Styrene Fact Sheet (CAS No. 100-42-5)

http://www.epa.gov/safewater/dwh/c-voc/styrene.html

What are the Health Effects?

Short-term: EPA has found styrene to potentially cause the following health effects when people are exposed to it at levels above the MCL for relatively short periods of time: nervous system effects such as depression, loss of concentration, weakness, fatigue and nausea.

Long-term: Styrene has the potential to cause the following effects from a lifetime exposure at levels above the MCL: liver and nerve tissue damage; cancer.

How much Styrene is produced and released to the environment?

Production of styrene was 10.7 billion lbs in 1993. It is released into the environment by emissions and effluents from its production and its use in polymer manufacture. Consumers may be exposed to styrene through contact with resin products used in fiberglass boat construction and repair, and in auto body fillers. **Styrene may also leach from polystyrene containers used for food products.**

Price

Hawaii was noted as the greatest consumer of takeout food in the US by the census, listing the average yearly expense of $609. If we estimate the average cost of a plate lunch to be $8 (about 76 meals a year) and the average cost to convert to compostables of $.175, this average Hawaii will spend an extra $13.33 a year on dinning out. Lets say you that you eat every working day lunch out for 50 weeks (250 lunches in a year) you would pay an extra $43.75 a year. In either case, the person eating out this often is probably not going to starve by paying extra pennies for lunch, and the long term savings of having the land fill last longer, composting become fully realized and the reduction of adverse health effects would vastly outweigh the initial cost. .

Styrofoam vs Paper vs Sugar Cane Bagasse 2008 numbers- we took same case weight paper items manufactured by few different companies and compared the prices to bagasse prices. For a 10" plate, that's 2 cents more. Let's put 2 cents for the environment, for tourism, and our health!

	Pactiv Styrofoam	Chinet Paper	Pactiv Paper	World Centric Bagasse
9" Plate, 500 count/ea.	$24 / .05ea	$62 / .12ea	$62 / .12ea	$38 / .07ea
6" Plate, 1000 count/ea.	$23 / .02ea	$58 / .06ea	$61 / .06ea	$35 / .04ea
7" Plate , 1000 count/ea.	$32 / .03ea	$91 / .09ea		$49 / .05ea
10" Plate, 500 count/ea.	$37 / .07ea		$87 / .17ea	$47 / .09ea
10" 3 Compt. Plate 500 ct./ea.	$45 / .09ea		$83 / .16ea	$46 / .09ea
12 oz bowls, 1000 count/ea.	$33 / .03ea	$70 / .07ea	$67 / .06ea	$52 / .05ea

Today

Fuel Value

The Hawaii Food Industry Association (HFIA) claims that styrofoam has a high fuel value for burning at Hpower. The weight of compostable 8' container (44g) vs. Styrofoam (10g) plates is 4.4 times more. Styrofoam with a fuel value of 16,000BTU/lb. and compostable at 6,400BTU/lb. or 2.5 times the fuel value by weight. Thus, compstable fiber containers offer 4.4/2.5 = **1.8** times the fuel value over their styrofoam counterpart. The HFIA styrofoam argument **fails** at HPower. Compostables will produce more BTU energy when burned.

Landfill

HFIA also claims that styrofoam takes up a very small percentage by weight, of the landfill. We know that styrofoam is light, but takes up a lot of volume. Our landfill is overflowing with volume, not weight. Let's hold the industry lobbyists to report what really matters.

Not Paper vs. Styrofoam – Compostable fiber!

While it is true paper costs more, sugar cane fiber is very close in price as shown above. What's the environmental cost we are paying in trash collection, turned off tourists, increased fish prices, and landfill issues? The plastics lobby claims paper is worse than plastic for the environment–while this is not true–they have left out renewable plant fibers, such as Sugar Cane Bagasse–whose production is by far the lowest carbon footprint of all options. Sugar cane absorbs CO2 during growth, is locally grown, and is a byproduct, otherwise inefficiently burned due to its initial water content. By making plates, we can close the cycle on locally produced, grown, and composted.

Local Agriculture

There presently are two major sugar cane companies remaining in Hawaii and other biomass companies looking to make fuels that will produce a fiber by product. We currently import our compostable plates, cups, bowls, and take-out containers. The fact is, these products could all be made in Hawaii, by local

companies, using local waste product. These companies will not move to manufacturing without a major shift from styrofoam. Please encourage local agriculture and manufacturing by passing a ban on Styrofoam.

Change

Testimony by K Yamada Distributors was that they might be put out of business by this bill. The fact is KYD offers a vast array of products other than styrofoam, and it is by diversifying that businesses adapt and grow. We believe KYD could easily diversify into sugar cane molded products. We also challenge KYD to what real effort has been made as a major local producer of styrofoam at recycling it or public awareness? This pollutant can not just me mass-produced without taking responsibility for the ecological consequences. McDonald's recognized this 18 years ago by eliminating styrofoam – so can KYD. The bill provides ample time to adapt.

Proven Success

The City of San Francisco passed legislation similar to SB2629 in 2007. In less than a year, according to the City agency SFEnvironment, they have an 80% compliance among the 1,440 restaurants and food establishments sampled. This - without one fine being issued. The bill works, and works well. The City had minimal expenditures, just a basic public education notice and vendor notification.

Posted by Don Loepp on June 15, 2007 1:29 PM; PlasticsNews.com

Bag bans in Britain

Plastic bag ban stories have been so commonplace in the media for the past few weeks that I've given up linking to most of them. The trend really seems to be building all over the world. I'll make an exception to the "no link" rule with this feature from Wednesday's *Christian Science Monitor*. It's a story about how British filmmaker Rebecca Hosking persuaded her hometown of Modbury, England, to ban plastic bags, and how the "revolt" is spreading across Britain.

It was watching sea creatures choke on plastic bags in the Pacific Ocean that finally persuaded Rebecca Hosking that enough was enough.

The British filmmaker had already recoiled in disgust at deserted Hawaiian beaches piled up with four feet of rubbish, the jetsam of Western consumerism washed up by an ocean teeming with plastic. Now, filming off the coast, she looked on aghast as sea turtles eagerly mistook bobbing translucent shapes in the water for jellyfish.

"Sea turtles can't read Wal-mart or Tesco signs on plastic bags," fumes Ms. Hosking, who returned to Britain in March. "They will home in on it and feed on it. Dolphins mistake them for seaweed and quite often they'll eat them and it causes huge damage."

Within a few weeks of coming back, Hosking persuaded her hometown to ban plastic bags outright and found herself in the vanguard of a sudden British revulsion for that most disposable convenience of the throwaway society.

Stores, grass-roots groups, and citizens are joining forces to reduce national consumption of plastic bags, and Hosking is fielding hundreds of requests a day for guidance.

According to the story, Hosking screened her film in Modbury, and invited the town's shopkeepers. After they watched the film, they unanimously decided to support a voluntary ban on plastic bags.

Retailers across Britain followed suit, and the Sainsbury chain has gotten quite a bit of press for its reusable cotton "I am not a plastic bag" bags, which it sold for $10.

Ari Patz

Styrophobia

NIEHS
National Institute of Environmental Health Sciences –
FOR IMMEDIATE RELEASE:
Friday, June 10, 2011

10 Jun 2011: News Releases

New Substances Added to HHS Report on Carcinogens

The U.S. Department of Health and Human Services today added eight substances to its Report on Carcinogens, a science-based document that identifies chemicals and biological agents that may put people at increased risk for cancer.

The industrial chemical formaldehyde and a botanical known as aristolochic acids are listed as known human carcinogens. Six other substances - captafol, cobalt-tungsten carbide (in powder or hard metal form), certain inhalable glass wool fibers, o-nitrotoluene, riddelliine, and styrene - are added as substances that are reasonably anticipated to be human carcinogens. With these additions, the 12th Report on Carcinogens now includes 240 listings. It is available at http://ntp.niehs.nih.gov/go/roc12.

"Reducing exposure to cancer-causing agents is something we all want, and the Report on Carcinogens provides important information on substances that pose a cancer risk," said Linda Birnbaum, Ph.D., director of both the National Institute of Environmental Health Sciences (NIEHS) and the National Toxicology Program (NTP). "The NTP is pleased to be able to compile this report."

John Bucher, Ph.D., associate director of the NTP added, "This report underscores the critical connection between our nation's health and what's in our environment."

The Report on Carcinogens is a congressionally mandated document that is prepared for the HHS Secretary by the NTP. The report identifies agents, substances, mixtures, or exposures in two categories: known to be a human carcinogen and reasonably anticipated to be a human carcinogen. A listing in the Report on Carcinogens does not by itself mean that a substance will cause cancer. Many factors, including the amount and duration of exposure, and an individual's susceptibility to a substance, affect whether a person will develop cancer.

Once a substance is nominated by the public or private sector and selected for consideration, it undergoes an extensive evaluation with numerous opportunities for scientific and public input. There were at least six opportunities for public input on each substance. The NTP used established criteria to evaluate the scientific evidence on each candidate substance under review. The NTP drew upon the scientific expertise of several federal agencies, including the National Institutes of Health, Centers for Disease Control and Prevention, Agency for Toxic Substances and Disease Registry, U.S. Food and Drug Administration, U.S. Environmental Protection Agency, U.S. Consumer Product Safety Commission, and Occupational Safety and Health Administration.

"The strength of this report lies in the rigorous scientific review process," said Ruth Lunn, Dr.P.H., director of the NTP Office of the Report on Carcinogens. "We could not have completed this report without the significant input we received from the public, industry, academia, and other government agencies."

A detailed description of each substance listed in the Report on Carcinogens is included in the new report.

Styrene is on the list based on human cancer studies, laboratory animal studies, and mechanistic scientific information. The limited evidence of cancer from studies in humans shows lymphohematopoietic cancer and genetic damage in the white blood cells, or lymphocytes, of workers exposed to styrene. Styrene is a synthetic chemical used worldwide in the manufacture of products such as rubber, plastic, insulation, fiberglass, pipes, automobile parts, food containers, and carpet backing. People may be exposed to styrene by breathing indoor air that has styrene vapors from building materials, tobacco smoke, and other products. The greatest exposure to styrene in the general population is through cigarette smoking. Workers in certain occupations may potentially be exposed to much higher levels of styrene than the general population.

The Report on Carcinogens, Twelfth Edition, is prepared by the National Toxicology Program, an interagency program headquartered at the National Institute of Environmental Health Sciences, part of the National Institutes of Health.

The NTP was established in 1978. The program was created as a cooperative effort to coordinate toxicology testing programs within the federal government, strengthen the science base in toxicology, develop and validate improved testing methods, and provide information about potentially toxic chemicals to health, regulatory, and research agencies, scientific and medical communities, and the public. The NTP is headquartered at the NIEHS. For more information about the NTP, visit http://ntp.niehs.nih.gov.

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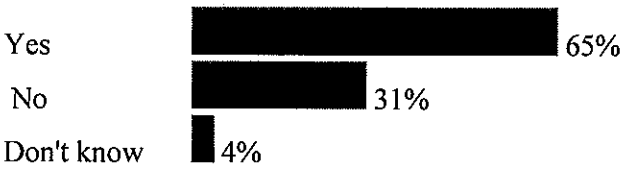
PACIFIC BUSINESS NEWS

SURVEY QUESTION:

Banning plastic bags and Styrofoam

2/13/2008

Should Hawaii ban plastic shopping bags and Styrofoam containers?



Check out reader comments
This poll is not a scientific sampling, but offers a quick view of what readers are thinking

Business Pulse Archive

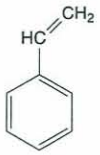
- 02/06/2008: Why do you think fewer people are visiting Hawaii?
- 01/23/2008: Should the state buy the Turtle Bay Resort to stop development of the area?
- 01/16/2008: What can the Legislature do to help Hawaii businesses?
- 01/09/2008: Would you like to see UH's next athletic director come from inside or outside Hawaii?
- 01/02/2008: Is one of your New Year's resolutions to get a new job?

Styrene

CAS No. 100-42-5

Reasonably anticipated to be a human carcinogen

First listed in the *Twelfth Report on Carcinogens* (2011)



Carcinogenicity

Styrene is *reasonably anticipated to be a human carcinogen* based on limited evidence of carcinogenicity from studies in humans, sufficient evidence of carcinogenicity from studies in experimental animals, and supporting data on mechanisms of carcinogenesis.

Cancer Studies in Humans

The limited evidence for the carcinogenicity of styrene in humans is based on studies of workers exposed to styrene that showed (1) increased mortality from or incidence of cancer of the lymphohematopoietic system and (2) increased levels of DNA adducts and genetic damage in lymphocytes from exposed workers. Elevated risks of lymphohematopoietic cancer were found among workers with higher exposure to styrene after an appropriate elapsed time since first exposure. In some studies, the risks increased with increasing measures of exposure, such as average exposure, cumulative exposure, or number of years since first exposure. However, the types of lymphohematopoietic cancer observed in excess varied across different cohort studies, and excess risks were not found in all cohorts. There is also some evidence for increased risks of esophageal and pancreatic cancer among styrene-exposed workers. Causality is not established, as the possibility that the results were due to chance or to confounding by exposure to other carcinogenic chemicals cannot be completely ruled out. However, a causal relationship between styrene exposure and cancer in humans is credible and is supported by the finding of DNA adducts and chromosomal aberrations in lymphocytes from styrene-exposed workers.

Most of the evidence in humans comes from occupational cohort studies in two major industries: (1) the reinforced-plastics industry and (2) the styrene-butadiene rubber industry. Studies of workers in a third industry, the styrene monomer and polymer industry, were not considered to be as informative, because they were limited by small numbers of cancer cases among exposed workers, and there was potential confounding by coexposure to benzene. Workers in the reinforced-plastics industry were exposed to the highest levels of styrene, and they had few other potentially carcinogenic exposures. However, the majority of the workers had short periods of employment. In the styrene-butadiene rubber industry, workers were exposed to lower levels of styrene than in the reinforced-plastics industry, but a large number of workers studied had long-enough follow-up times to permit detailed analysis of the incidences of lymphohematopoietic cancers. The main limitation of the studies in styrene-butadiene rubber workers is potential confounding by other exposures, principally to butadiene, which is a known human carcinogen associated with increased risk of leukemia (Grosse *et al.* 2007, NTP 2004a); exposures to butadiene and styrene are highly correlated in this industry.

The most informative studies in the reinforced-plastics industry were the two largest cohort studies: a Danish cohort of male workers (Kolstad *et al.* 1994, 1995) and a European multinational mortality cohort of predominantly male workers, which included a subset of the Danish workers (Kogevinas *et al.* 1994). In the styrene-butadiene industry, the major study was a large multi-plant cohort mortality study of male styrene-butadiene rubber workers in the United States and Canada (Graff *et al.* 2005, Delzell *et al.* 2006), which encompassed most of the workers from two earlier cohorts (a small study by Meinhardt *et al.* 1978 and a larger study by Matanoski *et al.* 1990). The studies in both industries included internal analyses (using unexposed members of the cohort as the comparison group); such analyses are less susceptible to confounding than those using external reference populations. Internal analyses were used to evaluate exposure-response relationships for cumulative exposure, average exposure, peak exposure (a measure of exposure intensity), or time since first exposure in the multinational cohort study of reinforced-plastics workers (Kogevinas *et al.* 1994) and in the multi-plant study of styrene-butadiene workers (Delzell *et al.* 2006). Without *a priori* knowledge, it is difficult to know which exposure metric is most appropriate for evaluating causality, so a positive relationship observed with any exposure metric is a concern. The studies also conducted standardized mortality ratio (SMR) or standardized incidence ratio (SIR) analyses, which compared observed with expected numbers of events (deaths or incident cases) based on national mortality or incidence rates. Two additional cohort studies of U.S. reinforced-plastics workers were less informative. A study by Ruder *et al.* (2004) had limited statistical power to detect positive associations between styrene exposure and uncommon types of cancer. A study by Wong *et al.* (1994) had a relatively large cohort and conducted internal analyses; however, the internal analyses were limited to exposure duration and cumulative exposure.

Lymphohematopoietic Cancer

Increased risks for leukemia, lymphoma, or all lymphohematopoietic cancer were found among styrene-exposed workers in both the reinforced-plastics and styrene-butadiene rubber industries. The evidence comes primarily from positive exposure-response relationships found in the multinational European study (reinforced-plastics workers) (Kogevinas *et al.* 1994) and the multi-plant cohort study of styrene-butadiene workers (Delzell *et al.* 2006) and is supported by findings of increased cancer risks among subgroups of workers with higher levels of styrene exposure or longer times since first exposure (Kogevinas *et al.* 1994, Kolstad *et al.* 1994). Although coexposure to butadiene is a concern in the styrene-butadiene industry, the finding of increased cancer risk in the reinforced-plastics industry, where such confounding is not an issue, suggests that styrene is a potential risk factor for lymphohematopoietic cancer. The types of lymphohematopoietic cancer observed in excess varied across different cohorts; a similar pattern has been observed for other epoxide-forming substances, such as 1,3-butadiene and ethylene oxide (see the profiles for those substances). Moreover, it is difficult to compare the risks for specific types of lymphohematopoietic cancer across studies, because (1) these cancers may have been grouped differently between studies or in the same study between different types of analyses (e.g., external and internal analyses in the study by Wong *et al.* 1994), (2) diagnoses based on death certificates may be inaccurate, and (3) lymphohematopoietic cancer classification and groupings have changed over time. In general, these limitations make it more difficult to see consistent associations between styrene exposure and specific types of lymphohematopoietic cancer across studies.

Reinforced-Plastics Industry

In the multinational study of reinforced-plastics workers, workers in the two highest categories of average styrene exposure had

significantly higher risks (or elevated risks approaching statistical significance) than did workers in the lowest exposure group for all lymphohematopoietic cancer (relative risk [RR] = 3.08, 95% confidence interval [CI] = 1.04 to 9.08, 13 cases with exposure of 120 to 199 ppm; RR = 3.59, 95% CI = 0.98 to 13.14, 8 cases with exposure ≥ 200 ppm). In addition, the risk of malignant lymphoma was significantly elevated in the second-highest exposure group (RR = 7.15, 95% CI = 1.21 to 42.11, 8 exposed cases). A fourfold higher risk of malignant lymphoma was also found for the highest-exposure group, but it was based on small numbers of exposed cases and was not statistically significant. Risks increased with increasing average exposure for all lymphohematopoietic cancer (P_{trend} = 0.019) and for malignant lymphoma (P_{trend} = 0.052). Time since first hire also was associated with lymphohematopoietic cancer (P_{trend} = 0.012) and malignant lymphoma (P_{trend} = 0.072); risk estimates for workers with the longest time since first hire compared with workers with the shortest time since first hire were 3.97 (95% CI = 1.30 to 12.13, 9 exposed cases) for all lymphohematopoietic cancer and 5.16 (95% CI = 0.90 to 29.47, 4 exposed cases) for malignant lymphoma (Kogevinas *et al.* 1994). No significant relationship with cumulative exposure was observed, although statistically nonsignificant elevated risks for lymphoma were found for all groups with cumulative exposure greater than 75 ppm. The proportion of short-term workers was higher among the workers with the highest exposure levels (laminators); therefore, measures of exposure intensity (such as average exposure level) may be more informative than measures of exposure duration for evaluating risks.

