DART
QUALITY PLASTIC PRODUCTS

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OF CALIFORNIA

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August 5, 2014

VIA E-MAIL

Jeanine Townsend, Clerk to the Board
State Water Resources Control Board
1001 I Street, 24th Floor
Sacramento, CA 95814
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Re: Comments on State Water Resources Control Board's draft staff report, including the draft substitute environmental documentation, for the draft <u>amendments to statewide water quality control plans to control trash</u>

Dear Board Members of the State Water Resources Control Board:

Dart Container Corporation of California ("Dart") is submitting the attached comments on the proposed Draft Amendments to Statewide Water Quality Control Plans to Control Trash.

Dart is a leading manufacturer of a broad range of quality single-use food service products. Our products are affordable, recyclable, and environmentally responsible. We are committed to environmental stewardship and strive to produce high-quality, cost-effective products in a manner that is sensitive to environmental concerns. From the lighting fixtures in our offices to the technologies on our factory floors, we scrutinize every element of our business for ways to reduce energy consumption, air emissions, and solid wastes.

Dart encourages polystyrene recycling by offering free public drop-off recycling sites at Dart facilities, where we accept foam food service and packaging containers from members of the public, regardless of the origin of that foam. Dart also helps our customers recycle foam through our CARE program, which enables customers to separate foam for recycling more easily, and our Recycla-Pak program, which helps businesses recycle foam cups. As a result of Dart's efforts to promote recycling, we were recognized in 2010 and 2011 with the prestigious CalRecycle WRAP (Waste Reduction Award Program).

Reducing trash in California's waterways is an important priority, and we are committed to doing our part to keep trash out of water. Unfortunately, the draft trash amendments will undermine this important priority by promoting "regulatory source controls" or product bans. Product bans are not effective in reducing trash from the waterways--experts show that bans simply replace one type of trash with another without reducing overall trash. In addition, bans can cause significant unintended environmental and economic consequences. We encourage the State Board to revise the trash amendments to remove their reliance on product bans, and to require proven, effective means of trash reduction.

Our comments are supported by the attached documents and expert reports, which we incorporate by reference into our comments. We thank you for considering our comments and supporting materials. If you have questions, you may reach me at (949) 262-3255 or Jonathan.Choi@dart.biz.

Sincerely yours,

/s/ Jonathan R. Choi

Jonathan R. Choi
Regional Manager, Western Region
Government Affairs & Environment

Enclosure
Attachments

COMMENTS ON STATE WATER RESOURCES CONTROL BOARD'S

DRAFT SUBSTITUTE ENVIRONMENTAL DOCUMENTATION AND DRAFT AMENDMENTS TO STATEWIDE WATER QUALITY CONTROL PLANS TO CONTROL TRASH

Submitted by

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EXECUTIVE SUMMARY

Bans of polystyrene foam and other single-use consumer products do not reduce overall trash and do cause significant unintended environmental impacts. Despite this, the proposed trash amendments encourage such bans—allowing permittees under municipal separate storm sewer system ("MS4") permits to adopt bans as "regulatory source controls," claim that the bans are reducing trash in receiving waters, and invest less in proven methods of trash reduction. Similarly, under an option for the State Water Resources Control Board's ("State Board") consideration, by adopting product bans, MS4 permittees would be allowed up to a three-year extension to comply with the trash amendments.

Unless the State Board amends the proposed trash amendments to eliminate the provisions encouraging MS4 permittees to adopt product bans, the proposed trash amendments will be ineffective at reducing trash in the receiving waters and counter-productive. And they will violate several federal and state laws regarding the protection of water quality. The key legal and technical problems with the proposed trash amendments are as follows:

♦ **The proposed trash amendments encourage and rely on product bans.** The staff report calls product bans one of the "most likely measures" that MS4 permittees will employ to comply with the trash amendments.[1] As described below, experts in municipal governance agree with this conclusion. The proposed trash amendments are very likely to cause at least some MS4 permittees—and likely many permittees—to adopt product bans.

♦ **The proposed trash amendments fail to account for the substitution effect.** Data on polystyrene foam bans show that bans do not reduce overall trash but simply result in the substitution of non-banned products for banned products.