Among Danish reinforced-plastics workers, the incidence of leukemia was significantly elevated for workers with earlier dates of first exposure (1964 to 1970, during which time the highest exposure levels occurred) (Kolstad *et al.* 1994). Significantly elevated risks were also found among workers with at least ten years since first employment; within this group, the increased risks were concentrated among short-term workers (those workers with exposure duration of less than one year). The findings for leukemia were similar in the internal analyses using unexposed workers as controls for short-term workers, thus helping to rule out confounding by socioeconomic status or lifestyle factors of the short-term workers.

Neither of the two U.S. cohort studies of reinforced-plastics workers found a significant association between styrene exposure and lymphohematopoietic cancer; however, neither study evaluated risk by average exposure intensity, and the smaller study (Ruder *et al.* 2004) had very limited statistical power to detect an association. In the larger U.S. study (Wong *et al.* 1994), no association was found between cumulative exposure or duration of exposure and all lymphohematopoietic cancer, non-Hodgkin's lymphoma, or leukemia. The analysis included both exposure measures, which are highly correlated with each other; this may have reduced the statistical power to detect an association (IARC 2002).

Styrene-Butadiene Rubber Industry

The multi-plant cohort study of male styrene-butadiene rubber workers found significantly increased risks (SMRs) of non-Hodgkin's lymphoma (NHL), NHL-chronic lymphocytic leukemia (NHL-CLL), and leukemia (overall and specific types) among subgroups of workers with long duration of employment (> 10 years) and long time since first exposure (20 to 29 years or ≥ 30 years), in specific job categories, and with the highest levels of cumulative exposure to styrene (Graff *et al.* 2005, Sathiakumar *et al.* 2005, Delzell *et al.* 2006).

In an attempt to disentangle the effects of styrene from those of butadiene, internal analyses were conducted for quartiles of cumulative exposure or exposure to periodic spikes of high styrene concentrations (styrene peaks, defined as ≥ 50 ppm) involving statistical models with (1) styrene exposure only, (2) styrene and butadiene exposure, and (3) styrene and butadiene exposure plus dermal exposure to dimethyldithiocarbamate (DMDTC). (The relevance of including DMDTC in these models is not clear, because there is no independent evidence that DMDTC is carcinogenic in animals or humans.) The number of cases at each exposure level was small, which limited the power to detect statistically significant risk estimates. No trend analyses were reported. The analyses suggested an exposure-response relationship between NHL and NHL-CLL combined and exposure to styrene that was not explained by exposure to butadiene. The relative risk of NHL or NHL-CLL increased with increasing level of cumulative exposure to styrene and was not attenuated by control for butadiene exposure. However, the relative risk reached statistical significance only for the highest styrene exposure level in the styrene-only model and only for NHL-CLL combined. Exposure to butadiene was not associated with risk of NHL or NHL-CLL (Graff *et al.* 2005, Delzell *et al.* 2006).

Evidence for an association between styrene exposure and leukemia comes from analyses of cancer among workers exposed to styrene peaks. The relative risk of leukemia increased with exposure to increasing numbers of styrene peaks in all three chemical models and was significantly elevated at the two highest styrene exposure levels with control for butadiene exposure. The relative risk of leukemia also increased with increasing cumulative styrene exposure, but the response was attenuated by control for butadiene exposure, and no association remained after additional control for DMDTC.

A nested case-control study from the Matanoski cohort also found significantly increased risks of all lymphohematopoietic cancer (P = 0.001) and of lymphoma (P = 0.020) (International Classification of Disease codes 200 and 202, which are the same codes as for NHL) with exposure to styrene (1-ppm time-weighted average, compared with 0 ppm) in a statistical model that accounted for exposure to butadiene. Although the study population overlapped with that of the multi-plant cohort, it provided supporting evidence for the increased risk of lymphoma reported by Delzell *et al.*, because it used a different exposure assessment (based on measurements) and a different statistical model (Matanoski *et al.* 1997).

Cancer at Other Tissue Sites

Studies in the reinforced-plastics industry provided evidence that suggests a possible association between styrene exposure and cancer of the esophagus or pancreas. Mortality from esophageal cancer was increased in two of the four studies (Ruder *et al.* 2004, Wong *et al.* 1994), and a third study found a statistically nonsignificant increased risk among the workers with higher cumulative exposure (Kogevinas *et al.* 1994). For pancreatic cancer, increased risks were suggested in the cohort studies. Internal analyses of the Danish cohort found a significant risk of pancreatic cancer (incidence) among workers classified as having "probable high exposure" (Kolstad *et al.* 1995). Statistically nonsignificant increased risks of pancreatic cancer mortality were reported by the two U.S. cohort studies (Ruder *et al.* 2004, Wong *et al.* 1994) and for workers with higher cumulative exposure in the European study (Kogevinas *et al.* 1994). There was some evidence of an exposure-response relationship for pancreatic cancer; cancer risk increased with increasing cumulative exposure in the European multi-plant cohort (P_{trend} = 0.068) (Kogevinas *et al.* 1993, 1994). No excess mortality from esophageal or pancreatic cancer was found in studies of styrene-butadiene rubber workers; however, the only analysis reported was the SMR for the entire multi-plant cohort (Delzell *et al.* 2006).

Genetic Damage

DNA adducts (primarily, N^2-guanine and O^6-guanine, but also βN1-adenine adducts) were found in circulating white blood cells in many studies of styrene-exposed workers employed mainly in the reinforced-plastics industry; levels of O^6-guanine were five- to seven-fold higher among styrene-exposed workers than controls (Vodicka *et al.* 2006a, Boffetta *et al.* 2009). In most studies in workers, single-strand DNA breaks showed exposure-related increases (Brenner *et al.* 1991, Maki-Paakkanen *et al.* 1991, Vodicka *et al.* 2006a). A meta-analysis of 22 studies found a positive association (weighted frequency ratio = 2.18, 95% CI = 1.52 to 3.13) between styrene exposure level and chromosomal aberration frequency when exposure levels were dichotomized as greater than or less than a threshold value of 30 ppm for an 8-hour time-weighted average (Bonassi *et al.* 1996).

Cancer Studies in Experimental Animals

Styrene caused lung tumors in several strains of mice and by two different routes of exposure. The most robust studies are two-year studies of inhalation exposure in CD-1 mice (Cruzan *et al.* 2001) and oral exposure (by stomach tube) in B6C3F_1 mice (NCI 1979). Inhalation exposure caused benign lung tumors (alveolar/bronchiolar adenoma) and increased the combined incidence of benign and malignant lung tumors (alveolar/bronchiolar adenoma and carcinoma) in CD-1 mice of both sexes; in females, it also increased the separate incidence of malignant lung tumors. In male B6C3F_1 mice, oral exposure to styrene increased the combined incidence of benign and malignant lung tumors (alveolar/bronchiolar adenoma and carcinoma), and a positive dose-response trend was observed (NCI 1979).

These findings are supported by findings of lung tumors in both sexes of O20 mice exposed to styrene (Ponomarkov and Tomatis 1978). In O20 mice, a single dose of styrene was administered to pregnant dams on gestational day 17, and pups were exposed orally once a week for 16 weeks after weaning. A significantly increased incidence and earlier onset of benign and malignant lung tumors combined (adenoma and carcinoma) occurred in mice of both sexes as early as 16 weeks after weaning. In a similar study with C57Bl mice administered a much lower dose of styrene, lung-tumor incidence was not significantly increased. In short-term studies, oral exposure to styrene caused cytotoxicity and increased cell replication in the mouse lung, supporting the findings of lung tumors following oral exposure to styrene in longer-term studies (Green *et al.* 2001).

The evidence from studies in rats is insufficient for reaching a conclusion concerning the carcinogenicity of styrene. Lung tumors were not observed in rats (IARC 2002); however, findings for mammary-gland tumors were equivocal. The incidence of mammary-gland tumors was increased in female Sprague-Dawley rats exposed to styrene in the drinking water (mammary fibroadenoma; Huff 1984) or by inhalation (malignant tumors; Conti *et al.* 1988), but decreased incidences of mammary-gland tumors (adenocarcinoma) were reported in another inhalation-exposure study of rats of the same strain (Cruzan *et al.* 1998).

Metabolism of Styrene

Styrene can be absorbed and widely distributed throughout the body through inhalation, ingestion, or skin contact, but the most important route of occupational exposure is inhalation (IARC 2002). Styrene is metabolized primarily (over 90%) to the genotoxic metabolite styrene-7,8-oxide, which can be detoxified by glutathione conjugation or conversion to styrene glycol by microsomal epoxide hydrolase. Pharmacokinetic models predict the concentration of styrene in the lung (Filser *et al.* 2002) or terminal bronchioles (Sarangapani *et al.* 2002) to be higher in mice than in rats and higher in rats than in humans. Systemic distribution of styrene-7,8-oxide in workers has been demonstrated from measurements of styrene-7,8-oxide-based hemoglobin adducts in erythrocytes and DNA adducts in lymphocytes (Tornero-Velez *et al.* 2001, Vodicka *et al.* 2003, 2006a). Further oxidation of styrene glycol produces mandelic acid and phenylglyoxylic acid, the major metabolites identified in the urine of styrene-exposed workers (Manini *et al.* 2002). Because styrene-7,8-oxide contains a chiral carbon, it and some subsequent styrene metabolites can exist as either R or S enantiomers. A second, minor pathway of styrene metabolism involves oxidation of the aromatic ring resulting in formation of 4-vinylphenol, presumably via the arene intermediate styrene-3,4-oxide, which has been detected in humans (Pfäffli *et al.* 1981, Manini *et al.* 2003) and rats (Bakke and Scheline 1970) and whose occurrence in mice *in vivo* was implicated by indirect measures (Boogaard *et al.* 2000).

Styrene is metabolized primarily in the liver and the lung. In mice, the Clara cell is regarded as the major lung-cell type in which styrene is activated to styrene-7,8-oxide following inhalation exposure (Hynes *et al.* 1999). The initial step in styrene metabolism is catalyzed by cytochromes P450, and there are tissue-specific differences in the enzymes responsible for styrene oxidation. In mice, Cyp2e1 predominates in the liver, and Cyp2f2 in the lung (Carlson 1997, 2004, Vodicka *et al.* 2006a). In humans, CYP2A13, CYP2F1, CYP1A2, CYP2C8, CYP2A6, and CYP2E1 are active in metabolizing styrene to styrene glycol in the lung, and CYP2B6 and CYP2E1 are most active in the liver (Nakajima *et al.* 1994, IARC 2002, Fukami *et al.* 2008). Human CYP2F1 (equivalent to Cyp2f2 in mice and CYP2F4 in rats) has been shown to metabolize styrene in vitro (Nakajima *et al.* 1994). In general, expression of CYP enzymes is more widely distributed in the human lung than in the lungs of experimental animals, where expression is concentrated in Clara cells, type II alveolar cells, and alveolar macrophages. CYP2B6 is expressed in human Clara cells, and CYP2E1 in human bronchial, bronchiolar, and alveolar epithelium, alveolar macrophages, and lung tumors (Kivistö *et al.* 1995, Hukkanen *et al.* 2002). CYP2E1 is also expressed in lymphocytes (Siest *et al.* 2008), and CYP2E1 protein and activity were detected in human hematopoietic stem cells (Kousalova *et al.* 2004).

Because many of the enzymes involved in styrene metabolism are polymorphic, individuals may differ in their susceptibility to styrene-induced toxicity. Some studies have found that polymorphisms in glutathione S-transferase mu 1 influence excretion of styrene metabolites (De Palma *et al.* 2001, Haufroid *et al.* 2002, Teixeira *et al.* 2004); however, studies evaluating genotoxicity and polymorphisms in genes involved in either styrene metabolism or DNA repair have not clearly identified specific polymorphisms related to genotoxic effects (Godderis *et al.* 2006, Migliore *et al.* 2006, reviewed by Vodicka *et al.* 2006a).

Studies on Mechanisms of Carcinogenesis

The mechanisms of styrene carcinogenicity are not fully understood. The primary metabolite of styrene, styrene-7,8-oxide, is listed in the Report on Carcinogens as *reasonably anticipated to be a human carcinogen* based on sufficient evidence in experimental animals. Oral exposure to styrene-7,8-oxide caused forestomach tumors in rats and mice and liver tumors in male mice (see the profile for styrene-7,8-oxide, NTP 2004b).

The proposed mechanisms for the carcinogenicity of styrene include both genotoxic and non-genotoxic pathways, which are not necessarily mutually exclusive. Most of the mechanistic studies have focused on either general genotoxicity or issues considered relevant to the mouse lung tumors, and there has been little research on mechanisms specific to lymphohematopoietic cancer in humans. Possible

modes of action for styrene-induced carcinogenicity involve (1) genotoxicity (relevant to all types of cancer), (2) cytotoxic effects of styrene metabolites in the mouse lung, and (3) immunosuppression (relevant to lymphohematopoietic cancer).

Genotoxicity

Most of the genetic damage associated with styrene exposure is thought to be due to styrene-7,8-oxide. The predominant DNA adducts formed as a result of styrene-7,8-oxide exposure occur at the N7, N^2, and O^6 positions of guanine (these have been detected in cells); however, styrene-7,8-oxide adducts can also form at the N1, N3, and N^6 positions of adenine, the N3, N^4, and O^2 positions of cytosine, and the N3 position of thymine. N7-adducts are formed in the largest amounts but are the least persistent (i.e., they are either repaired or lost), whereas O^6-adducts are formed in the smallest amounts but are the most persistent. Other than the N7-guanine and N3-adenine adducts, the styrene-7,8-oxide–DNA adducts listed above are considered promutagenic, because they can interfere with base pairing and lead to miscoding during DNA replication. The major styrene-7,8-oxide adduct at N7-guanine may also be promutagenic, because it can undergo spontaneous or glycosylase-mediated depurination, thus creating abasic sites that promote coding errors during DNA replication (Vodicka *et al.* 2006a). Styrene-7,8-oxide, without metabolic activation, is mutagenic in most *in vitro* systems, causing a variety of transition and transversion mutations (Bastlová and Podlutsky 1996). Both styrene and styrene-7,8-oxide caused cytogenetic effects (sister chromatid exchange, chromosomal aberrations, and micronucleus formation) in human lymphocytes or other mammalian cells *in vitro*. In mice and rats exposed to styrene *in vivo*, N7-guanine, O^6-guanine, and N1-adenine adducts were detected in liver and lung cells (Pauwels *et al.* 1996, Boogaard *et al.* 2000b, Vodicka *et al.* 2001, 2006a,b). Most studies in mice also found single-strand DNA breaks following exposure to styrene-7,8-oxide or styrene (Walles and Orsen 1983, Vaghef and Hellman 1998, Vodicka *et al.* 2001), and the cytogenetic effect reported most consistently was sister chromatid exchange (Conner *et al.* 1979, 1980, Sharief *et al.* 1986, Kligerman *et al.* 1992, 1993, Simula and Priestly 1992; reviewed by IARC 1994, 2002 and Scott and Preston 1994).

Styrene-7,8-oxide was measured in the blood of styrene-exposed workers, and several different styrene-7,8-oxide–based DNA adducts were detected in their lymphocytes. Styrene-7,8-oxide–DNA adducts identified in exposed workers include O^6-guanine, N1-adenine, and N^2-guanine. Styrene-7,8-oxide adducts were also detected in human volunteers exposed to styrene under conditions designed to eliminate or minimize non-enzymatic oxidation to styrene-7,8-oxide (Johanson *et al.* 2000). Adduct studies in workers showed that a DNA-reactive intermediate of styrene metabolism circulates in the blood of styrene-exposed humans (Vodicka *et al.* 2006a). The most consistent cytogenetic effects in styrene-exposed workers were single-strand DNA breaks and chromosomal aberrations (Anwar and Shamy 1995, Bonassi *et al.* 1996, Lazutka *et al.* 1999, Somorovská *et al.* 1999, reviewed by Cohen *et al.* 2002).

Lung Cytotoxicity in Mice

Cytotoxicity can cause regenerative hyperplasia, leading to the promotion of spontaneous or styrene-induced mutations and tumor formation. Styrene caused lung tumors and pulmonary toxicity in mice but did not cause lung tumors in rats (Cruzan *et al.* 1998, 2001). The induction of lung tumors in mice but not in rats has also been observed in studies of exposure to epoxides and other epoxide-forming chemicals, including the known human carcinogens vinyl chloride, 1,3-butadiene, and ethylene oxide (NTP 2004a,b; see the profiles for those substances).

Although several studies found no evidence of toxicity in the lungs of rats exposed to styrene (Cruzan *et al.* 1997, 1998, Green *et al.* 2001, Gamer *et al.* 2004), one study reported toxic effects on bronchiolar and alveolar type II cells in Sprague-Dawley rats exposed to styrene by inhalation or intraperitoneal injection (Coccini *et al.* 1997). Alveolar/bronchiolar hyperplasia from styrene exposure has been hypothesized to play a role in the development of lung tumors in mice. Effects of repeated styrene exposure in mice included focal crowding of bronchiolar cells, bronchiolar epithelial hyperplasia, and bronchiolar/alveolar hyperplasia (Cruzan *et al.* 2001). Interspecies differences in lung toxicity are proposed to result from differences in the extent of metabolism of styrene to ring-oxidized metabolites by Cyp2f in the Clara cells (Cruzan *et al.* 2002, 2009).

Indirect data supporting the role of Cyp2f in styrene-induced lung toxicity comes from short-term intraperitoneal-injection studies with wild-type and Cyp2e1 knock-out mice, which showed similar lung toxicity (Carlson 2004). Also, the cytotoxic effects of styrene and tumor formation were seen primarily in respiratory tissues that are high in Cyp2f isoforms, and Cyp2f inhibitors prevented cytotoxicity (Cruzan *et al.* 2002). Styrene-7,8-oxide, 4-vinylphenol, and 4-vinylphenol metabolites can be formed by Cyp2f2. Metabolites formed from ring oxidation, including 4-vinylphenol, occur at several-fold higher levels in mice than in rats (Boogaard *et al.* 2000a, Cruzan *et al.* 2002). Some data suggest that 4-vinylphenol is more toxic than styrene-7,8-oxide in mouse lung; however, the two metabolites were tested in separate experiments in two different mouse strains (Gadberry *et al.* 1996, Carlson 2002). Short-term toxicity studies of 4-vinylphenol in wild-type and Cyp2e1 knock-out mice and studies with CYP inhibitors suggest that metabolites of 4-vinylphenol are responsible for its lung and liver toxicity in mice (Carlson 2002, Vogie *et al.* 2004).

Immunosuppression

The mechanism for styrene-induced lymphohematopoietic cancer is not known. As discussed above, CYP2E1 is expressed in lymphocytes (Siest *et al.* 2008), and CYP2E1 protein and activity were detected in human hematopoietic stem cells (Kousalova *et al.* 2004), suggesting that styrene can be metabolized to styrene-7,8-oxide in the target tissues. Moreover, studies on genotoxicity and oxidative stress in styrene-exposed workers indicated that styrene causes DNA and chromosomal damage in peripheral blood lymphocytes. Immunosuppression has been proposed as a mechanism for solvent-induced lymphoma (Vineis *et al.* 2007). Styrene-exposed workers had decreased numbers of activated helper T-cell lymphocytes, suggesting that styrene exposure can cause immunosuppression; however, this study was limited in size, and the workers were exposed to other agents (Biró *et al.* 2002). In a review of studies in experimental animals and humans, Veraldi *et al.* (2006) concluded that there was "immediate" evidence for the immunotoxicity of styrene oxide, and that the main immunotoxic effect was immunosuppression.

Summary

Although styrene disposition differs quantitatively among species, no qualitative differences between humans and experimental animals have been demonstrated that contradict the relevance of cancer studies in rodents for evaluation of human hazard. Detection of styrene-7,8-oxide–DNA adducts at base-pairing sites and chromosomal aberrations in lymphocytes of styrene-exposed workers supports the potential human cancer hazard from styrene through a genotoxic mode of action.

National Toxicology Program

Headquartered at the
National Institute of Environmental
Health Sciences NIH-HHS
www.niehs.nih.gov

Styrene

Key Points

Styrene

- *Reasonably anticipated to be a carcinogen*
- *Widely used to make plastics and rubber*
- *Found in tobacco smoke*

Report on Carcinogens Status

Reasonably anticipated to be a human carcinogen

What is styrene?

Styrene is a colorless, flammable liquid, which has a sweet odor and is highly volatile. It is an industrial chemical used to make polystyrene and resins, such as reinforced plastic and rubbers.

How is styrene used?

Styrene is widely used to make plastics and rubber, which are used to manufacture a variety of products, such as insulation, pipes, automobile parts, printing cartridges, food containers, and carpet backing.

How are people exposed to styrene?

People are exposed to styrene in the workplace and in the environment.

Workers in certain occupations are potentially exposed to much higher levels of styrene than the general population. For example, workers who fabricate boats, car and truck parts, tanks, and bath tubs and shower stalls with glass fiber-reinforced polyester composite plastics, may breathe in high levels of styrene in the workplace. Workers may also absorb styrene through the skin. Exposures in the workplace have decreased over time.

People may be exposed to styrene through breathing indoor air that has styrene vapors from building materials, photocopiers, tobacco smoke, and other products.

Smokers are exposed to styrene because it occurs in cigarette smoke.

Living near industrial facilities or hazardous waste sites is another way people may be exposed to styrene.

Styrene may also leach from polystyrene containers used for food products, but levels of styrene are very low.

What evidence is there that styrene causes cancer?

Human Studies

The limited evidence for cancer from styrene in humans is from occupational studies showing increased risks for lymphohematopoietic cancers, such as leukemia and lymphoma, and genetic damage in the white blood cells, or lymphocytes, of workers exposed to styrene. There is also some evidence for increased risk of cancer in the pancreas or esophagus among some styrene workers, but the evidence is weaker than that for lymphohematopoietic cancers.

Animal Studies

Styrene caused lung tumors in several strains of mice.

Mechanistic Studies

Exactly how styrene causes cancer is not fully understood, but styrene is converted, in laboratory animals and humans, to styrene-7,8-oxide, which is listed in the Report on Carcinogens as *reasonably anticipated to be a human carcinogen*. Styrene-7,8-oxide causes genetic damage and has been found in the blood of workers exposed to styrene.

What are some things I can do to prevent exposure to styrene?

- Stop smoking. Styrene is found in tobacco smoke.
- Limit children's exposure to tobacco smoke.
- Adhere to federal government regulations.

Workers and employers should practice good occupational health behaviors. This may include wearing protective clothing, respirators, and gloves. Work places should be well ventilated.

Where do I go for more information?

National Toxicology Program
http://ntp.niehs.nih.gov/go/roc12candidates

Agency for Toxic Substances and Disease Registry
http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=74

National Institute for Occupational Safety and Health
http://www.cdc.gov/niosh/topics/styrene

Occupational Safety and Health Administration
http://www.osha.gov/SLTC/styrene/index.html

12th Edition Report on Carcinogens

The Report on Carcinogens, Twelfth Edition, is prepared by the National Toxicology Program, an interagency group coordinated by the U.S. Department of Health and Human Services. The report identifies agents, substances, mixtures, or exposures in two categories: *known to be a human carcinogen* and *reasonably anticipated to be a human carcinogen*. **The full Report on Carcinogens is available at http://ntp.niehs.nih.gov/go/roc12.**

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
National Institutes of Health

MARINE DEBRIS: THE PACIFIC PROTECTION INITIATIVE

The Problem

An estimated 80% of marine debris comes from land-based sources, while only 20% comes from sea-based sources, like shipping and boating.[1]

Roughly 60–80% of all marine debris, and 90% of floating debris is plastic.[2]

Plastic gut contents of a deceased albatross. Photo courtesy of the California Coastal Commission.

Plastic resin polymers are so durable that it can take hundreds of years for plastics to break down at sea, and some may never truly biodegrade in the marine environment.[2]

Marine debris is ubiquitous and can be found from remote artic regions to highly populated urban beaches.[3]

The North Pacific Gyre is home to the world's largest floating island of trash that is estimated to be 5 million square miles—larger than the entire United States.[3]

A study conducted by the Algalita Marine Research Foundation in the North Pacific Gyre found six more times the mass of plastic particles than plankton in these waters.[4]

"Despite global treaties to prevent dumping at sea and minimize land-based sources, and increasing efforts worldwide to protect water quality, the quantity of marine debris in the world's oceans is increasing"
– California Ocean Protection Council

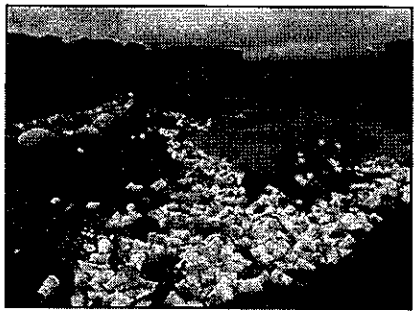
A Need for Legislation

9 in 10 Californians say the quality of the beach and ocean is just as important to them personally as well as for the overall quality of life and economy in the state.[10]

California's "ocean economy" is valued at $43 billion.[11]

On February 8th, 2007 the Ocean Protection Council adopted a comprehensive resolution on marine debris that outlines specific actions for California to prevent and reduce marine debris. The Council's resolution is not regulation, but if paired with strong legislative action, it could be a catalyst for state, and potentially nationwide and international action on marine debris.[5]

Legislation will implement some of the solutions to reduce and prevent marine debris pollution called for by the OPC. Specifically, current legislation - SB 898, SB 899, AB 258, AB 904, and AB 820 - will address the following: the need to eliminate discharge of plastic resin pellets, commonly known as "nurdles" (AB 258); reduce single-use plastic packaging and promote recycling (AB 904,AB 820,SB 898); greatly reduce derelict fishing gear (SB 898); and introduce phased bans on the most toxic chemicals in plastic packaging (SB 899).



Trash piled up in Ballona Creek after a storm. Photo courtesy of the CA Coastal Commission.

Marine Impacts

Marine debris has injured or killed at least 267 species world-wide, primarily through ingestion and entanglement.[2]

More than 1 million seabirds, 100,000 marine mammals, and countless fish have died annually in the north pacific from ingesting or becoming entangled in marine debris.[2,3]

Commonly ingested items include bottle caps, cigarette lighters, plastic bags, and polystyrene pieces.[2]

Sea Lion ingesting a plastic bag. Photo courtesy of the Whale Rescue Team.

Plastic marine debris can attract dangerous chemicals present in the marine environment, like PCBs and DDT. Researchers have found concentrations of these chemicals on plastics in the marine environment at nearly one million times background levels.[6]

Past and Current Solutions

In addition to legislation, solutions include Clean Water Act pollution limits - Total Maximum Daily Loads, or "TMDLs" - which are critical to removing trash from our shores. In 2001, The Los Angeles Regional Water Quality Control Board adopted TMDLs for the Los Angeles River and Ballona Creek, which sets a zero-trash target for this waterbody.[7]

Education is also important; over 50,000 people statewide participate in Coastal Clean-up Day each year. The state Education and the Environment Initiative will reach all public school children, grades K-12, with environmental curricula. Efforts such as these are critical for raising public awareness and achieving marine debris reduction.[8,9]

References: [1]U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Public and Constituent Affairs, (1999) "Turning to the Sea: America's Ocean Future;" United Nations Environment Programme (1995) "Global Programme of Action for the Protection of the Marine Environment from Land-based Activities." Note by the secretariat. UNEP (OCA) /LBA/IG.2/7; [2]California Coastal Commission, (2006) "Eliminating Land-based Discharges of Marine Debris in California: A Plan of Action from The Plastic Debris Project;" [3]S. Casey, (2006) "Our Oceans are Turning in to Plastic, Are we?" Best Life: 103-109; [4]C.J. Moore et al., (2001) "A Comparison of Plastic and Plankton in the Pacific Central Gyre," Marine Pollution Bulletin 42: 297-1300; [5]Ocean Protection Council Resolution on Reducing and Preventing Marine Debris, adopted February 8, 2007; [6]Y. Mato et. al., (2001) "Plastic Resin Pellets as a Transport Medium for Toxic Chemicals in the Marine Environment" Environ. Sci. Technol. 35:318-324; [7]Los Angeles River Trash TMDL: http://www.waterboards.ca.gov/losangeles/html/meetings/tmdl/tmdl_ws_los_angeles.html; [8]California Coastal Commission Coastal Cleanup Day website: http://www.coastal.ca.gov/publiced/ccd/ccd.html; [9]AB 1548, the Education and Environment Initiative (Pavley – Chapter 665, Statutes of 2003) and AB 1721 (Pavley – Chapter 581, Statutes of 2005. [10]2006 PPIC Poll data; [11]National Ocean Economics Program, *California's Ocean Economy, 2005.*

Properties

Styrene is an aromatic hydrocarbon that occurs as a colorless or yellowish viscous liquid with a sweet, floral odor (HSDB 2008). It has a flash point of 34°C (closed cup), a lower explosive limit of 0.9% to 1.1% v/v, an upper explosive limit of 6.1% to 6.8% v/v, and an autoignition temperature of 490°C. Styrene is highly flammable and easily ignited by heat, sparks, or flames, and its vapors may form explosive mixtures with air as a result of the formation of peroxides. Styrene may polymerize when contaminated by oxidizing agents or halides, or when heated, and it emits acrid fumes upon decomposition (SPA 2008, Akron 2010). Styrene usually is stabilized for safe storage, transport, and use by an inhibitor, commonly *p-tert*-butylcatechol (HSDB 2008). Other typical impurities are ethylbenzene, polymer content, aldehydes, peroxides (as H_2O_2), benzene, sulfur, and chlorides. Physical and chemical properties of styrene are listed in the following table.

Property	Information
Molecular weight	104.2
Specific gravity	0.906 at 20°C
Melting point	–31°C
Boiling point	145°C
Log K_{ow}	2.95
Water solubility	310 mg/L at 25°C
Vapor pressure	6.4 mm Hg at 25°C
Vapor density relative to air	3.6

Source: HSDB 2008.

Use

Styrene is an important industrial chemical, used in the synthesis and manufacture of polystyrene and hundreds of different copolymers, as well as numerous other industrial resins (Guest 1997). Styrene producers sell styrene monomer to companies that use styrene to make various compounds and resins. Fabricators then process the resins into a wide variety of products (Cohen *et al.* 2002). Roughly 99% of the industrial resins produced from styrene can be grouped into six major categories: polystyrene (50%), styrene-butadiene rubber (15%), unsaturated polyester resins (glass reinforced) (12%), styrene-butadiene latexes (11%), acrylonitrile-butadiene-styrene (10%), and styrene-acrylonitrile (1%). Another minor category of use is unsaturated polyester resins (not reinforced) (Luderer *et al.* 2005).

Polystyrene is used extensively in the manufacture of plastic packaging, thermal insulation in building construction and refrigeration equipment, and disposable cups and containers. Styrene polymers and copolymers are also increasingly used to produce various housewares, food containers, toys, electrical devices, automobile body parts, corrosion-resistant tanks and pipes, various construction items, carpet backings, house paints, computer printer cartridges, insulation products, wood-floor waxes and polishes, adhesives, putties, personal-care products, and other items, and they are used in paper processing (IARC 2002, Luderer *et al.* 2005, NLM 2008).

Styrene-butadiene rubber is the most widely used synthetic rubber in the world (ICIS 2008). Over 70% of styrene-butadiene rubber is consumed in the manufacture of tires and tire products; however, non-tire uses are growing, with applications including conveyor belts, gaskets, hoses, floor tiles, footwear, and adhesives.

Another major use of styrene is as a cross-linking agent in polyester resins used in gel-coating and laminating operations in the production of glass-fiber-reinforced plastic products such as boats, bathtubs, shower stalls, tanks, and drums (Miller *et al.* 1994, EPA 1997). The resins generally contain between 30% and 50% styrene by weight (EPA 1997).

Production

There are two commercially viable methods of producing styrene (ATSDR 1992, HSDB 2008). The most common process, which accounts for over 90% of total world styrene production, involves catalytic dehydrogenation of ethylbenzene. The second process involves oxidation of ethylbenzene to its peroxide, which is then reacted with propylene to produce propylene oxide and α-methylphenyl carbinol. The carbinol is then dehydrated to produce styrene. U.S. production of styrene has risen fairly steadily since 1960. Between 1960 and 2006, estimated production ranged from a low of 1,740 million pounds in 1960 to a high of 11,897 million pounds in 2000. In 2006, eight U.S. manufacturers produced an estimated 11,387 million pounds of styrene; the three largest producers accounted for 54% of production. U.S. consumption of styrene in 2006 was 9,600 million pounds, over 99% of which was consumed in the production of polymers and copolymers (Berthiaume and Ring 2006). U.S. imports and exports of styrene increased steadily from 1975 through 2007, from 7 million pounds to 1,475 million pounds for imports and from 574 million pounds to 4,200 million pounds for exports (Berthiaume and Ring 2006, USITC 2008a,b).

Exposure

Exposure to styrene can occur in both occupational and nonoccupational settings. However, workers in certain occupations potentially are exposed to much higher levels of styrene than the general population. The greatest source of exposure for the general population is cigarette smoking, and daily styrene intake by the nonsmoking population is expected to be orders of magnitude lower than daily intakes for workers in occupations with high styrene exposure levels (Cohen *et al.* 2002, IARC 2002).

Exposure of the General Population

Styrene exposure to the general population can occur through environmental contamination. For the non-smoking general population, inhalation of indoor air and ingestion of food resulted in the highest daily styrene intakes (IARC 2002). Styrene has been measured in outdoor air, but higher levels generally are found in indoor air, drinking water, groundwater, surface water, soil, and food. Styrene can be emitted to the air from industrial production and use of styrene and styrene-based polymers and copolymers, motor-vehicle emissions and other combustion processes, offgassing of building materials and consumer products, and cigarette smoking (ATSDR 2010, IARC 1994). Numerous spills containing styrene have been reported to the National Response Center since 1990, and these spills have the potential to contaminate air, water, soil, and food supplies (NRC 2008). Uptake of styrene by biological organisms is expected to be low; however, styrene has been detected in fish and other aquatic organisms (Howard 1989, ECB 2002, HSDB 2008).

Food can contribute to styrene exposure (Lickly *et al.* 1995a, Tang *et al.* 2000, Cohen *et al.* 2002, Holmes *et al.* 2005). Styrene has been detected in a wide range of foods and beverages, with the highest measured levels occurring in unprocessed, raw cinnamon, possibly resulting from the natural degradation of cinnamic acid derivatives (IARC 1994). Styrene also occurs at very low concentrations in many agricultural food products; however, it is not known whether the styrene is produced endogenously or results from environmental contamination (Tang *et al.* 2000). The presence of styrene in packaged foods is due primarily to leaching of monomer from polystyrene containers (Howard 1989, ATSDR 2010). The rate of migration of styrene monomer from polystyrene containers is determined mainly by the lipophilicity of the food, surface area of the container per volume of

food, duration of contact, and food temperature (ATSDR 2010, Lickly *et al.* 1995b, ECB 2002, Choi *et al.* 2005).

In a study comparing styrene intake from various sources, estimated daily intake for adults was lowest from polluted drinking water and highest from cigarette smoke, polluted urban air, and indoor air (Fishbein 1992). Estimated daily styrene intake for the Canadian general population from sources other than smoking was less than 0.8 µg/kg of body weight for children and less than 0.4 µg/kg for adults, but estimated daily intake for cigarette smokers was as high as 3.5 µg/kg (CEPA 1993). While this study demonstrated that inhalation of both indoor and outdoor air and ingestion of food are important sources of exposure for nonsmokers, it also estimated that exposure from smoking cigarettes was roughly 10 times that from all other routes (indoor and outdoor air, drinking water, soil, and food) combined. Other studies estimated that styrene exposure of smokers was six times that of nonsmokers (Cohen *et al.* 2002) and that up to 15% of nonsmokers' styrene exposure could be attributed to environmental tobacco smoke (Miller *et al.* 1998).

In a 1982 study by the U.S. Environmental Protection Agency, styrene was detected in all of eight human-breast milk samples from women in four U.S. cities and in all of an unspecified number of wet adipose tissue samples (Howard 1989). Styrene also was detected in the general population at mean concentrations of 0.4 µg/L in blood and 0.7 to 1.6 µg/m^3 in exhaled breath (ATSDR 2010). Blood styrene levels were assessed in the Priority Toxicant Reference Range Study conducted as part of the Centers for Disease Control and Prevention's Third National Health and Nutrition Examination Survey. Of 624 samples, 78 (12.5%) contained no detectable styrene, and 546 contained styrene at concentrations ranging from 0.019 to 4.006 µg/L; the mean concentration for all 624 samples was 0.07 µg/L, the median was 0.04 µg/L, and the 95th percentile value was 0.18 µg/L (Ashley *et al.* 1994, Sexton *et al.* 2005).