♦ **The proposed trash amendments fail to account for the potential unintended environmental and economic consequences of bans.** Polystyrene foam—one of the key products targeted for bans under the proposed trash amendments—has life-cycle advantages over substitute products. Thus, bans of polystyrene foam will result in greater energy use, pollutant emissions, and water use. In addition, foam is recyclable, and bans will undermine California's ability to meet its aggressive recycling goals. Similarly, bans will impose unintended costs on California consumers, local governments, hospitals, schools, and taxpayers.

♦ **The proposed trash amendments violate state and federal law.** By encouraging MS4 permittees to adopt ineffective product bans instead of investing in proven trash-reduction methods, the proposed trash amendments violate state and federal laws:

- **The California Environmental Quality Act.** Bans can have significant environmental impacts. Yet the staff report fails to analyze these impacts, alternatives to Track 2 that do not encourage product bans, or mitigation measures.

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[1] State Water Resources Control Board, *Draft Staff Report Including the Draft Substitute Environmental Documentation, Draft Amendments to Statewide Water Quality Control Plans to Control Trash*, at 83 (June 2014) [hereinafter *Staff Report*].

- **The Clean Water Act**. By allowing MS4 permittees to rely on bans, the trash amendments violate the "maximum extent practicable" standard that the Clean Water Act imposes on MS4 permittees and the anti-degradation policy. The trash amendments also fail to require adequate monitoring of the effectiveness of Track 2.

- **The Water Code**. The trash amendments fail to comply with the Porter-Cologne Act's substantive requirements, including requirements that implementation measures be "appropriate" and "necessary" and requirements for effective compliance monitoring.

♦ **The proposed trash amendments improperly assert product regulatory authority.** The State Board's mandate to protect water quality does not include general authority to regulate products or individual consumer choices or individual actions before a discharge occurs or before a particular product becomes a "waste." By encouraging bans, the State Board is exceeding its authority.

Product bans are ineffective at removing trash from the receiving waters and they cause unintended environmental and economic harms. Accordingly, the State Board should revise the trash amendments to eliminate their reliance on regulatory source controls, to provide no extension for MS4 permittees that adopt regulatory source controls, and to explicitly prohibit MS4 permittees from relying on regulatory source controls as a measure to meet the water quality objective for trash.

I. BANS ARE INEFFECTIVE AT REDUCING TRASH IN THE RECEIVING WATERS AND CAN HAVE SIGNIFICANT ENVIRONMENTAL AND ECONOMIC CONSEQUENCES

A. Bans are not an effective way to reduce overall trash

Product bans result in product substitution with no reduction in overall trash. Data from the City of San Francisco's street litter audits before and after the city adopted a polystyrene foam ban show this substitution effect.[2] Data from Santa Cruz corroborates this substitution effect: a ban on foam changed the composition of trash collected on beaches, but "total mass of trash on the beach [] remained relatively constant since a ban was enacted in 2007 and enforced in 2008."[3] This substitution effect means that "if one particular type of container, bag or food ware is banned (i.e., plastic/polystyrene) whatever material takes its place will in all likelihood be discarded and introduced into the storm drain[.]"[4]

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2 Dr. Mark Grey, *Proposed Polystyrene Foam Food Ware Ban in San Jose Will Not Reduce Trash Loads in Storm Drains and Receiving Waters*, at 2 (Aug. 2013) [hereinafter *2013 Grey Technical Report*]. The *2013 Grey Technical Report* is attached hereto as **Exhibit 1.**

3 *Id.*

4 Michael Harding, *Comments on Bay Area Stormwater Management Agencies Association's Preliminary Baseline Trash Generation Rates for San Francisco Bay Area MS4s and Trash Load Reduction Tracking Method* (Mar. 2012) [hereinafter *Harding Report*]. The *Harding Report* is attached hereto as **Exhibit 2**.