Occupational Exposure

Workers can be exposed to styrene during production of styrene monomer, polystyrene and various styrene copolymers, glass-fiber-reinforced plastics, and styrene-butadiene rubber; exposure can also occur in other miscellaneous occupations (ATSDR 2010, IARC 2002).

The highest levels of occupational exposure to styrene occur in the fabrication of products such as boats, car and truck parts, tanks, bathtubs, and shower stalls from glass-fiber-reinforced polyester composite plastics (IARC 2002). Historically, the highest styrene exposure levels for reinforced-plastics workers were in the range of several hundred parts per million; however, estimated exposure levels have decreased by a factor of 10 over the past several decades as a result of improved work practices and products (Kolstad *et al.* 2005). In general, the average exposure levels reported since the 1980s have been less than 100 ppm. In 2006, the U.S. Bureau of Labor Statistics estimated that 32,510 workers were employed as Fiberglass Laminators and Fabricators (defined as "laminate layers of fiberglass on molds to form boat decks and hulls, bodies for golf carts, automobiles, or other products"). Ship and Boat Building was the largest subcategory in this Standard Occupational Classification segment, with 12,910 employees (BLS 2007). Workers in the reinforced-plastics industry are potentially exposed to styrene-7,8-oxide, as well as styrene, but at levels 2 to 3 orders of magnitude lower than styrene (Serdar *et al.* 2006).

Styrene exposure levels are generally lower in the styrene-butadiene rubber and the styrene monomer and polymer industries than in the reinforced-plastics industry; however, significant exposure of workers still can occur. Reported mean exposure levels for these industries generally have been less than 20 ppm. No data were found on the numbers of employees in these industries. As in the reinforced-plastics industry, styrene exposure levels in these industries have declined over the past several decades (Macaluso *et al.* 1996, IARC 2002).

Low levels of styrene (usually in the low parts-per-billion range) have been reported in a variety of other occupational settings, including nuclear power plants, photocopy centers, a petrochemical complex, printing plants, wood surface-coating operations, tollbooths, and a waste incinerator, and during the production of PVC film (Kim *et al.* 2003, Bakoğlu *et al.* 2004, Leung *et al.* 2005, Sapkota *et al.* 2005, Thorud *et al.* 2005, Chan *et al.* 2006, Hsieh *et al.* 2006, Lee *et al.* 2006). Levels in the low parts-per-million range were measured in a sculpture class where polyester resins were used, during the production of buttons, and during firefighting. Higher levels were seen during the production or use of paints and putties (exceeding 20 ppm), for taxidermists (up to 70 ppm), and during the manufacture of cooking ware (up to 186 ppm) (IARC 2002).

Regulations

Coast Guard, Department of Homeland Security

46 CFR 150 and 151 detail procedures for shipping styrene monomer and for shipping styrene monomer and various styrene co-polymers with incompatible mixtures.

Department of Transportation (DOT)

Styrene is considered a hazardous material, and special requirements have been set for marking, labeling, and transporting this material.

Environmental Protection Agency (EPA)

Clean Air Act

Mobile Source Air Toxics: Listed as a mobile source air toxic for which regulations are to be developed.
National Emissions Standards for Hazardous Air Pollutants: Listed as a hazardous air pollutant.
New Source Performance Standards: Manufacture of styrene is subject to certain provisions for the control of volatile organic compound emissions.

Clean Water Act

Designated a hazardous substance.

Comprehensive Environmental Response, Compensation, and Liability Act

Reportable quantity (RQ) = 1,000 lb.

Emergency Planning and Community Right-To-Know Act

Toxics Release Inventory: Listed substance subject to reporting requirements.

Safe Drinking Water Act

Maximum contaminant level (MCL) = 0.1 mg/L.

Food and Drug Administration (FDA)

Maximum permissible level in bottled water = 0.1 mg/L.
The food additive poly(2-vinylpyridine-co-styrene) may be safely used as a nutrient protectant in feed for beef cattle and dairy cattle and replacement dairy heifers, with residual styrene levels not to exceed 200 ppb.
Polystyrene basic polymers used as components of articles intended for use in contact with food shall contain not more than 1% by weight of total residual styrene monomer (0.5% by weight for certain fatty foods).
Rubber-modified polystyrene basic polymers used as components of articles intended for use in contact with food shall contain not more than 0.5% by weight of total residual styrene monomer.
Styrene-maleic anhydride co-polymers may be used as articles or as components of articles intended for use in contact with food provided that conditions are met, including residual styrene monomer levels not exceeding 0.3% by weight.
Styrene-acrylic co-polymers may be used as components of the food-contact surface of paper and paperboard provided that certain conditions are met, including residual styrene monomer levels not exceeding 0.1% by weight.

Occupational Safety and Health Administration (OSHA)

While this section accurately identifies OSHA's legally enforceable PELs for this substance in 2010, specific PELs may not reflect the more current studies and may not adequately protect workers.
Acceptable peak exposure = 600 ppm (5-min maximum peak in any 3 h).
Ceiling concentration = 200 ppm.
Permissible exposure limit (PEL) = 100 ppm.

Guidelines

American Conference of Governmental Industrial Hygienists (ACGIH)

Threshold limit value – time-weighted average (TLV-TWA) = 20 ppm.
Threshold limit value – short-term exposure limit (TLV-STEL) = 40 ppm.

Biological exposure indices: Mandelic acid plus phenylglyoxylic acid in urine, end of shift = 400 mg/g of creatinine; styrene in venous blood, end of shift = 0.2 mg/L.

National Institute for Occupational Safety and Health (NIOSH)

Immediately dangerous to life and health (IDLH) limit = 700 ppm.
Short-term exposure limit (STEL) = 100 ppm.
Recommended exposure limit (REL) = 50 ppm.

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THE CASE FOR BANNING STYROFOAM FOODSERVICE WARE IN HAWAII

GEORGE O. WHITE
May 1, 2008

THE CASE FOR BANNING STYROFOAM FOODSERVICE WARE IN HAWAII

George O. White

This is the beginning of us finally taking control of our destiny. We know what is good for this State, what is proper and what is achievable.

We share an awesome responsibility, you and I, a responsibility that transcends this time and this place.[1]

I. INTRODUCTION

Hawaii eats more take-out food, per capita, than any other State in the Country.[2] Every day, thousands upon thousands of expanded polystyrene foam (commonly referred to as "Styrofoam"[3]) containers are used to provide Hawaii's consumer plate-lunch culture with sustenance.[4]

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[1] George R. Ariyoshi, Governor, State of Hawaii, State-of-the-State Address to the Ninth State Legislature in Joint Session, State Capitol, January 23, 1978. (Governor Ariyoshi stated that as representatives of the people of the State of Hawai'i, it is the responsibility of the Legislature to find the right direction, the direction, which will leave Hawaii in a better place than they found it.)

[2] U.S. Census Bureau, Economic Census 2002, NAICS 722211 Limited Service-Restaurants, *available at* http://www.census.gov/econ/census02/data/industry/E722211.HTM#T4; Robbie Dingeman, *Isles top fast-food spender in nation*, Honolulu Advertiser, January 29, 2008, *available at* http://honoluluadvertiser.com/apps/pbcs.dll/article?AID=/20080129/NEWS01/801290353/1001 ("Hawaii came in tops when the federal number crunchers calculated the per capita amount purchased for all take-out food").

[3] Styrofoam™ is a Dow Chemical Company brand trademark for an extruded polystyrene foam thermal insulation product.

[4] WorldCentric, Biocompostables – Biodegradable Food Service and Packaging Disposable, *available at* http://www.worldcentric.org/bio/index.htm (noting that tens of billions of Styrofoam containers are thrown away in the United States each year).

While recognized as a sturdy, sanitary and economic product,[5] Styrofoam is also an inherently nonbiodegradable and nonrecyclable material that takes hundreds of years to decompose.[6] Additionally, the chemical composition of Styrofoam raises concerns that the neurotoxin styrene leaches not only into our take-out food,[7] but also into Hawaii's ecosystems.[8]

Numerous legislative bodies across the United States,[9] including the Hawaii State Legislature, have considered[10] or are considering[11] the possibility of

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[5] American Chemistry Council, Polystyrene facts, *available at* http://www.americanchemistry.com/s_plastics/sec_pfpg.asp?CID=1421&DID=5213 (noting polystyrene gets the job done and nothing else offers the combination of strength, lightness and durability to protect your morning coffee or salad at lunch).

[6] California Integrated Waste Management Board. Use and Disposal of Polystyrene in California: A Report to the Legislature (December 2004), at 4, *available at* http://www.p2pays.org/ref/26/25858.pdf (noting that Styrofoam by its nature, has a useful life that can be measured in minutes or hours. Yet, it takes hundreds of years to deteriorate in the environment or landfill).

[7] The Pacific Protection Initiative, SB 899: Toxic Plastic Additives, *available at* http://www.healthebay.org/currentissues/ppi/bills_SB899.asp (noting medical evidence, scientific study, as well as the Food and Drug Administration suggest that styrene leaches from polystyrene containers into food and beverages).

[8] The Pacific Protection Initiative, *supra* note 7, (noting marine life and seabirds can easily confuse plastic marine debris for food, which harms or kills them by clogging their digestive systems or ingesting the toxin styrene.)

[9] San Francisco, Cal., Mun. Code, Ch. 16, §1603 (Ord. 295-06(1)(n)) *available at* http://www.sfgov.org/site/uploadedfiles/bdsupvrs/ordinances06/o0295-06.pdf ("Due to these concerns, nearly 100 cities have banned polystyrene foam food service ware"); Press Release, Office of Senator Liz Krueger, Krueger Introduces Bill Banning Styrofoam Products, *available at* http://www.nyssenate26.com/press_archive_story.asp?id=1347 (noting similar bills have been enacted in Oakland, San Francisco, Berkeley, Portland, and about 100 other municipalities across the country).

[10] Suffolk Co., NY; Carmel, CA; Sonoma Co., CA; Freeport, ME; Portland, OR; Berkeley, CA; St. Paul, MN; San Clemente, CA; San Juan Capistrano, CA; Laguna Woods, CA; Aliso Viejo, CA; Ventura, CA; Huntington Beach, CA; Malibu, CA; Emeryville, CA; Oakland, CA; Capitola, CA; Santa Monica, CA; Calabasas, CA; San Francisco, CA; Alameda, CA; Santa Cruz, CA; Millbrae, CA; Laguna Beach, CA; and Fairfax, CA.

banning the use of Styrofoam food-service products and requiring the use of Styrofoam alternatives. These proposals, however, are often met with substantial opposition by the food,[12] restaurant,[13] and plastics industries,[14] who contend that Styrofoam is a safe consumer product that poses no threat to our health or environment.[15]

Efforts to curtail the use of Styrofoam food service ware began in Suffolk County, NY, in the late 1980s[16] in response to growing solid waste concerns and

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[11] New York City, NY; Seattle, WA; Los Angeles, CA; Los Angeles Co., CA; Long Beach, CA; Santa Barbara, CA; San Mateo, CA; Monterey, CA; New York State, California, and Hawaii.

[12] Hearing on SB2629 Before the S. Comm. On Energy & Env., 2008 Leg., 25th Sess. (February 5, 2008) (statement of Dick Botti, Exec. Director, Hawaii Food Industry Association, *available at* http://capitol.hawaii.gov/session2008/Testimony/SB2629_ENE_02-07-08.pdf (in oppposition)).

[13] Hearing on SB2629 Before the S. Comm. On Energy & Env., 2008 Leg., 25th Sess. (February 5, 2008) (statement of Gail Ann Chew, Exec. Director, Hawaii Restaurant Association, *available at* http://capitol.hawaii.gov/session2008/Testimony/SB2629_ENE_02-07-08.pdf (in opposition)).

[14] Hearing on SB2629 Before the S. Comm. On Energy & Env., 2008 Leg., 25th Sess. (February 5, 2008) (statement of Tim Shestek, Director, State Affairs and Grass Roots of the American Chemistry Council, *available at* http://capitol.hawaii.gov/session2008/Testimony/SB2629_ENE_02-07-08.pdf (in opposition)).

[15] Hearing on HB2495 Before the H. Comm. On Energy & Envtl. Prot., 2008 Leg., 25th Sess. (January 29, 2008) (statement of Dick Botti, Exec. Director, Hawaii Food Industry Association, *available at* http://capitol.hawaii.gov/session2008/Testimony/HB2495_EEP_01-29-08_2_.pdf (noting that HFIA disputes the strong comments in HB2495 that state Styrofoam poses a significant threat to Hawaii's ecosystems and environment and to the general health and welfare of the citizens of Hawaii noting it is just the opposite)).

[16] Peter Montague, *Suffolk County, NY, Bans Plastic Food Containers – First in Nation*, Rachel's Env. & Health Weekly, May 9, 1988, *available at* http://www.mindfully.org/Plastic/Suffolk-CoNY-Bans-Plastic.htm (noting industry's contention that the Styrofoam foodservice products were the scapegoat, not the problem).

the permanent closure of all landfills on Long Island.[17] Legislative enactments such as those in Suffolk County, and similar ones that followed,[18] began to pressure the plastics industry to address the environmental concerns of Styrofoam which were for many years neglected and ignored.[19] As public pressure continued to grow, even McDonald's Corporation abandoned its use of Styrofoam foodservice packaging.[20]

The Industry challenged Suffolk County's pioneering legislation in court,[21] and ultimately lost[22] and has never legally challenged any legislation concerning the regulation of Styrofoam foodservice ware, since that challenge. The Industry, however, continues to maintain its opposition to Styrofoam

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[17] Laws of Suffolk County, New York, Part IV, Ch. 301, Art. II, § 301-7(C) (March 29, 1988) *available at* http://www.mindfully.org/Plastic/Suffolk-Co-NY-Ban.htm ("This Legislature further finds that landfill space within Suffolk County is diminishing rapidly; that state law currently in effect precludes the establishment of new landfills on Long Island").

[18] Carmel, CA; Sonoma Co., CA; Freeport, ME; Portland, OR; Berkeley, CA; St. Paul, MN, all enacted bans on Styrofoam within two years of Suffolk Co.

[19] Josh Barbanel, *Suffolk County's Ban on Plastics Loses Allies*, N.Y. Times, December 31, 1991, *available at* http://query.nytimes.com/gst/fullpage.html?res=9D0CE7D61439F932A05751C1A967958260 ("The Suffolk law and later ones were widely credited with pressuring the plastics industry to address long-neglected environmental concerns").

[20] Philip S. Gutis, *McDonald's Is Urged to Alter Packaging*, N.Y. Times, November 11, 1987, *available at* http://query.nytimes.com/gst/fullpage.html?res=9B0DE0DC1F3DF932A25752C1A961948260&sec=&spon=&pagewanted=all; Press Release, Environmental Defense Fund, *McDonald's & Environmental Defense Fund Mark 10th Anniversary of Landmark Alliance, available at* http://www.edf.org/pressrelease.cfm?contentID=1299 (noting the tremendous environmental results Since EDF and McDonald's agreed to work together a decade ago, to replace polystyrene foam sandwich clamshells with paper wraps and light-weight recycled boxes).

[21] Society of Plastics Industry, Inc. v. County of Suffolk, 154 A.D.2d 179, 552 N.Y.S.2d 138 (Feb 26, 1990).

[22] Society of the Plastics Industry v. County of Suffolk, 77 N.Y.2d 761, 573 N.E.2d 1034 (1991).

regulations,[23] contending that Styrofoam is being singled out as a scapegoat to solve the solid waste crisis,[24] and that the solution is more landfills, more recycling, and more incinerators.[25] Over the last two decades these solutions have not been successful, and have not been popularly supported nor substantiated. However, they continue to be promoted.[26]

This report argues that in Hawaii there is a constitutional mandate[27] to protect the environment and a statutory mandate[28] to perpetuate the future of Hawaii, through its elected leadership providing the way[29] to foster and promote a sustainable Hawaii. Considering the present solid waste crisis facing the State, the prohibition of Styrofoam food-service products is a legislative issue which requires public discussion, debate and responsible resolution. Part II of this report reviews the history, uses and impact of Styrofoam upon the environment and economy. Part III analyzes regulations, both enacted and proposed, concerning

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[23] Shestek, Hearing on SB2629, *supra* note 14.
[24] Montague, *supra* note 16, (noting industry's contention that the Styrofoam foodservice products were the scapegoat, not the problem).
[25] Montague, *supra* note 16, (noting industry's contention that "the solution to solid waste crisis is more recycling, siting of new landfills, and construction of new incinerators).
[26] Botti, Hearing on SB2629, *supra* note 12, (noting HFIA believes the solution to the landfill crisis lies in recycling of Styrofoam and building more waste-to-energy facilities).
[27] *See* HI Const. art. IX § 8; *See also* HI Const. art. XI § 9.
[28] Act 8 SSLH 2005
[29] Calvin Say, Speaker of the House of Representatives, State Legislature, Opening Day Address, State Capitol, January 15, 2008. ("We are thousands of miles away from the resources necessary to support the lives of well over a million people. So we must significantly increase our efforts to achieve greater sustainability. Our commitment to that effort will truly help Hawaii take charge of its destiny"); *See also,* Colleen Hanabusa, Senate President, State Legislature, Opening Day Address, State Capitol, January 2007 ("Sustainability is not just another buzz word for this Legislature. Dare us. Challenge us. Hold us to our commitment. And then join us...Together, we will make sustainability a reality, and not just the political word of the week... We will sustain our economy, and our environment, and our tomorrows").

Styrofoam food-service products across the United States. Part IV applies this analysis to the Hawaii model, suggesting the elements necessary for the enactment of a successful ban in Hawaii, and, finally, Part V concludes that a ban on Styrofoam food-service products is consistent with the intent underlying both constitutional and statutory provisions whose purpose is to protect Hawaii's environment and sustain its future.

II. STYROFOAM BACKGROUND: PROS & CONS

While Styrofoam®[30] is the Dow Chemical Co. trademarked form of polystyrene foam insulation used for industrial, commercial, and residential construction, the term is also commonly used in reference to various types of polystyrene foam products[31] prevalent in our daily lives. These include products not only for foodservice applications, but also products used in shipping and the packaging of electronics and fragile items.[32]

The primary focus of this report is on the use of Styrofoam food service-ware products, such as the hinged-clamshell container in which our favorite L&L Drive-inn plate-lunch is served, the 5-compartment lunch tray upon which school lunches are served, and the coffee cup which holds our morning 'cup of joe'. These are all examples of expanded polystyrene foam foodservice packaging.

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[30] Dow Chemical Co., What is Styrofoam?, *available at* http://www.dow.com/Styrofoam/media/what.htm.

[31] Universal Foam Products, Styrofoam Brand Insulation and Foam versus Expanded Polystyrene, *available at* http://univfoam.com/products/Styrofoam (noting Styrofoam is often used to refer to expanded polystyrene even though the materials are completely different).

[32] Id., (noting EPS (Styrofoam) is used in a variety of packaging applications).

What started as an accidental invention in the early 1950s[33] in an effort to develop a flexible electrical insulator, "gained widespread popularity in the 1970s as an inexpensive and effective insulating material for disposable cups and containers."[34] As a point of comparison and reference, it is estimated in 1960 (before Styrofoam entered the market), American consumers used approximately 270,000 tons of disposable plates and cups. This number has exploded to 1,830,000 tons, 710,000 tons of which are Styrofoam.[35] Americans throw away nearly 70 billion Styrofoam containers, cups and plates each year.[36]

Styrofoam is a light-weight material, composed of approximately ninety-five (95) percent air and five (5) percent polystyrene.[38] While recognized as more cost effective than its alternatives,[39] such as sugar cane and starch based products, polystyrene (the main component in Styrofoam) is a recognized neurotoxin and

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[33] Mary Bellis, About.com:Inventors, Polystyrene and Styrene, *available at* http://inventors.about.com/library/inventors/blpolystyrene.htm ("Ray McIntire invented Styrofoam for the Dow Chemical Co.. McIntire said his invention of foamed polystyrene was accidental").

[34] Ashville Magazine, Earth Talk, *available at* http://www.newfrontier.com/asheville/earth-talk4.htm.

[35] U.S. Environmental Protection Agency, Office of Solid Waste, Characterization of Municipal Waste in the United States: 1998 Update, Report No. EPA530-R-99-021 (Washington, DC), 1999, Table 9.

[36] WorldCentric, *supra* note 4, (noting that according to the EPA, 710 thousand tons of Styrofoam foodservice containers were disposed in 2003. Assuming 10 grams weight for each cup or plate, it is estimated that 73 billion Styrofoam containers are thrown away every year in USA).

[38] Earth Resource Foundation, Polystyrene Foam Report, *available at* http://www.earthresource.org/campaigns/capp/capp-Styrofoam.html.

[39] American Chemistry Council, *supra* note 5, (noting Styrofoam is generally more economical to use than disposable paperboard products and reusable food service items).

possible carcinogen.[40] Additionally, polystyrene is a manufactured by-product of petroleum, a limited, non-renewable and non-sustainable resource.[41]

To manufacture Styrofoam, polystyrene is expanded through a gaseous blowing agent to create the lightweight material composed of millions of air pockets. Until the 1970s, the agent used to create Styrofoam was the chlorofluorocarbon (CFC) isobutylene,[42] a major contributor to global warming. Presently, the most common agent used in manufacturing Styrofoam is pentane. While considered less harmful to the environment, the use of pentane as a gaseous blowing agent has been found to contribute to the formation of smog.[43]

The manufacturing process involved in creating polystyrene, has been studied by numerous entities including the U.S. Environmental Protection Agency (EPA), which reported polystyrene's manufacturing process as being "the fifth largest creator of hazardous waste in the United States."[44] According to California's Integrated Waste Management Board, polystyrene's manufacturing process, greenhouse gas effect and total environmental effects and impact are second only to aluminum."[45]

Once manufactured, polystyrene foam enters the market as a well-

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[40] U.S. Environmental Protection Agency, Technology Transfer Network, Air Toxics Website, Styrene, *available at* http://www.epa.gov//ttn/atw/hlthef/styrene.html ("EPA does not have a carcinogen classification for styrene; the chemical currently is undergoing an EPA Integrated Risk Information System (IRIS) review to establish such a classification").

[41] *Berkeley, Cal,. Municipal Code § 11.60.010 (1988)*

[42] Andrea Kramer, Comment, Cradle to Grave: The Life Cycle of Styrofoam, San Francisco State University (2003), *available at* http://bss.sfsu.edu/raquelrp/projects/Styrofoam.ppt.

[43] *Supra* note 41.

[44] *Oakland, Cal., Ordinance 12747 C.M.S. (Jun. 27, 2006).*

[45] Id.

recognized, sturdy, and reliable product, which is resistant to elemental forces of nature such as time, water, cold, heat, and pressure.[46] This resiliency is an asset and a liability given the fact that polystyrene foam, with a useful food or liquid container life that can be measured in minutes or hours, persists in the environment for centuries, following its one time intended use, and may never completely degrade.[47]

A. Arguments in favor of the continued use of Styrofoam disposable foodservice products

With the advent of Styrofoam foodservice products into the retail market during the 1970s, a revolution in the foodservice industry occurred with far-reaching implications for retail food consumption, consumer habits and customer satisfaction.

Styrofoam, unlike paper or cardboard products, is sturdy, maintains its shape, and prevents moisture damage.[52] Being composed of approximately 95%

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[46] DiversiFoam Products, What is Extruded Polystyrene Foam?, *available at* http://www.diversifoam.com/xeps.htm.

[47] California Integrated Waste Management Board, *supra* note 5, (noting it can take several hundred years for these products to deteriorate and degrade in the environment or landfill).

[52] American Chemistry Council, Polystyrene facts, *available at* http://www.americanchemistry.com/s_plastics/sec_pfpg.asp?CID=1421&DID=5213.

air,[53] Styrofoam is not only extremely light-weight, but also possesses incredible insulative properties.[54] Similarly, with today's on-the-go lifestyles, Styrofoam foodservice products have proven very convenient for fast-food and take-out menu options[55]

Styrofoam is an FDA approved product[56] for its one-time intended use and is more sanitary than reusable food service-ware[57] and cheaper than other FDA approved[58] disposable alternatives.[59] The affordability of sytrofoam foodservice products allows institutions such as schools and hospitals to direct a larger share of their budgeted monies to more important uses[60] than the more expensive alternative foodservice products.

In a recent study,[61] Styrofoam foodservice products were shown to be more energy efficient and eco-friendly in terms of their manufacturing processes when compared to other food service containers.[62]

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[53] Earth Resource Foundation, Polystyrene Foam Report, *available at* http://www.earthresource.org/campaigns/capp/capp-Styrofoam.html.
[54] American Chemistry Council, *supra* note 52.
[55] Id.
[56] Botti, Hearing on HB2495, *supra* note 15, (noting that the product is "Generally Recognized as Safe" (GRAS) by the FDA for consumer use).
[57] American Chemistry Council, *supra* note 52, (Citing tests that have shown disposable food service-ware is more sanitary than re-usable food service-ware and reducing the use of disposable-ware would increase the spread of diseases).
[58] WorldCentric, *supra* note 4, (noting these biodegradable foodservice products are FDA processed and approved).
[59] WorldCentric, Biocompostables – Biodegradable Food Service and Packaging Disposable, *available at* http://www.worldcentric.org/bio/index.htm.
[60] American Chemistry Council, *supra* note 52.
[61] Franklin & Associates, Life Cycle Inventory of Polystyrene Foam, Bleached Paperboard, and Corrugated Paperboard Foodservice Products, *available at* http://www.americanchemistry.com/s_plastics/sec_pfpg.asp?CID=1439&DID=5337.
[62] Hearing on SB2629 Before the S. Comm. On Energy & Env., 2008 Leg., 25th Sess. (February 5, 2008) (statement of American Chemistry Council, at 3), *available at* http://capitol.hawaii.gov/session2008/Testimony/HB2495_EEP_01-

Styrofoam poses a minimal threat to the environment because it takes up less than one (1) percent of available landfill space, by weight.[63] Further, Styrofoam foodservice ware is recyclable,[64] and if a program can be implemented similar to the one in the State of Massachussetts, recycling of Styrofoam products will divert a percentage of the waste stream heading to the landfill.

And, finally, the solution to the landfill crisis presently facing the State of Hawaii is not to build more landfills, but rather build more waste-to-energy facilities.[65] Styrofoam is recognized as a valuable source of fuel[66] for waste to energy facilities such as HPOWER on the island of Oahu, where incinerated products generate electricity. Styrofoam offers a product with a very high BTU (energy) value, approximately 16,000 BTU per pound,[67] and should be collected and captured from the landfills as a tremendous energy resource.[68]

29-08_2_.pdf (claiming polystyrene foam foodservice products, when compared to other food service containers, are very energy efficient and environmentally friendly. The study, however, failed to analyze or compare Styrofoam to compostable non-petroleum based products, such as those made of sugarcane bagasse or potato starch).

[63] American Chemistry Council, Plastics Division, *available at* http://www.americanchemistry.com/s_plastics/doc_pfpg.asp.

[64] Hearing on SCR134 Before the S. Comm. On Commerce & Cnsmr. Prot., 2008 Leg., 25th Sess. (March 31, 2008) (statement of Dick Botti, Exec. Director, Hawaii Food Industry Association), *available at* http://capitol.hawaii.gov/session2008/Testimony/SCR134_SD1_CPH_03-31-08_.pdf (noting that Styrofoam foodservice ware can be recycled in Hawaii, as is done in Massachusetts).

[65] Hearing on SB2001 Before the S. Comm. On Energy & Env., 2008 Leg., 25th Sess. (February 7, 2008) (statement of Dick Botti, Exec. Director, Hawaii Food Industry Association, *available at* http://capitol.hawaii.gov/session2008/Testimony/SB2001_ENE_02-07-08_.pdf

[66] Id.

[67] American Chemistry Council, *Take a Closer Look at Today's Polystyrene Packaging*, *available at* http://www.americanchemistry.com/s_plastics/doc.asp?CID=1861&DID=7206.

[68] Botti, Hearing on HB2495, *supra* note 15, (stating fuel value of Styrofoam is good).

A. Arguments opposing the continued use of Styrofoam disposable foodservice products.

Despite the fact that Styrofoam revolutionized the foodservice industry and played a significant role in transforming consumer culture in the twentieth century, the product produces certain unavoidable environmental[69] and health[70] concerns. As markets develop and change, businesses and industries adapt and evolve. The opportunity to move away from Styrofoam foodservice products to more environmentally-friendly compostable alternatives is available, and businesses should begin this transition.

i. The indisposability of Styrofoam

The inherent non biodegradable, non compostable and impractical recyclable nature of Styrofoam raises fundamental concerns regarding what happens to the product when it is disposed following its one-time intended use. In Hawaii, possible disposal options are limited to landfills,[71] incineration at HPOWER,[72] or discarded trash, which becomes litter.[73]

Given Styrofoam's inherent resistance to the elemental forces of nature such as time, water, cold, heat, and pressure,[74] it wholly frustrates decomposition in the natural environment or in landfills. Further, landfills are the second highest source of greenhouse gas emissions in the United States (after fossil fuel

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[69] California Integrated Waste Management Board, *supra* note 6
[70] The Pacific Protection Initiative, *supra* note 7.
[71] H.B. 2495, 25th Leg., Reg. Sess. (Haw. 2008).
[72] Id.
[73] Id.
[74] DiversiFoam Products, *available at* http://www.diversifoam.com/xeps.htm

combustion)[75] although they serve a critical and necessary function in modern society.

a. More landfills unlikely and not the solution

The landfill crisis faced by Suffolk County[76] in the late 1980s is comparable to the landfill crisis presently facing the State of Hawaii, specifically on the Big Island[77] and the island of Oahu.[78] With landfills at, or near capacity,[79] coupled with an unwillingness to 'site' a new landfill,[80] city officials are considering the shipment of trash to the mainland.[81] Interestingly, New York City has engaged in such a practice for the last twenty years following the shutdown of all landfills on Long Island in 1990.[82] Such an alternative for Hawaii, however, is

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[75] Office of the Federal Environmental Executive, White House Task Force on Recycling, Recycling . . . for the future: Consider the benefits, at 61, (1998), *available at* http://www.ofee.gov/wpr/future.pdf.

[76] Laws of Suffolk County, *supra* 17, (stating that landfill space within Suffolk County was diminishing rapidly and that no new landfills would be built on Long Island).

[77] Kevin Dayton, *Garbage to energy plant for Big Island*, Honolulu Advertiser (March 5, 2008), *available at* http://www.honoluluadvertiser.com/apps/pbcs.dll/article?AID=/20080305/NEWS01/803050441/1001/NEWS01.

[78] Peter Boylan, *Hawaii sending more waste to landfill*, Honolulu Advertiser (February 3, 2008) *available at* http://www.honoluluadvertiser.com/apps/pbcs.dll/article?AID=/20080203/NEWS01/802030365/1001

[79] Boylan, *supra* note 77; *See also* Kevin Dayton, *Garbage to energy plant for Big Island*, Honolulu Advertiser (March 5, 2008), *available at* http://www.honoluluadvertiser.com/apps/pbcs.dll/article?AID=/20080305/NEWS01/803050441/1001/NEWS01.

[80] Laurie Au, *2 plans for trash*, Honolulu StarBulletin (January 18, 2008), *available at* http://starbulletin.com/2008/01/18/news/story06.html.

[81] Boylan and Dayton, *supra* note 79.

[82] Sarah Lyall, *Court Upholds Law Closing L.I. Landfills*, N.Y. Times, February 19, 1993, *available at* http://query.nytimes.com/gst/fullpage.html?res=9F0CE4D9153BF93AA25751C0A965958260

viewed as an immediate and expensive short-term solution[83] until a 25-year master plan for solid waste management is finalized[84] and further investment is made into waste-to-energy technology.[85]

With the minimal likelihood of a new landfill being built,[86] the focus remains on diverting as much of the waste-stream from the landfill as possible.[87] Diversion of the waste stream is accomplished through recycling, incineration at the City's waste-to-energy facility (HPOWER), and composting.

Currently, on Oahu, approximately 57% of solid waste (refuse) is diverted annually from the landfill either through incineration at Honolulu's waste-to-energy facility (H-POWER),[88] or through recycling,[89] or through greenwaste composting.[90] This means that roughly 43% of our waste still ends up in the landfill.[91] Statewide, including the islands of Hawaii, Maui, and Kauai, the diversion rate of solid waste to H-POWER, recycling or composting, is estimated at being just over 31%[92]

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[83] Boylan, *supra* note 78.
[84] Id.
[85] Dayton, *supra* note 77.
[86] Boylan, *supra* note 78.
[87] Id.
[88] Id.
[89] Id.
[90] Id.
[91] Diana Leone, *Firms offer to take city trash to mainland*, Honolulu StarBulletin (Sept. 25, 2004), *available at* http://starbulletin.com/2004/09/25/news/story10.html (600,000 tons of trash incinerated per year at HPOWER, reducing it to 168,000 tons ash and residue to be buried at Waimanalo Gulch Landfill).
[92] Sustainability Task Force, Hawaii 2050 Sustainability Plan (January, 2008), p. 62, *available at* http://www.hawaii2050.org/images/uploads/Hawaii2050_Plan_FINAL.pdf;

Locally, an estimated 40% of solid waste in Hawaii comes from imported paper products and petroleum based plastics (including Styrofoam).[93] Nationally, polystyrene-based plastics (including Styrofoam) take up an estimated 25% to 30% of available landfill space by volume.[94] The weight of these products in landfills is largely irrelevant because given its lightweight nature, the volume is much greater,[95] and for landfills, the problem is simply a lack of space.[96]

b. Recycling Styrofoam is an ineffective waste-stream diversion

Efforts to divert this product from the landfill by recycling will not work. Nearly twenty years ago[97], the plastics industry attempted to encourage recycling of Styrofoam products by investing millions of dollars to build a nationwide infrastructure, through the National Polystyrene Recycling Company (NPRC).[98] The NPRC ultimately failed because foodservice polystyrene recycling was viewed as unsuccessful from an economic vantage point.[99]

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[93] Hawaii 2050 Plan, *supra* note 92, at 43.
[94] Foundation for Advancements in Science and Education, Polystyrene Fact Sheet, *available at* http://www.earthresource.org/campaigns/capp/capp-Styrofoam.html.
[95] California Integrated Waste Management Board. Use and Disposal of Polystyrene in California: A Report to the Legislature (December 2004), at 4, *available at* http://www.p2pays.org/ref/26/25858.pdf.
[96] Will Hoover, *Mayor: Landfill a "terrible problem"*, Honolulu Advertiser, Aug. 29, 2007, *available at* http://the.honoluluadvertiser.com/article/2007/Aug/29/In/hawaii708290431.html.
[97] American Chemistry Council, *Polysytyrene Recycling: Long-term Market Trends, available at* http://www.americanchemistry.com/s_plastics/sec_pfpg.asp?CID=1437&DID=5229.
[98] American Chemistry Council, *Economic Realities of Recycling, available at* http://www.americanchemistry.com/s_plastics/sec_pfpg.asp?CID=1436&DID=5228.
[99] Id.

This is not to say that Styrofoam cannot be recycled, simply that at this time it is not a profitable business model. Nevertheless, recycling of Styrofoam does occur on a very limited and temporary basis.[100] One such example is in the State of Massachussetts Public School System, where foodwaste and polystyrene food trays are separated in the cafeterias and sent to respective locations for recycling.[101]

This is viewed strictly as an intermediate step, since Massachusetts is actively encouraging composting programs across the State, and not Styrofoam or polystyrene recycling.[102] In fact, the State of Massachusetts' Solid Waste Master Plan (June 2006) doesn't even mention polystyrene or Styrofoam once.[103]

To highlight this point, the recycling information sheets provided to the Massachusetts public schools emphasize an eventual preference to use compostable products instead of Styrofoam products[104] in order to reduce disposal costs and achieve greater sustainability[105] because the only role Styrofoam plays in composting efforts, is an adversarial one.[106]

c. Styrofoam produces fuel, but compostables produce better fuel

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[100] Cambridge Public Schools, *Recycling & Waste Procedures*, *available at* http://www.cambridgema.gov/TheWorks/departments/recycle/pdffiles/school_recycling_procedures.pdf.

[101] Botti, Hearing on SCR134, *supra* note 64.

[102] Cambridge Department of Public Works, *Compost that stuff!*, *available at* http://www.cambridgema.gov/TheWorks/departments/recycle/compost_that_stuff.html.

[103] Commonwealth of Massachussetts, Solid Waste Master Plan: Revision 2006, *available at* http://www.mass.gov/dep/recycle/priorities/dswmpu01.htm#swmp

[104] Cambridge Public Schools, *supra* note 100.

[105] Id.