Other agencies in California agree that the substitution effect occurs and that bans are generally ineffective in reducing total litter and trash. For instance, in a 2004 report commissioned by the Legislature, the California Integrated Waste Management Board (CalRecycle's predecessor agency) made the following findings regarding the efficacy of polystyrene foam bans:

- Single-product "[b]ans are narrow in scope, addressing a very specific problem with a very specific solution. This narrow approach is an ineffective means of addressing a material with the global applications and ramifications of plastics";[5]

- Bans are "not an effective long-term solution";[6]

- "[U]sing biodegradable food service products alone"—as might result from a ban—"will not eliminate litter problems"; indeed, "[s]ome have argued that it may even increase litter if consumers believe that it no longer poses an environmental problem".[7]

More recently, in 2008, the Department of Toxic Substances Control ("DTSC") came to a similar conclusion as CalRecycle. In its final report on the California Green Chemistry Initiative, DTSC recognized "[p]oorly conceived actions like bans that do not consider alternatives and often create new problems when substitutions are made" as one of the obstacles effectively addressing California's waste.[8]

B. Foam is environmentally beneficial, and encouraging bans will cause significant environmental and economic impacts

1. Foam has substantial environmental benefits

Bans of certain products—including polystyrene foam—will have significant environmental impacts. This is because foam has less environmental impacts over its lifecycle than the products that will replace it. These impacts include:

- Increased energy consumption—the life-cycle of foam containers consumes less energy than that of alternative products;[9]

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5 California Integrated Waste Mgmt. Bd., *Use and Disposal of Polystyrene in California*, at 6 (Dec. 2004) [hereinafter *CalRecycle 2004 Report*]. The *CalRecycle 2004 Report* is attached hereto as **Exhibit 3**.

6 *Id.*

7 *Id.*

8 Cal. EPA & DTSC, *California Green Chemistry Initiative Final Report*, at 2 (Dec. 2008). The *California Green Chemistry Initiative Final Report* is attached hereto as **Exhibit 4**.

9 Dr. Mark Berkman & Dr. David Sunding, The Brattle Group, *Comments on the Draft Amendments to Statewide Water Quality Control Plans to Control Trash*, at 17 (Aug. 2014)

- Greater greenhouse gas emissions—the life-cycle of foam containers generates lower greenhouse gas emissions;[10] and

- Increased water use—the life-cycle of foam containers consumes less water.[11]

Certain bans, such as foam bans, would also have an adverse impact on recycling in California.[12] Foam is readily recycled across California and the country.[13] For example, Dart Container Corporation has spearheaded recycling initiatives for both individuals and large end-users of foam. As of June 2014, Dart had sold several thousand Recycla-Paks, which allow customers to purchase a corrugated container from Dart that serves as a foam cup collection device as well as a shipping container.[14] And as noted by economists, there is a viable market for recycled foam.[15]

Finally, Track 2's focus on encouraging bans could cause new impacts on the marine environment. Foam—one of the common targets of local government bans—is not a major contributor to plastic debris in the ocean.[16] Moreover, studies do not show foam to be a hazard to marine life.[17] And the bans that the trash amendments encourage will cause other environmental impacts, including potentially increased greenhouse gas emissions, with the potential to impact the oceans "in far more profound ways than marine debris does . . . ."[18]

[hereinafter, *2014 Brattle Group Report*]. The *2014 Brattle Group Report* is attached hereto as **Exhibit 5.** *See also* Dr. Mark Berkman & Dr. David Sunding, The Brattle Group, *Economic Analysis of SB568's Proposed Polystyrene Foam Ban*, at 5 (Aug. 2011) [hereinafter *2011 Brattle Group Report*]. The *2011 Brattle Group Report* is attached hereto as **Exhibit 6**.

10 *2014 Brattle Group Report*, *supra* note 9, at 17.

11 *Id*.

12 *See generally* Dart, Foam Recycling Addendum (Aug. 2014) (showing steady increases in foam recycling in the United States, with nearly 100 million pounds of foam recycled in 2012). The Foam Recycling Addendum is attached hereto as **Exhibit 7**.

13 *See, e.g.*, Dart, *California Recycling Information*, http://www.dart.biz/recycleca (last visited July 25, 2014) (attached hereto as **Exhibit 8**).

14 *See* Dart, *A Home for Foam Recycling Update 2nd Qtr, 2014* (June 2014) (attached hereto as **Exhibit 9**).

15 Dr. Mark Berkman & Dr. David Sunding, The Brattle Group, *Economic Analysis of San Jose's Proposed Polystyrene Ban*, at 14–16 (Feb. 2012) [hereinafter *2012 Brattle Group Report*]. The *2012 Brattle Group Report* is attached hereto as **Exhibit 10**.