[106] Hearing on HCR192 Before the H. Comm. On Econ. Dev. & Bus. Concerns, 2008 Leg., 25th Sess. (April 4, 2008) (statement of Ron Westmoreland, Regional Manager, Hawaiian Earth Products, *available at* http://capitol.hawaii.gov/session2008/Testimony/HCR192_EDB_04-04-08_.pdf.

The Industry suggests that given Styrofoam's high BTU (fuel value), a concerted effort should be made to focus on collection and diversion of Styrofoam as a valuable energy resource for waste-to-energy facilities.[107] However, when lightweight Styrofoam is compared to heavier bagasse-based Styrofoam alternative products, these alternatives offer nearly twice the overall fuel value[108] and a better burn for higher energy production. [109]

Finally, while the plastics and foodservice industries are staunch supporters of waste-to-energy technologies, in Hawaii, there is only one waste-to-energy facility (HPOWER),[110] located on the island of Oahu, and one currently under consideration for construction on the Big Island at a cost of 125 million dollars.[111]

Hawaii County's proposed waste-to-energy project is a significantly scaled-down operation compared to H-POWER on Oahu.[112] It will process 230 tons of waste per day, diverting approximately 40% of the island's waste-stream from landfill.[113] On the other hand, H-POWER diverts approximately 57% of the island's waste stream from landfill by processing 2000 tons of waste per day.[114] Once capacity at HPOWER is reached, solid waste that cannot be burned is

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[107] Botti, Hearing on SB2001, *supra* note 65.
[108] Hearing on HCR192 Before the H. Comm. On Econ. Dev. & Bus. Concerns, 2008 Leg., 25th Sess. (April 4, 2008) (statement of Mike Elhoff, Partner, Styrophobia, *available at* http://capitol.hawaii.gov/session2008/Testimony/HCR192_EDB_04-04-08_.pdf.
[109] Id.
[110] Boylan, *supra* note 78.
[111] Dayton, *supra* note 77.
[112] Id.
[113] Id.
[114] Id.

dumped back in the landfill together with the 200,000 tons of residual ash produced annually from the incineration process[115]

Waste-to-energy facilities come with an expensive price-tag, and are not sole solutions. They are considered as part of a multi-faceted approach, including recycling and composting, to address the solid waste crisis presently perplexing the State.[116]

Eco-friendly (compostable) alternatives are readily available

There are alternatives to Styrofoam disposable foodservice products.[117] Although a nascent industry, the manufacture, recycling and composting of these Styrofoam alternative products is presently a multi-billion dollar industry[118] with potential for exponential growth.[119] These alternatives are biodegradable, compostable, non-petroleum based products made from readily renewable resources including sugarcane, corn, potato starch, limestone and bamboo.[120]

Presently, it is estimated that anywhere from 30-40%[121] of the waste in landfills is compostable, which includes green waste, food waste and commercial

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[115] Leone, *supra* note 90, (600,000 tons of trash incinerated per year at HPOWER, reducing it to 168,000 tons ash and residue to be buried at Waimanalo Gulch Landfill).
[116] Boylan, *supra* note 78.
[117] WorldCentric, *supra* note 59.
[118] R.W. Beck , U.S. Recycling Economic Information Study, prepared for the National Recycling Coalition, (2001), (noting that 34 billion dollars in annual wages in 2001 of Americans working in recycling, collecting, processing of plastic waste and manufacturing of alternatives), *available at* http://www.epa.gov/jtr/econ/rei-rw/pdf/exe-sum.pdf.
[119] U.S. Environmental Protection Agency, Office of Solid Waste, Characterization of Municipal Waste in the United States: 1998 Update, Report No. EPA530-R-99- 021 (Washington, DC), 1999, Table 9. Citing that in 1998, 5.2 percent of all plastic products produced were recycled.
[120] California Integrated Waste Management Board, *supra* note 95.
[121] California Integrated Waste Management Board, *Market Status Report: Urban Compost & Mulch, available at* http://www.ciwmb.ca.gov/Markets/StatusRpts/compost.htm.

food service ware products. In the State of Hawaii, however, there is only one composting facility,[122] on the island of Oahu, which currently, only processes green waste such as yard clippings and tree trimmings.

This facility is currently seeking approval from the State Department of Health for a permit to expand its operations to include foodwaste recycling[123] and eventually is looking to expand into a commercial composting facility, capable of processing all compostable materials including foodservice products.[124]

It is correct that at the present time, there is no commercial composting facility in the State, and once compostable alternatives are disposed of, they meet the same end as Styrofoam products do, either being incinerated at H-POWER or dumped in the landfill. This situation highlights the ubiquitous chicken or the egg question. In the present situation, one could argue that use of compostable foodservice products should not be encouraged until a commercial composting facility is actually operating in the State,[125] yet on the other hand, composting companies aren't willing to invest the necessary infrastructure capital until they have a dedicated, and larger volume, compostable waste stream.[126]

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[122] Hawaiian Earth Products, *available at* http://www.menehunemagichawaii.com.
[123] Interview with Ron Westmoreland, Regional Manager, Hawaiian Earth Products, in Haw. (April 4, 2008).
[124] Id.
[125] Hearing on HCR192 Before the H. Comm. On Econ. Dev. & Bus. Concerns, 2008 Leg., 25th Sess. (April 4, 2008) (statement of Dick Botti, Exec. Dir., Hawaii Food Industry Assoc., *available at* http://capitol.hawaii.gov/session2008/Testimony/HCR192_EDB_04-04-08_.pdf.
[126] *Supra* note 123

Regardless, however, the City & County of Honolulu is integrating compostable pickups in its island-wide curbside recycling initiative.[127] Thus it appears as though the infrastructure is being laid to promote composting as an effective mechanism to achieve greater waste-stream diversion from the landfills. One fact is uncontested, and that is that Styrofoam only plays an adversarial role in such an effort.[128]

Health concerns

Opponents of a ban on Styrofoam foodservice products contend that Styrofoam is an FDA approved "Generally Recognized as Safe" (GRAS) product,[129] and that there is no reason Styrofoam should be considered a threat to human health. There is, however, cause for concern, given that Styrofoam's GRAS approval is only applicable for its intended one-time disposable use,[130] and not for reheating.[131] This is because the FDA has either not tested or not approved as safe, the product for that purpose[132]

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[127] Honolulu Department of Environmental Services, *Greencycling – Curbside & Drop-off, available at* http://www.envhonolulu.org/solid_waste/Greencycling.htm.

[128] Westmoreland, Hearing on HCR192, *supra* note 106.

[129] Hearing on HB2495 Before the H. Comm. On Energy & Envtl. Prot., 2008 Leg., 25th Sess. (January 29, 2008) (statement of Dick Botti, Exec. Director, Hawaii Food Industry Association, *available at* http://capitol.hawaii.gov/session2008/Testimony/HB2495_EEP_01-29-08_2_.pdf (noting that the product is "Generally Recognized as Safe" (GRAS) by the FDA for consumer use).

[130] Michelle Meadows, *Plastics and the Microwave*, FDA Consumer, Nov.-Dec. 2002, *available at* http://www.fda.gov/fdac/features/2002/602_plastic.html (intended use language hey must be found safe for their intended use before they can be marketed. … consumers should be sure to use any plastics for their intended purpose and in accordance with directions. If you don't find instructions for microwave use, you should).

[131] Meadows, *supra* note 130.

[132] Nancy Ferrari, *Microwaving food in plastic: Dangerous or not?*, Harvard Medical School HEALTHbeat, August 16, 2006, *available at*

Recent studies, however, indicate that when food or liquid is reheated (contrary to its one-time intended use) in Styrofoam containers, leaching of the chemical styrene into the food or liquid being reheated occurs.[133]

Styrene is recognized as a neurotoxin[134] and classified as a possible human carcinogen by the United States Environmental Protection Agency (EPA)[135] and the International Agency for Research on Cancer (IARC).[136] Acute exposure to styrene results in adverse respiratory effects, such as mucous membrane irritation, eye irritation, and gastrointestinal problems.[137] Consequences from chronic exposure include effects on the central nervous system producing headaches, hearing loss, depression, lethargy and peripheral neuropathy. Ingestion may cause convulsions and possible pulmonary edema.[138]

More than just aesthetics

Improper disposal of Styrofoam foodservice products (also known as littering) raises not only aesthetic concerns but also poses a serious threat to wildlife and marine mammals.

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http://www.health.harvard.edu/healthbeat/HEALTHbeat_081606.htm#art1 ("the FDA tests all containers that come in contact with food, but only those labeled microwave safe have been tested and found safe for that purpose").

[133] The Pacific Protection Initiative, SB 899: Toxic Plastic Additives, *available at* http://www.healthebay.org/currentissues/ppi/bills_SB899.asp; U.S. Environmental Protection Agency, Technology Transfer Network, Air Toxics Website, Styrene, *available at* http://www.epa.gov//ttn/atw/hlthef/styrene.html.

[134] U.S. Environmental Protection Agency, Technology Transfer Network, Air Toxics Website, Styrene, *available at* http://www.epa.gov//ttn/atw/hlthef/styrene.html.

[135] Id.

[136] Agency for Toxic Substances and Disease Registry, ToxFAQS for Styrene, *available at* http://www.atsdr.cdc.gov/tfacts53.html.

[137] *Supra* note 134.

[138] Id.

A study in California conducted between 1998 and 2000 found that Styrofoam foodservice products constituted nearly fifteen percent of the litter volume in the State's storm drains.[139] The City of Berkeley, California, for example, found that Styrofoam take-out food packaging constituted the "single greatest source of litter" in their city.[140] Following a ban on polystyrene foam food service ware, Berkeley found very little Styrofoam litter on their streets.[141]

Perhaps more important than the aesthetic concerns of Styrofoam litter is the grave environmental threat the litter poses to surrounding wildlife.[142] Due to its lightweight characteristic, Styrofoam breaks down into smaller and smaller pieces over time. These small, broken down pieces are carried off by the wind and scattered across the surrounding marine and terrestrial environments.[143] Many creatures, including birds, marine mammals and fish, mistake these smaller, broken down pieces of Styrofoam for food, which end up choking them, clogging their digestive systems, and, frequently, causing death.[144]

III. STYROFOAM REGULATIONS ACROSS THE COUNTRY

During the last twenty years, numerous municipalities have enacted some form of regulation or prohibition regarding Styrofoam food service products.[145]

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[139] California Integrated Waste Management Board, *supra* note 95 at 3, 6.
[140] *Supra* note 41.
[141] *San Francisco, Cal., Ordinance 295-06 (Nov. 9th 2006).*
[142] California Integrated Waste Management Board, *supra* note 95.
[143] The Pacific Protection Initiative, *supra* note 133.
[144] Capital Municipal Code, Chapter 8.36.010, Findings and intent, *available at* http://www.ci.capitola.ca.us/capcity.nsf/vlookup/Food%20Packaging%20Ord/$file/Food%20Packaging%20Ord.%20Current%20Ch%208_36%20Attch2.pdf.
[145] Press Release, Office of Senator Liz Krueger, Krueger Introduces Bill Banning Styrofoam Products, *available at* http://www.nyssenate26.com/press_archive_story.asp?id=1347.

Minneapolis, Minnesota,[146] Freeport, Maine,[147] and Suffolk County, New York[148] were among the first cities in the United States to do so.[149] In addition, there are presently three states, New York,[150] California,[151] and Hawaii,[152] along with numerous other municipalities,[153] that are considering enacting legislation to ban Styrofoam foodservice products.

As regulations concerning the use of Styrofoam foodservice products have developed across the country in the last twenty years, there has been only one legal challenge of record,[154] and this challenge ultimately failed.[155] The legal action was brought against the County of Suffolk in upstate New York, which was

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[146] Minneapolis Code of Ordinances, § 204.10 (1990), *available at* http://www.municode.com/Resources/gateway.asp?pid=11490&sid=23.
[147] Town of Freeport Ordinance & Code, Ch. 33, Styrofoam, (1990), *available at* http://www.greenpolicy.us/Freeport,_ME_Styrofoam.
[148] Laws of Suffolk County, New York, Part IV, Ch. 301, Art. II, § 301-7(C) (March 29, 1988) *available at* http://www.mindfully.org/Plastic/Suffolk-Co-NY-Ban.htm
[149] Stephen Maxwell Reck, *The Expanding Environmental Consciousness of Local Government: Municipalities that Have Banned Styrofoam and the Legal Consequences,* 11 U. Bridgeport L. Rev. 127 (1990).
[150] Press Release, Office Sen. Liz Krueger, *Krueger Moves to Bring Bill Banning Styrofoam Products to Floor for Vote of Full Senate, available at* http://www.nyssenate26.com/press_archive_story.asp?id=2126.
[151] A.B. 680, California State Assembly (2007), *available at* http://www.leginfo.ca.gov/pub/07-08/bill/asm/ab_0801-0850/ab_820_bill_20070222_introduced.html.
[152] S.B. 2629, 25th Leg., Reg. Sess. (Haw. 2008); HB2495 H.B. 2495, 25th Leg., Reg. Sess. (Haw. 2008).
[153] Seattle, WA, New York City, NY, Los Angeles, CA, Long Beach, CA, Santa Barbara, CA, San Mateo, CA, Monterey, CA
[154] Society of the Plastics Industry v. County of Suffolk, 77 N.Y.2d 761, 573 N.E.2d 1034 (1991)
[155] Id.

one of the first municipalities to regulate Styrofoam foodservice products in the country.[156]

In Society of the Plastics Industry v. County of Suffolk,[157] the plastics industry challenged an ordinance,[158] aimed at reducing solid waste entering the County landfill.[159] The ordinance banned the use of certain plastics, including Styrofoam foodservice products.[160] The plastics industry argued that these products had been singled out as scapegoats by local governments who were trying to solve the solid waste crisis.[161]

The plastics industry claimed that the Suffolk County Council violated the State Environmental Quality Review Act (SEQRA)[162] (fashioned after the National Environmental Protection Act (NEPA)[163] by failing to conduct an adequate environmental review before passing the plastics law.[164]

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[156] Barbanel, *supra* note 19, ("The Suffolk law and later ones were widely credited with pressuring the plastics industry to address long-neglected environmental concerns").
[157] Society of Plastics Industry, Inc. v. County of Suffolk, 154 A.D.2d 179, 552 N.Y.S.2d 138 (Feb 26, 1990)
[158] Laws of Suffolk County, New York, Part IV, Ch. 301, Art. II, § 301-7(C) (March 29, 1988) *available at* http://www.mindfully.org/Plastic/Suffolk-Co-NY-Ban.htm
[159] 573 N.E.2d 1034, at 1045.
[160] 573 N.E.2d 1034.
[161] Peter Montague, *Suffolk County, NY, Bans Plastic Food Containers – First in Nation*, Rachel's Env. & Health Weekly, May 9, 1988, *available at* http://www.mindfully.org/Plastic/Suffolk-CoNY-Bans-Plastic.htm (noting industry's contention that the Styrofoam foodservice products were the scapegoat, not the problem).
[162] 573 N.E.2d 1034, at 1037.
[163] Reck, *supra* note 149, at 155.
[164] 573 N.E.2d 1034, at 1035.

Though the lower courts nullified the ordinance[165], the Court of Appeals of New York ultimately reversed the lower court's ruling[166] on the basis of standing and dismissed the industry's cause of action.[167] This decision was not appealed, and in the seventeen years since that decision the plastics industry has chosen not to challenge any of the subsequent Styrofoam regulations that have been enacted in numerous other cities across the country.

A survey of enacted[168] and proposed[169] legislation regarding Styrofoam foodservice products reveals certain elements likely applicable to Hawaii, or any other legislative body which is considering the enactment of legislation concerning Styrofoam. While certain municipalities, such as San Francisco, target not only Styrofoam but also all polystyrene-based plastics (including forks, knives, spoons, cups & deli-containers), the following survey examines provisions specific to Styrofoam, only.

In response to the environmental and health concerns raised by Styrofoam, most cities address the issue by first focusing on retail food vendors and restaurants,[170] who use the product extensively for their day-to-day operations. In an effort to offset any potential economic hardship, many municipalities include provisions in their ordinance, which provide specific exemptions[171] for retail

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[165] Society of Plastics Industry, Inc. v. County of Suffolk, 76 N.Y.2d 705, 559 N.E.2d 678, 559 N.Y.S.2d 984 (N.Y. Jul 05, 1990)
[166] 573 N.E.2d 1034, at 1046.
[167] 573 N.E.2d 1034, at 1046.
[168] See Appendix 1
[169] Id.
[170] Id.
[171] Id.

establishments who are unable to procure a readily available alternative or the alternative is simply too expensive for the retail establishment.[172]

Many municipalities, in addition to addressing retail food establishments' use of Styrofoam, seek also to set an example by similarly prohibiting the procurement or use of Styrofoam foodservice products by any agency of, or contractor working for, the local government.[173]

There are a variety of penalties provided by municipalities when a violation of the Styrofoam ordinance occurs. Certain cities impose monetary fines that range from 50 dollars to 500 dollars, while others hold the violator of the ordinance guilty of a misdemeanor infraction. Interestingly, San Francisco estimates an 80 percent compliance rate without having issued a single citation.[174]

Over the last two decades, ordinances regulating Styrofoam foodservice products have been modified and amended in drafting, as various municipalities try to apply that which has worked in one city to their own needs.[175] This can be seen in measures currently being considered by the New York State Legislature and the New York City Council[176] where legislators worked in close consultation with San Francisco's Board of Supervisors[177] incorporating verbatim, provisions from the San Francisco Ordinance, such as public education and certain exemptions, into their own proposed legislation.

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[172] Id.
[173] Id.
[174] Telephone Interview with Julie Bryant, Associate, S.F. Dept. of the Env., in S.F. (Feb. 10, 2008).
[175] Interview with Liz Krueger, Senator, N.Y. State Senate, in N.Y. (Feb. 19, 2008).
[176] Telephone Interview w/ Josh Proulx, Legislative Aide, Office of Sen. Liz Krueger, in N.Y. (Oct. 13, 2007).
[177] Krueger, *supra* note 175.

Similarly, there appears to be a growing trend among municipalities enacting such ordinances to require the agency implementing the ban to compile, create and distribute a list of Styrofoam alternative products, which assists businesses in transitioning and complying with the law.[178]

IV. BANNING STYROFOAM IN HAWAII

Support for protecting the environment is not something new in Hawaii. Protection dates back thirty years to the 1978 Constitutional Convention and the voter approved amendment which granted the State the power to promote and maintain a healthful environment, and prevent excessive demands upon the environment and the State's resources.[179] Over the last few years, Hawaii has experienced public support for measures aimed at protecting the environment.

For example, the success of the Hawaii Deposit Beverage Container Program,[180] which became effective January 1, 2005,[181] places a 5 cent redeemable deposit on plastic, glass and aluminum beverage containers.[182] With approximately 900 million beverage containers sold in Hawaii annually,[183] the State Department of Health, which administers the recycling program, estimates a

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[178] Bryant, *supra* note 174.
[179] HI Const. art. IX § 8.
[180] Hawaii State Department of Health, Hawaii Beverage Deposit Container Program, *available at* http://hawaii.gov/health/environmental/waste/sw/sw/hi5/index.html.
[181] HRS § 342G-101
[182] News Release, Hawaii State Department of Health, Beverage Container Recycling Redemption Rates, May 16, 2006, *available at* http://www.hi5deposit.com/health/about/pr/2006/06-36.pdf.
[183] *Supra* note 180.

70% redemption rate[184] and has collected and recycled nearly two billion containers over the last three years.[185]

Similarly, in November, 2006, public support for protecting the environment was evident, when 82% of the voters in the City & County of Honolulu approved an amendment to the City Charter to mandate a curbside recycling program[186] which is now one of the more substantial environmental initiatives of the City in recent times.[187]

A ban on Styrofoam foodservice products which encourages use of alternative products is a measure which is consistent with the public's expressed desires[188] to protect the environment and promote sustainability by reducing landfill waste. In fact, 61.3% of Hawaii residents even appear willing to pay higher taxes in order to protect the environment.[189]

While there is no definitive solution, it appears that efforts to divert waste from the landfill such as recycling and composting are gaining support. Given that Styrofoam cannot be feasibly recycled,[190] does not biodegrade, and is not compostable,[191] a closer look at this product and its alternatives, is warranted.

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[184] Id.
[185] Diana Leone, *70% of HI-5 containers redeemed, state says*, Honolulu StarBulletin, Feb. 8, 2006, *available at* http://starbulletin.com/2006/02/08/news/story02.html.
[186] Jeff Mikulina, *Making the case for curbside recycling*, Honolulu Advertiser, September 16, 2007, *available at* http://the.honoluluadvertiser.com/article/2007/Sep/16/op/hawaii709160336.html.
[187] Lynda Arakawa, *Honolulu Expanding Curbside Recycling*, Honolulu Advertiser, April 21, 2008, *available at* http://www.honoluluadvertiser.com/apps/pbcs.dll/article?AID=2008804210359.
[188] Id.
[189] Hawaii 2050 Plan, *supra* note 92, at 22.
[190] *Supra* note 98.
[191] Elhoff, Hearing on HCR192, *supra* note 108.

The motivation behind pursuing such a ban is to address the growing concern Styrofoam poses to Hawaii's future for sustainability. There appears to be growing public support for measures that promote sustainability and a balance between economic, social, and environmental priorities.[192] It is not intended to place an additional hardship on Hawaii's industries or small businesses; rather, it is an effort to foster continued discussion and support for environmentally-conscious initiatives that provide consumers with an informed choice about alternatives to promote a more sustainable State.

A. The Styrofoam Bills

Until January, 2008, the Hawaii State Legislature had never formally discussed measures concerning Styrofoam. During the 2008 Regular Session, state legislators considered three separate measures[195] to address the environmental and health concerns raised by the continued use of Styrofoam foodservice ware. All three measures sought to prohibit commercial, non-profit,

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[192] Hawaii 2050 Plan, *supra* note 92, at 14.

[195] H.B. 2495 25th Leg., Reg. Sess. (Haw. 2008), *available at* http://www.capitol.hawaii.gov/session2008/Bills/HB2495_HD1_.pdf; S.B. 2629 25th Leg., Reg. Sess. (Haw. 2008), *available at* http://www.capitol.hawaii.gov/session2008/Bills/SB2629_SD1_.pdf; H.B. 2176 25th Leg., Reg. Sess. (Haw. 2008), *available at* http://www.capitol.hawaii.gov/session2008/Bills/HB2176_.pdf.

and government entities from using Styrofoam products starting January 1, 2010,[196] and encouraged the use of biodegradable, compostable alternative products. [197]

Of the three bills, House Bill 2495 (HB2495) was the most comprehensive, incorporating the elements consistently identified in the survey of Styrofoam legislation across the Country, [198] and tailoring these elements to a Hawaii model. These elements include promoting and ensuring the availability of Styrofoam alternative products in the State, raising public awareness, consumer conscience, and promoting composting as a viable alternative waste-stream diversion.

i. **The availability and need to use alternatives**

Encouraging the use of biodegradable products by state agencies is one of the priority actions and recommendations of the Hawaii 2050 Sustainability Report[202] submitted in January, 2008 to the State Legislature.

Biodegradable alternatives for Styrofoam foodservice products are readily available and affordable, despite contrary contentions by the Industry.[203] The

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[196] H.B. 2495 25th Leg., Reg. Sess. (Haw. 2008), *available at* http://www.capitol.hawaii.gov/session2008/Bills/HB2495_HD1_.pdf.
[197] Id.
[198] *Supra* note 168.
[202] Sustainability Task Force, Hawaii 2050 Sustainability Plan (January, 2008), *available at* http://www.hawaii2050.org/images/uploads/Hawaii2050_Plan_FINAL.pdf.
[203] Botti, Hearing on HCR192, *supra* note 125.

Industry also argues that the alternatives are 200-300% more expensive. However, the numbers used by the Industry are based solely upon a comparison between Styrofoam and paper-based alternatives, and fail to take into consideration alternatives manufactured from renewable plant fibers such as sugar cane bagasse, where the price differential is only between 20-30% more expensive.[204]

Bagasse is the fiber pulp waste product that results when sugarcane stalks are crushed to extract their juices during the manufacturing process.[205] Typically, this waste product is then burned either at the sugar mill to generate electricity or sold to local electric companies for the same purpose.[206] Additionally, business has also developed another use for this waste product by molding the crushed sugarcane fiber at a high temperature and pressure, into various FDA approved products, such as plates, cups and trays,[207] which can withstand temperatures up to 190 degrees Fahrenheit,[208] and can be refrigerated, microwaved, and even frozen.[209]

These bagasse-based alternative products are completely biodegradable in 30-90 days, [210] and are considered environmentally friendly because they are more

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[204] Elhoff, Hearing on HCR192, *supra* note 108.
[205] Packaging Environmental, *Eco-Packaging Solutions, available at* http://packagingenvironmental.co.uk/product-info.htm.
[206] WorldCentric, Biocompostables – Biodegradable Food Service and Packaging Disposable, *available at* http://www.worldcentric.org/bio/index.htm.
[207] Packaging Environmental, *supra* note 205.
[208] WorldCentric, *supra* note 211.
[209] Id.
[210] Id.

sustainable and energy efficient, when compared to paper and polystyrene-based products.[211]

ii. **The economics of these alternatives**

The Hawaii restaurant industry (not including food retailers or packagers) consists of over 3,500 locations and employs more than 82,000 people.[212] A majority of the businesses that make up this industry are considered small businesses[213] which do not have the financial resources of larger businesses to withstand substantial increases in their bottom-line expenditures.[214]

Despite the Industry's contentions that use of Styrofoam alternative products is not economically feasible,[215] several restaurants and businesses[216] around the State of Hawaii have already transitioned or are transitioning to biodegradable products[217] without the impetus of a government mandate.

For example, the Kokua Hawaii Foundation's[218] Plastic Free Haleiwa[219] project brings together community members and business owners in Haleiwa

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[211] Packaging Environmental, *supra* note 205.
[212] Hawaii Restaurant Association, *About Hawaii Restaurant Association, available at* www.hawaiirestaurants.org/about.aspx.
[213] Dan Martin, *Small business here to face high costs, labor shortages and government indifference*, Star Bulletin, Dec. 26, 2004. (in 2004, 97% of the businesses in Hawaii were classified as small businesses).
[214] Interview with Micheal Elhoff, Partner, Styrophobia, in Honolulu, Haw. (Apr. 10, 2008)
[215] Botti, Hearing on HCR192, *supra* note 125.
[216] Styrophobia, *Our Community*, Conscious Restaurants, Organizations & Businesses, *available at* http://stores.styrophobia.com/Page.bok?template=ourcommunity.
[217] Elhoff, *supra* note 215.
[218] Kokua Hawaii Foundation is a 501(c)3 non-profit organization that supports environmental education in schools and communities around the State.
[219] Press Release, Kokua Hawaii Foundation, Plastic free Haleiwa *available at* http://www.kokuahawaiifoundation.org/index.php?id=67.

Town[220] and strives to educate stores, restaurants and patrons on the environmental and health benefits of going Styrofoam-free.[221] These businesses in turn pledge to make a commitment to reduce and ultimately eliminate their consumption and distribution of Styrofoam products.[222] As a result, Haleiwa will be one of the first towns in Hawaii to "go green".[223]

Presently, in comparing the price differential between Styrofoam and bagasse-based alternative products we find that a coffee cup costs two cents more and a plate-lunch container costs an additional nine cents.[224] And there is a reasonable expectation, based on the principles of supply and demand that the price difference between Styrofoam and bagasse-based alternatives will drop as the market demand for bagasse-based products expands.[225]

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[220] Press Release, Kokua Hawaii Foundation, Plastic Free Haleiwa Coalition Members, *available at* http://www.kokuahawaiifoundation.org/index.php?id=69 (Coalition members include: Growing Keiki, Food For Thought, Patagonia, Cholo's, Haleiwa Joe's, Oceans In Glass, Haleiwa Art Gallery, Salon Atlantis, Crank and Carve, The Sand Castle, Paradise Real Estate, Scoop of Paradise, Del's Photo Lab, North Shore Therapeutic Massage, Jack Tyrrel Inc. Realtor, Haleiwa Active Healing, Lisa Carley Skin Care, Silver Moon, The Soap Cellar, Kona's, Twelve Tribe, Art...Is, Cafe Haleiwa, Deep Ecology, Storto's Deli & Sandwich Shop, Bali Moon, Global Creations, Heather Brown, City Councilmember Donovan de la Cruz, Rex Dubiel, teacher and Vice President of the Outdoor Circle, North Shore Chamber of Commerce, NOAA, Sierra Club, Surfrider Foundation, The Green House, Kokua Hawaii Foundation, Styrophobia).

[221] Press Release, Plastic Free Haleiwa *available at* http://www.kokuahawaiifoundation.org/index.php?id=67.

[222] Press Release, Plastic Free Haleiwa *available at* http://www.kokuahawaiifoundation.org/index.php?id=68

[223] Honolulu Weekly, Haleiwa goes plastic free, *available at* http://honoluluweekly.com/cover/2008/01/hawaiis-carbon-footprint (announcing the launch of the Plastic Free Haleiwa campaign.)

[224] Elhoff, *supra* note 215.

[225] Bryant, *supra* note 174

San Francisco is an example of this principle: following enactment of its ban on Styrofoam, the alternative product market exploded and "distributors started popping up out of the woodwork."[229] As a result, distributors had to compete with each other for business, pricing competitively for an edge in this new market.

While an expanded and competitive market is beneficial to the consumer, it is not the only way in which prices for these alternative products can be lowered. Hawaii businesses must import most, if not all of their consumer goods, and bear the high costs of shipping. These shipping costs can be reduced if demand for the bagasse-based alternative products increases because Hawaii distributors will be able to order in larger quantities and reduce their overhead.[230]

iii. **Compostable alternatives represent a new industry for Hawaii**

Hawaii's economy was once built on a booming sugar industry. There is certainly a possibility that these alternative products could be manufactured in-State,[231] reducing the need for import, and also creating a marketable export.

One of the provisions of HB2495, tasks the State Department of Business, Economic Development, and Tourism (DBEDT) to evaluate the feasibility and potential of Hawaii as a manufacturer of Styrofoam alternative products.[232] Such

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[230] Elhoff, *supra* note 215.
[231] Id.
[232] H.B. 2495, 25th Leg., Reg. Sess. (Haw. 2008).

a possibility could introduce a new industry into the State and promote Hawaii's vital agricultural industry and add to its economy.[233]

By using the waste-product (bagasse) from locally grown, harvested, and processed sugarcane, the manufacturing of Styrofoam alternative products within the State becomes a profitable and real possibility.[234] With sugar operations on Kauai and Maui, there is currently enough sugarcane being harvested, and as a result, bagasse produced to meet the State's potential demand for these products, five times over.

Typically, bagasse is sold by sugar operations, to electric utilities for energy, at approximately $60 per ton.[235] Presently, bagasse manufactured foodservice ware commands an asking price of $850 per ton,[236] with an estimated profitability for the manufacturer of over $300 per ton. [237]

The estimated infrastructure investment necessary for such manufacturing to occur is approximately four million dollars[238] with representatives from the sugar industry privately expressing interest in considering such a venture should a statewide ban be enacted.[239]

Interestingly, the New York State Legislature, in considering its ban on Styrofoam foodservice products, is similarly looking at the possibility of

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[233] Hearing on HCR192 Before the H. Comm. On Econ. Dev. & Bus. Concerns, 2008 Leg., 25th Sess. (April 4, 2008) (statement of Ryan Yamane, Representative, Hawaii State Legislature).
[234] Elhoff, *supra* note 215.
[235] Id.
[236] Id.
[237] Id.
[238] Id.
[239] Elhoff, *supra* note 215.

manufacturing Styrofoam-alternative foodservice products in-state.[240] Instead of bagasse, however, they look to manufacturing these products out of potato starch, utilizing their abundant "ugly" potato crop, which is farmed in upstate New York.[241]

B. Public education and awareness is key

San Francisco's Department of the Environment, tasked with implementing their city's ban on Styrofoam, estimates that within nine months of the ban's enactment there was an 80% compliance rate without having issued a single citation.[242] Director Jack Macy attributes this success to the public education campaign his Department undertook before the ban came into effect.[243]

One of the provisions in HB2495 tasked the State Department of Health (DOH) to create and administer a public education campaign to raise awareness.[244] This campaign included development and of a list of alternative products to Styrofoam[245] and to make that list accessible and available to businesses and the general public.[246]

San Francisco introduced its ban with a six month education campaign,[249] which included the development of two mailings to the 6,000 foodservice

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[240] Krueger, *supra* note 175
[241] Id.
[242] Telephone Interview with Jack Macy, Director, S.F. Dept. of Env., in S.F., Cal. (Feb. 12, 2008).
[243] Id.
[244] H.B. 2495, 25th Leg., Reg. Sess. (Haw. 2008).
[245] Id.
[246] Id.
[249] Macy, *supra* note 244.

establishments in the city,[250] and six foodservice product events across the city[251] which provided information and enabled the public and businesses to ask questions, obtain answers, and become aware of the many available Styrofoam alternatives.[252]

In addition to the mailings and public information events, the San Francisco Department of Environment also compiles, regularly updates, and makes readily accessible, an exhaustive list[253] of available Styrofoam alternative products for businesses, as required by the enacting ordinance.[254]

While there is no state government agency in Hawaii that has exclusive authority over environmental matters, the Hawaii State Department of Health (DOH) is the appropriate agency to oversee implementation of a ban on Styrofoam foodservice products and the administration of a public education campaign.[255]

While concerns have been raised that DOH does not have the necessary resources to administer such a campaign,[256] the example set by San Francisco highlights an implementation effort undertaken with zero monies appropriated from the government to implement the ban using an extensive corps of volunteers

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[250] Id.
[251] Id.
[252] Id.
[253] San Francisco, Compostable Foodware List, *available at* http://www.sfenvironment.com/foodservice/FoodWare031407.pdf
[254] *Supra* note 141.
[255] DOH's mission is to protect and improve the health and environment for all people in Hawai`i. DOH already performs inspections in every location that handles or deals with food. DOH administers the Environmental Response Revolving Fund, a possible funding mechanism for implementing a ban.
[256] Hearing on SB2629 Before the S. Comm. On Energy & Env., 2008 Leg., 25th Sess. (February 5, 2008) (statement of Chiyome Fukino, Director, Hawaii State Department of Health, *available at* http://capitol.hawaii.gov/session2008/Testimony/SB2629_ENE_02-07-08.pdf.

who played a critical role in the campaign by going door-to-door talking to businesses and providing information.[257]

San Francisco has had city-wide curbside recycling for well over a decade[258], and is considered one of the more environmentally conscious cities in the Country.[259] Their efforts to educate and inform the public offer an outstanding example of where Hawaii should begin to tout the value of its ban on styrofoam foodservice ware in order to earn the public's support of this program.

C. There is funding and support for implementation

Though San Francisco implemented its ban on Styrofoam foodservice products with no dedicated appropriation from the government,[260] it is highly unlikely a ban in Hawaii could be successfully implemented, statewide, without funding.[261] It is estimated that funding to implement such a ban would cost approximately $200,000.[262]

Fortunately, given the tight fiscal constraints on the State Budget, the money, need not come from the State's General Fund because the Hawaii State Legislature has established the Environmental Response Revolving Fund (ERRF), codified at Hawaii Revised Statutes § 128 (d)(2).[263]

Funding for the ERRF is generated primarily through the environmental

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[257] Macy, *supra* note 243.
[258] California Integrated Waste Management Board, *Case Study: San Francisco Fantastic Three Program, available at* http://www.ciwmb.ca.gov/LGLibrary/Innovations/Curbside/CaseStudy.htm
[259] Popular Science, America's 50 Greenest Cities, *available at* http://www.popsci.com/environment/article/2008-02/americas-50-greenest-cities?page=1.
[260] Macy, *supra* note 243.
[261] Fukino, Hearing on SB2629, *supra* note 257.
[262] Macy, *supra* note 243
[263] H.R.S. § 128D-2

response tax of 5 cents per petroleum barrel.[264] The ERRF is administered by Hawaii State Department of Health (DOH) and required by statute to have, at any point in time, not less than $3,000,000 and not more than $20,000,000.[265]

The ERRF's primary purpose is to make funds available to be expended for preparedness and emergency response actions[266] to environmental crises such as oil spills.[267] The fund may also be used, to support environmental[268] and natural resource[269] protection programs, and to address concerns related to solid and hazardous waste.[270]

A ban on Styrofoam foodservice products constitutes such an environmental protection program to address the solid waste crisis[271] presently facing the State of Hawaii, by attempting to reduce the volume of non-biodegradable materials entering the landfill. As such, funds from the ERRF may be appropriated to support this effort, which includes funding for the administration of the ban, together with the creation and implementation of a state-wide education campaign to raise public awareness and support.