16 Dr. Angelique White, *Comments on Amendments to Statewide Water Quality Control Plans to Control Trash*, at 2 (Aug. 2014) [hereinafter *Dr. White Report*]. The *Dr. White Report* is attached hereto as **Exhibit 11**.

17 *Id.* at 3.

18 *Id.* at 1.

2. Foam has substantial economic benefits

Bans encouraged by the trash amendments will have unintended economic consequences. A 2014 economic analysis by Dr. David Sunding, an economist at the College of Natural Resources at the University of California, Berkeley, and Dr. Mark Berkman, an expert in applied microeconomics with a Ph.D. from The Wharton School of the University of Pennsylvania, found that if every city in California adopted a foam ban, the costs to consumers, schools, and healthcare providers could be very large:[19]

- Total costs to California consumers could easily reach $238 million per year;
- Costs to California's school system could be $42 million per year; and
- Costs to California health care industry could be over $1 million per year, and "would likely be significantly higher."

Although the proposed trash amendments do not ban polystyrene foam statewide, they encourage such bans, and this economic analysis shows the potential economic impacts. In some sense it is conservative: the substantial costs above are limited to just one product—foam—and encouraging the enactment of even broader product bans at the local level could lead to even higher costs.[20]

II. THE TRASH AMENDMENTS WILL CAUSE PRODUCT BANS, UNDERMINING THE STATE BOARD'S OBJECTIVES

Encouraging bans is a centerpiece of the proposed trash amendments. The staff report acknowledges that "municipal ordinances prohibiting food packaging with polystyrene materials" are one of the "most likely measures" that MS4 permittees will use to comply with the trash amendments.[21] And given the incentives that the trash amendments set up for MS4 permittees, this is a sound conclusion.

First, under a proposal for State Board consideration, regulatory source controls would be specially encouraged—if the proposal is adopted, it would allow MS4 permittees to seek an additional year to comply with the trash amendments for each regulatory source control (ban) they enact (up to a three-year extension).[22]

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[19] *2014 Brattle Group Report*, *supra* note 9, at 2–4.

[20] *See* Robb Korinke, *Comment Letter on Proposed Amendments to Statewide Water Quality Control Plans to Control Trash* (Aug. 2014) [hereinafter *GrassrootsLab Report*]. The *GrassrootsLab Report* is attached hereto as **Exhibit 12**. *See 2014 Brattle Group Report, supra* note 9, at 10 ("[T]his analysis is potentially very conservative: it measures the cost only of polystyrene foam bans, while the trash amendments encourage bans of apparently all single-use consumer products . . . .").

[21] *Staff Report*, *supra* note 1, at 83.

[22] *Id.* at D-6, E-6.

Second, under "Track 2" of the amendments, MS4 permittees will be able to ban single-use consumer products and claim that the bans constitute "regulatory source controls" that count towards their compliance with the trash amendments. For example, the proposed amendments to the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California allows MS4 permittees to use Track 2, which allows MS4 permittees to propose a mix of "full capture systems, other treatment controls, institutional controls, and/or multi-benefit projects" to meet the new water quality objective for trash.[23] "Institutional controls" are defined to include regulatory source controls, which in turn are defined as including "bans of single use-consumer products."

Third, the practical reality is that MS4 permittees are under tremendous economic strains. Structural best management practices ("BMPs") are highly effective, but they also require a commitment of resources. Bans are relatively inexpensive to adopt (though they impose large costs on consumers). Though bans are ineffective at reducing trash in the receiving waters and cause significant adverse environmental impacts, many cities may feel constrained to adopt bans and reduce their investment in proven trash-reduction methods.[24]

By encouraging bans, the trash amendments will cause the environmental and economic impacts described above. And because of the substitution effect, the bans will not be effective in reducing trash in the receiving waters. As such, the trash amendments are arbitrary and capricious and without evidentiary support.[25]

III. THE BOARD HAS NOT COMPLIED WITH THE CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)

A. The staff report fails to analyze the significant impacts that are a likely outcome of the trash amendments

The staff report describes "municipal ordinances prohibiting food packaging with polystyrene materials" as one of the "most likely measures" that MS4 permittees will undertake to comply with the trash amendments.[26] CEQA requires an analysis of reasonably foreseeable consequences of the project.[27] Despite this requirement and despite the staff report's acknowledgment that bans are one of the "most likely" results of the trash amendments, the staff report contains no analysis of the environmental impacts of bans.

As described above, these impacts include increased energy usage, greater greenhouse

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[23] *Id.* at E-2, E-3.

[24] *GrassrootsLab Report*, *supra* note 20, at 1–2. *See also 2014 Brattle Group Report, supra* note 9, at 9 ("[I]t is reasonable to assume that many, perhaps even a significant majority, of cities in California will adopt bans as a result of the trash amendments").

[25] *See, e.g., City of Arcadia v. State Water Resources Control Bd.*, 191 Cal. App. 4th 156, 170 (2010).

[26] *See, e.g., Staff Report*, *supra* note 1, at 83.

[27] *See City of Santee v. County of San Diego*, 214 Cal. App. 3d 1438, 1455 (1989).

gas emissions, increased emissions of air pollutants, and increased water use.[28] Bans may also make it more difficult for California to meet its recycling goals. The Legislature has established a target of recycling 75% of the state's waste by 2020.[29] By encouraging bans, the trash amendments undermine this goal: polystyrene foam is readily recyclable, where as many substitute, alternative products are not.

The State Board must analyze these impacts—both direct and cumulative—before it takes action on the trash amendments.[30] Similarly, the State Board must analyze the impacts of encouraging regulatory source controls by granting MS4 permittees extensions to comply with the water quality objective. This provision will have impacts related both to delayed implementation of effective trash-reduction measures and the bans and associated impacts that it encourages.

B. The proposed trash amendments are not supported by an adequate analysis of a reasonable range of alternatives

Similarly, the alternatives analysis is deficient both in the range of alternatives and in its level of analysis of alternatives. "[T]he key to the selection of the range of alternatives is to identify alternatives that meet most of the project's objectives but have a reduced level of environmental impacts."[31] Given that bans are ineffective in reducing trash in the receiving waters and have significant environmental impacts, it is especially important for the State Board to analyze alternatives to the trash amendments that do not encourage or rely on MS4 permittees adopting bans. These alternatives could include, for example:

- Enhanced recycling, producer responsibility, and product stewardship approaches, which have been proven to work in some areas of California;[32]

- Incentives and support for proven measures such as structural controls;[33]

- A material-neutral approach based on sound science, which accounts for the substitution effect, reduces overall trash in the waterways, and results in real water

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28 *See supra* notes 9–11 and accompanying text.

29 PUB. RES. CODE § 41780.01(a).

30 *See Los Angeles Unified School Dist. v. City of Los Angeles*, 58 Cal. App. 4th 1019, 1025 (1997) ("Assessment of a project's cumulative impact on the environment is a critical aspect of the EIR"); *Friends of Sierra Madre v. City of Sierra Madre* (2001) 25 Cal. 4th 165, 184, 185 (purpose of CEQA review is to inform the public and the agency "in detail" of the project's impacts and potential ways to mitigate the impacts").

31 *Watsonville Pilots Ass'n v. City of Watsonville*, 183 Cal. App. 4th 1059, 1089 (2010).

32 *See, e.g., 2012 Brattle Group Report, supra* note 15, at 14–16.

33 *See, e.g., 2013 Grey Technical Report*, *supra* note 2, at 8.

quality improvements.[34]

- An alternative that prohibits the use of "regulatory source controls" by MS4 permittees for compliance, that requires the State Board to pre-certify as effective trash-reduction methods MS4 permittees propose to use, and that requires adequate monitoring in the receiving waters to determine compliance with the trash amendments.[35]

The analysis must quantify the impacts of different alternatives in a way that allows the public and the State Board to compare the environmental impacts of different alternatives.[36]

C. The State Board must analyze mitigation measures

Because Track 2 will encourage bans that cause significant impacts, the State Board must propose and analyze mitigation measures for these impacts.[37] Those mitigation measures should include, but not be limited to:

- Requiring MS4 permittees to offset the carbon emissions of their proposed bans;

- Requiring MS4 permittees to purchase renewable-energy credits for the increased energy use that bans will cause; and

- Requiring MS4 permittees to conduct restoration projects to compensate for the increased water use and pollutant discharges that bans will cause.