Similarly, as was done in San Francisco,[272] DOH can look to individuals, organizations and groups within the State to volunteer and assist in this public

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[264] H.R.S. § 243-3.5
[265] H.R.S. § 128D-2
[266] H.R.S. § 128D-2(b)
[267] H.R.S. § 128D-2(b)(1)
[268] H.R.S. § 128D-2 (b)(2)
[269] Id.
[270] Id.
[271] Boylan, *supra* note 77.
[272] Macy, *supra* note 243

education effort,[273] in addition to funding from the ERRF. In doing so, DOH need look no further than to solicit the more than 1,000 individuals[274] from across the State that chose to have their voices heard and participate in the process, by supporting the Styrofoam measures considered by the 2008 Legislature.

V. A MANDATE FOR ACTION

Our Hawaii State government is obligated to uphold and act in accordance with the Hawaii Constitution, which articulates and provides for the protection of our environment. The Hawaii State Constitution grants the State "the power to promote and maintain a healthful environment, including the prevention of any excessive demands upon the environment and the State's resources."[275]

As a result of the 1978 Constitutional Convention, protecting Hawaii's environment became a constitutional mandate.[276] The Legislature has the power and ability to address the landfill crisis facing the State, and, similarly, to address the broader question of whether the demands placed on the environment by Styrofoam products are necessary and avoidable.

During the 1970s, Hawaii was considered a pioneer in long-range planning, [277] having one of the first planning documents in the nation that

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[273] Over the course of six weeks, over 1000 individuals expressed support either through testimony or letters of support for the Styrofoam bills (HB2495, SB2629) before the 2008 Legislature.

[274] Stop Styrofoam Hawaii, Petition, *available at* http://stopstyrofoamhawaii.org/signers/show.

[275] HI Const. art. IX § 8.

[276] On November 7, 1978, amendments to the Constitution proposed by the Constitutional Convention of 1978 were presented to the electorate for its approval. The electorate approved the amendment concerning the State's responsibility in preserving a healthful environment.

[277] Hawaii 2050 Plan, *supra* note 92, at iii.

integrated far-reaching policies concerning the economic, social and environmental future of the State.[278]

In 2005, Governor Linda Lingle signed Act 8 of the Special Sessions Laws of Hawaii into law.[279] It provides for the development of a sustainability plan to address the vital needs of Hawaii through the year 2050.[280] As a result, the Hawaii 2050 Sustainability Task Force (Task Force)[281] was created to develop a new long-term plan for the State, the first in over 30 years.

In doing so, the Legislative and Executive branches of the State government affirmed their belief that government is responsible not only for resolving daily pressing issues and public needs, but also for providing guidance and assurance relating to the preferred future of the State.[282]

The work of the Task Force has proved to be one of the most comprehensive and inclusive planning processes in Hawaii's history,[283] involving over 10,500 participants through summits, forums, public opinion polls and candid feedback from Hawaii's leaders.[284]

Ultimately, the Task Force concluded that the majority of people in Hawaii want an approach to Hawaii's future, which balances economic, social and environmental interests.[285] The task force recognized the threat to Hawaii's fragile environment as a pressing issue to be addressed[286] and drafted a long-term

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[278] Id.
[279] *Supra* note 28.
[280] Hawaii 2050 Plan, *supra* note 92, at 5.
[281] *Supra* note 28.
[282] Id.
[283] Hawaii 2050 Plan, *supra* note 92, at 1.
[284] Hawaii 2050 Plan, *supra* note 92, at 68.
[285] Hawaii 2050 Plan, *supra* note 92, at iv.
[286] Hawaii 2050 Plan, *supra* note 92, at 5.

action agenda to achieve sustainability for Hawaii,[287] noting the need to change social behavior[288] and educate Hawaii's people on the value and necessity of sustainability.[289]

The Task Force defined sustainability[290] by identifying the following guiding principles: (i) meeting the needs of the present without compromising the ability of future generations to meet their own needs, and, (ii) respecting and living within the natural resources and limits of our islands. [291] Living sustainably, the Task Force noted, is part of our daily practice in Hawaii, and Government must lead and set an example.[292] Government actions and policies will have a dramatic bearing on whether or not Hawaii's sustainable future is attained.[293] The Task Force noted that buying biodegradable products is one such policy action.[294]

As a result of the work of the Task Force, the Hawaii 2050 Sustainability Plan (Plan) was submitted to the Legislature in January 2008. The Plan highlighted certain strategic items (priority actions) to be addressed immediately, to kick-start Hawaii's sustainability process.[295] The target date by which these priority actions must be accomplished is the year 2020.

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[287] Hawaii 2050 Plan, *supra* note 92, at 9.
[288] Id.
[289] Id.
[290] Hawaii 2050 Plan, *supra* note 92, at 11.
[291] Hawaii 2050 Plan, *supra* note 92, at 13.
[292] Hawaii 2050 Plan, *supra* note 92, at 16.
[293] Id.
[294] Id.
[295] Hawaii 2050 Plan, *supra* note 92.

These priority actions include: **1)** reducing reliance on fossil fuels;[296] **2)** increasing production and consumption of local agricultural products.[297] **3)** increasing recycling, reuse and waste reduction strategies;[298] **4)** developing a more diverse and resilient economy;[299] and **5)** developing a sustainability ethic.[300]

A ban on Styrofoam foodservice products is consistent with these priority actions:

1) Being a petroleum-based product, continued use of Styrofoam foodservice products does not diminish our dependence upon fossil fuels, given the millions upon million of barrels of oil required to sustain the Styrofoam demand for the U.S.[301] In addition, the possibility of manufacturing environmentally-friendly foodservice products, in-state, will reduce our dependence upon importation of these daily necessities, and in turn, the amount of fossil fuels used in transporting them.

2) As the market for environmentally-friendly foodservice products continues to grow, so does the very real possibility for the birth of a new industry in the State that is rooted in our local agriculture, which utilizes local labor and resources, and manufactures a product, which will be consumed in the State.

3) Composting is being pursued by the City & County of Honolulu[302] as part if its landfill waste diversion and reduction efforts.[303] Encouraging the use of alternative compostable products to replace Styrofoam in the waste stream will

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[296] Hawaii 2050 Plan, *supra* note 92, at 62-68.
[297] Id.
[298] Id.
[299] Id.
[300] Id.
[301] Elhoff, *supra* note 215.
[302] Honolulu Department of Environmental Services, *supra* note 127.
[303] Boylan, *supra* note 77

greatly benefit these efforts.[304] With an estimated 30-40% of our landfill filled with compostable materials[305] diversion of compostable materials to a commercial composting facility is a tremendous strategy to pursue.[306]

In the meantime, the Legislature appears to gradually take steps in the right direction. Whereas during the 2008 Regular Session the Legislature adopted Senate Concurrent Resolution 134, which encourages the Department of Education (DOE) to utilize compostable foodware products[307] and urges DOE to develop and implement foodware and foodwaste recycling programs through composting.[308]

4) Difficult economic times has forced the shutdown of companies[309] and the layoff of a great number of employees across the State.[310] The growth of a biodegradable product market posits the possibility that two new industries, commercial composting and biodegradables manufacturing could diversify the economy and revitalize a portion of the economy by promoting new technologies and a new market.

Similarly, the actions of the State Senate in adopting Senate Resolution 78

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[304] Westmoreland, Hearing on HCR192, *supra* note 106.
[305] *Supra* note 121.
[306] Boylan & Dayton, *supra* note 78
[307] S.C.R. 134, 25th Leg., Reg. Sess. (Haw. 2008), *available at* http://www.capitol.hawaii.gov/session2008/Bills/SCR134_HD1_.pdf.
[308] Id.
[309] E.g., Rick Daysog, *Aloha Airlines shuts down cargo operations*, Honolulu Advertiser, April 28, 2008, *available at* http://www.honoluluadvertiser.com/apps/pbcs.dll/artikkel?Dato=20080428&Kategori=BREAKING03&Lopenr=80428053&Ref=AR&Show=0; Andrew Gomes, *Molokai Ranch to close, lay off 120*, Honolulu Advertiser, March 25, 2008, *available at* http://www.honoluluadvertiser.com/apps/pbcs.dll/article?AID=/20080325/NEWS01/803250367/1001/NEWS01.
[310] Id.

during the 2008 Regular Session, promotes continued discussion of these two possibilities, by requesting the State Department of Business, Economic Development & Taxation (DBEDT) to conduct a comparison study of the recyclability, compostability, and biodegradability of styrofoam alternative products, along with the availability of disposal methods for each product.[311]

5) This is perhaps the most challenging of the priority actions in that developing an ethic of sustainability requires individuals and businesses to deliberately change their daily habits and customary practices. This type of change takes time and patience, but as awareness grows, an ethic of sustainability can be attained and more importantly maintained.

The 2050 Sustainability Plan is a work in progress, and will continue to be discussed and developed over the next 18 months.[312] In the meantime, through gradual steps, such as urging communities and businesses around the State to voluntarily adopt sustainable practices[313] or encouraging our public schools to implement sustainability into their daily routine,[314] our elected representatives should continue to promote the growth and development of this ethic of sustainability.

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[311] S.R. 78, 25th Leg., Reg. Sess. (Haw. 2008), *available at* http://www.capitol.hawaii.gov/session2008/Bills/SR78_SD1_.pdf.
[312] S.B. 2833, 25th Leg., Reg. Sess. (Haw. 2008), *available at* http://www.capitol.hawaii.gov/session2008/Bills/SB2833_CD1_.pdf.
[313] S.R. 78, *supra* note 312.
[314] S.C.R. 134, *supra* note 308.

VI. CONCLUSION

Styrofoam poses a serious threat to our environment and a potential threat to human health. There are affordable alternatives available, and banning Styrofoam is consistent with Hawaii's plan for a sustainable future. It will take government encouragement and leadership to protect Hawaii's environment and to promote a greater awareness among its People to embrace an ethic of sustainability.

This report has examined arguments both in support and in opposition to a possible ban on Styrofoam foodservice product. It has reviewed what various legislative bodies across the Country have done, or are considering doing, to address the Styrofoam issue. In fact, the threat posed by Styrofoam upon our environment and health cannot be ignored. Banning Styrofoam needs to continue to be discussed and debated in public forums, and, ultimately a compromise for sustainability needs to be reached.

APPENDIX 1: Enacted & Proposed Styrofoam Regulations

State	Municipality	Effect	Retail Food[326]	Government Agencies[327]	Government Contract[328]	Exempt[329]
NY	Suffolk Co	03/88	☒	☐	☐	☒
CA	Carmel	01/89	☒	☐	☐	☒
CA	Sonoma Co	06/89	☐	☒	☒	☐
ME	Freeport	01/90	☒	☐	☐	☐
OR	Portland	01/90	☒	☐	☒	☐
CA	Berkeley	01/90	☒	☒	☒	☐
MN	St. Paul	04/90	☒	☐	☐	☒
MN	Minneapolis	01/91	☒	☐	☐	☐
CA	San Clemente	03/04	☐	☒	☒	☐
CA	San Juan	04/04	☐	☒	☒	☐
CA	Laguna Woods	05/04	☐	☒	☒	☐
CA	Aliso Viejo	06/04	☐	☒	☒	☐
CA	Huntington Beach	01/05	☐	☒	☒	☒
CA	Malibu	09/05	☒	☒	☒	☒
CA	Emeryville	03/06	☒	☒	☒	☒
CA	Oakland	06/06	☒	☒	☒	☒
CA	Capitola	12/06	☒	☒	☒	☒
CA	Santa Monica	12/06	☒	☒	☒	☒
CA	Calabasas	02/07	☒	☒	☒	☒
CA	San Francisco	06/07	☒	☒	☒	☐
CA	Alameda	01/08	☒	☐	☐	☒
CA	Santa Cruz	01/08	☒	☐	☐	☐
CA	Millbrae	01/08	☒	☒	☒	☒
CA	Laguna Beach	07/08	☒	☒	☒	☒
CA	Fairfax		☒	☒	☒	☐
WA	Seattle	propos	☒	☒	☒	☐
NY	New York	propos	☒	☒	☒	☐
CA	Los Angeles	propos	☒	☒	☒	☒
CA	Los Angeles County	propos	☒	☒	☒	☐
CA	Long Beach	propos	☒	☒	☒	☐
CA	Santa Barbara	propos	☒	☒	☒	☒
CA	San Mateo	propos	☒	☒	☒	☒
CA	Monterey	propos	☒	☒	☒	☒
NY	New York	propos	☒	☒	☒	☐
HI	Hawaii	propos	☒	☒	☒	☐
CA	California	propos	☒	☒	☒	☐

[327] Ban applicable to retail food establishments
[327] Ban applicable to Government agencies and offices
[328] Ban applicable to Government contractors
[329] Whether there are exemptions provided for the Ban

SB620
Submitted on: 2/4/2013
Testimony for ENE/CPN on Feb 7, 2013 14:45PM in Conference Room 225

Submitted By	Organization	Testifier Position	Present at Hearing
Marjorie Zieglerm		Support	No

Comments:

SB620
Submitted on: 2/6/2013
Testimony for ENE/CPN on Feb 7, 2013 14:45PM in Conference Room 225

Submitted By	Organization	Testifier Position	Present at Hearing
Aimee Stiner	Individual	Comments Only	No

SB620
Submitted on: 2/6/2013
Testimony for ENE/CPN on Feb 7, 2013 14:45PM in Conference Room 225

Submitted By	Organization	Testifier Position	Present at Hearing
Lisa Franklin	Individual	Support	No

Comments: Please, let us move forward as an island of sustainability. Styrofoam is not the answer...

SB620
Submitted on: 2/7/2013
Testimony for ENE/CPN on Feb 7, 2013 14:45PM in Conference Room 225

Submitted By	Organization	Testifier Position	Present at Hearing
chris kobayashi	Individual	Support	No

Comments:

SB~~619~~620
Submitted on: 2/7/2013
Testimony for ENE/CPN on Feb 7, 2013 14:45PM in Conference Room 225

Submitted By	Organization	Testifier Position	Present at Hearing
Harvey Arkin	Individual	Support	No

Comments: aloha, Passing SB 620 will help us live in better balance with the 'Aina.
Thank you

Adopting sustainable practices, and in particular, reducing deleterious marine debris, is imperative for Hawaii, where the ocean is an essential part of both culture and economy.

My name is Cameron Fumar, I am a Research Associate for the University of Hawaii Oceanography Department and I support Bill SB620.

I spend my life in, on, and near the ocean. I dedicate much of my time picking up marine debris every day and have noticed an alarming amount of EPS foam (Styrofoam) washing up on our shores.

The passing of SB620 is crucial to the reduction of waste accumulated throughout the State of Hawaii and around the World. As an avid ocean-goer, I regularly see pieces of EPS foam floating in the water, being tossed about the sand in the wind, and being lodged in the rocks and the plants that line the ocean. Due to the light weight properties of EPS foam, it is easily blown into the environment. As an increasing amount of this is ending up on our beaches, it is imperative that Hawaii be a leading force in it's regulation.

There are many threats to humans and our environment when using EPS foam. Toxic chemicals are leached out of EPS foam as the degrade such as Styrene, a known carcinogen. This causes two main concerns, that for the animals in the ocean which ingest EPS foam and that for humans as more of this EPS foams enters our environment.

Please, for the sake of the people of Hawaii, all ocean lovers around the World, the animals which inhabit the ocean, and the shorelines of the Pacific, pass Bill SB620 and make Hawaii a leading force in the reduction of EPS foam in the environment.

Thank you,

Cameron Fumar

SB620
Submitted on: 2/7/2013
Testimony for ENE/CPN on Feb 7, 2013 14:45PM in Conference Room 225

Submitted By	Organization	Testifier Position	Present at Hearing
janice palma-glenie	Individual	Support	No

Comments: as with SB619, this bill will go a long way to help protect our islands environmentally and economically by preventing the need to create space in our landfills for so much avoidable waste. mahalo.

February 7, 2013

Senate Committee on Energy and Environment

Senate Committee on Commerce and Consumer Protection

Hearing Date: Thursday, February 7, 2013 at 2:45 p.m.

Re: Senate Bill 620 Relating to the Environment

Chairs Baker and Gabbard, and Members of the Committees on Commerce and Consumer Protection, Energy and Environment, thank you for the opportunity to testify on Senate Bill 620, Relating to the Environment.

I am in support of Senate Bill 620 because I believe that Hawaii needs to take the lead in protecting our oceans from harmful debris, and must reduce exposure to the harmful chemicals in the products in use in our environments. I believe the research is clear that the use of styrene plastic products is a destructive practice and I urge you to require the use of safer products.

Thank you for the opportunity to testify.

Kathleen Reinhardt
5412 Poola Street
Honolulu, Hawaii

February 5, 2013

To: Committee on Energy and Environment
Senator Mike Gabbard, Chair
Senator Russell E. Ruderman, Vice Chair

Committee on Commerce and Consumer Protection
Senator Rosalyn H. Baker, Chair
Senator Brickwood Galuteria, Vice Chair

100 form letters signed by 100 individuals

RE: SB 619 and SB 620 Relating to the Environment

POSITION: IN OPPOSITION

I strongly oppose these measures because the reasons for which they are being promulgated do not support various studies and facts about using the alternative to polystyrene products.

The measures advocate for the use of compostable products. As of now, we do not have a composting facility. Both polystyrene and compostable alternatives will not biodegrade in our current landfills. The utilization of more costly alternative packaging mostly manufactured overseas will result in a much larger carbon footprint for the islands.

If our concern is the trash seen on beaches, parks and other places, then the answer should be to educate our citizens on a responsible, useful and intelligent disposition of our trash, especially the polystyrene food containers. Please note that foam provides the highest BTU (18 BTU) for H Power. Since we just expanded the capacity of the H Power plant, banning polystyrene will deprive Oahu's waste to energy program of a valuable source of energy conversion. A bigger question is why are all plastics being diverted to landfills instead of H Power, where they will be converted into useful energy?

There are advantages to using foam. Foam consists of 90% air. Less than 10% is actual material cost. This is a high yielding product that has a low cost base and can be internally recycled at almost 100% rate. Sanitation is another key reason why foam was created. It keeps food clean and insulated and helps prevent spoilage. Bacteria grow quickly, especially in tropical temperatures here in Hawaii. In today's age, we are faced with an ever escalating problem of dealing with antibiotic resistant bacteria. Doing away with a packaging product that has served us well for over 50 years does not make sense.

Finally, a large majority of the polystyrene food packaging utilized in the State of Hawaii is manufactured by a local plant in Kalihi contributing to the local economy and supporting Hawaii's sustainability. Banning polystyrene will result in the closure of this plant and the lay-offs of nearly 100 workers many of whom are hard-working immigrants who have become citizens of the United States and are full contributing members of our community.

For all of these reasons, I strongly urge you to hold this bill.

Thank you for your time.

Sincerely yours,

Mel Ancheta — M Anchita

Printed Name