These mitigation measures cannot be deferred, and they must be feasible and enforceable.[38]

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34 *See, e.g.*, *id.* at 10 (trash load reduction actions such as hot-spot clean up, street sweeping, and storm drain maintenance result in verified and quantified reductions in trash loads and volumes).

35 *See, e.g.*, Dr. Mark Grey, *Comments On Draft Amendments to Statewide Water Quality Control Plans to Control Trash*, 3-4 (Aug. 2014) [hereinafter *2014 Grey Technical Report*]. The *2014 Grey Technical Report* is attached hereto as **Exhibit 13**.

36 *Kings County Farm Bureau v. City of Hanford*, 221 Cal. App. 3d 692, 735 (1990).

37 PUB. RES. CODE § 21801.

38 *Oakland Heritage Alliance v. City of Oakland*, 195 Cal. App. 4th 884, 906 (2011) (identification of mitigation may not be deferred); *Napa Citizens for Honest Gov't v. Napa County Bd. of Supervisors*, 91 Cal. App. 4th 342, 360 (2001) (mitigation must be feasible and enforceable).

IV. THE PROPOSED TRASH AMENDMENTS VIOLATE FEDERAL AND STATE LAW

A. The proposed trash amendments violate the Clean Water Act

1. The proposed trash amendments will violate the maximum extent practicable ("MEP") standard

Under the Clean Water Act, permits for discharges from municipal storm sewers must "require controls to reduce the discharge of pollutants to the maximum extent practicable."[39] The trash amendments violate this standard by encouraging MS4 permittees to use bans of polystyrene foam and other materials—without any demonstration that the bans reduce trash and contrary to the evidence that they do not—as a method of compliance.

The State Board has analyzed the term "maximum extent practicable" and found that "the relevant factors, to determine whether [the MEP standard] is met in choosing solutions and treatment technologies, include technical feasibility, cost, and state and public acceptance."[40] The State Board explained that "[t]here must be a serious attempt to comply, and practical solutions may not be lightly rejected."[41]

The State Board's analysis further emphasized the importance of requiring effective BMPs:

> MEP requires permittees to choose effective BMPs, and to reject applicable BMPs only where other effective BMPs will serve the same purpose, the BMPs would not be technically feasible, or the cost would be prohibitive.

Bans have not been shown to be an "effective" BMP—quite the contrary, the evidence shows that bans do not reduce trash in receiving waters. In contrast, other BMPs, such as structural controls, education, and anti-littering enforcement, are known to be technically feasible and effective. Thus, by allowing (and encouraging) MS4 permittees to rely on bans instead of proven, effective BMPs, the trash amendments violate the MEP standard and the Clean Water Act.

2. The proposed amendments will violate the anti-degradation policy

California's anti-degradation policy prohibits a new water quality objective from resulting in lower water quality, where the existing water quality standard is more protective than

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39 33 U.S.C. § 1342(p)(3)(B)(iii) (Clean Water Act § 402(p)(3)(B)(iii)).

40 State Water Resources Control Board, Order WQ 2000-11, at 20 (Oct. 2000) [hereinafter *Order WQ 2000-11*]. *Order WQ 2000-11* is attached hereto as **Exhibit 14**.

41 *Id.*

the proposed new standard.[42]

Basin plans across the state contain water quality objectives that prohibit floatable, suspendable, and settleable material.[43] To the extent that the trash amendments would allow such materials to enter the receiving waters as a result of ineffective regulatory source controls that the trash amendments encourage, the trash amendments are relaxing these water quality objectives and, therefore, violating California's anti-degradation policy.

Furthermore, State Water Board Resolution No. 68-16 requires discharges into "high quality waters" to meet the "best practicable treatment control."[44] Bans of polystyrene foam, which the draft trash amendments encourage, are ineffective and do not qualify as "best practicable treatment control."

3. The proposed trash amendments do not require adequate monitoring to assure compliance

The Clean Water Act requires that the State Board and other permitting authorities "prescribe conditions for such permits to assure compliance with [all applicable requirements, including effluent limitations]."[45] The proposed trash amendments fail to comply with this clear federal mandate, by allowing local governments to make their own unverified claims regarding the effectiveness of nonstructural BMPs such as single-product bans.[46]

Stormwater expert Dr. Mark Grey cautions that the trash amendments repeat the mistakes of the San Francisco MS4 permit with respect to trash.[47] Instead of explicitly requiring permittees to monitor compliance through direct measurements in the receiving waters and storm drains, the trash amendments could be interpreted to allow a "credit scheme" that allows permittees to claim trash reductions without actually demonstrating actual trash reductions. To remedy this, the State Board must clarify that monitoring for Track 2 must be based on direct measurements of trash in the receiving waters and in the storm drain.

B. The proposed trash amendments violate equal protection and due process

The State Board's purpose for the proposed trash amendments is to protect the water quality of the waters of the state. Yet the distinctions that the State Board draws are irrational and

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42 *See, e.g.*, State Water Resources Control Board, *Statement of Policy with Respect to Maintaining High Quality of Waters in California*, Resolution No. 68-16 (Oct. 1968) [hereinafter *State Anti-Degradation Policy*]. The *State Anti-Degradation Policy* is attached hereto as **Exhibit 15**. *See also* 40 C.F.R. § 131.12.

43 *See, e.g.*, *Staff Report*, at A-19 to A-22.

44 *State Anti-Degradation Policy*, *supra* note 42.

45 33 U.S.C. § 1342(a)(2).

46 *See 2014 Grey Technical Report*, *supra* note 35, at 3–4.

47 *Id.*

actually undermine this purpose.[48] For example, bans are ineffective at reducing trash in the receiving waters, yet the State Board proposes to specially encourage bans. Bans—unlike many other means of trash reduction—have significant environmental impacts, yet the State Board proposes to specially encourage bans. And products like polystyrene foam are a small fraction of the trash found in receiving waters, yet the State Board proposes to target those products with bans.

These irrational distinctions violate due process and equal protection under the law as guaranteed by the United States and California Constitutions.[49]

C. The proposed trash amendments violate the Porter-Cologne Act

1. The proposed trash amendments violate Water Code § 13241

The Porter Cologne Act requires that the State Board consider "[w]ater quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area."[50] To the extent the State Board is relying on regulatory source controls to control trash—including ineffective methods such as bans of polystyrene foam—it has not properly considered the water quality conditions that can reasonably be achieved. Bans are ineffective and merely lead to the substitution of other forms of trash in the water. If the State Board has not accounted for this substitution effect—and there is no evidence that it has—it does not know what "[w]ater quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area."

Furthermore, Water Code section 13241(d) requires that the State Board consider "economic considerations" in adopting a water quality objective. The staff report considers some economic considerations related to costs of compliance to permittees for the installation of structural controls and the costs of trash cleanup to individual taxpayers.[51] But the staff report does not consider the costs of regulatory source controls such as product bans, which will place substantial economic burden on local business, individuals, and government agencies (including schools).[52]

2. The proposed trash amendments violate Water Code § 13242

Water Code section 13242(a) requires that the State Board provide "[a] description of the nature of actions which are necessary to achieve the objectives, including recommendations for appropriate action by any entity, public or private." However, bans of polystyrene foam are not "necessary" or "appropriate"—quite the contrary, these types of single-product bans have been shown to be ineffective in general and thus cannot be an effective means of achieving the

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48 *See supra* notes 1–8 and accompanying text.

49 *See, e.g., Walgreen Co. v. City and County of San Francisco*, 185 Cal. App. 4th 424 (2010).

50 WATER CODE § 13241(c).

51 *See Staff Report*, *supra* note 1, at 173.

52 *Id.*; *2014 Brattle Group Report*, *supra* note 9.

proposed trash-related water quality objective.

Moreover, Water Code section 13242(c) requires that the State Board provide "[a] description of surveillance to be undertaken to determine compliance with objectives." The proposed trash amendments do not meet this requirement because they lack any monitoring of the effectiveness (or lack thereof) of these single-product bans.[53]

V. THE TRASH AMENDMENTS EXCEED THE STATE BOARD'S AUTHORITY UNDER THE WATER CODE

Through the proposed trash amendments, the State Board is purporting to assert authority that it does not have under state law—the authority to regulate individual consumer products and individual consumers. Water Code section 13243 grants the State Board the power to regulate the "discharge of waste"—not the product itself before it becomes "waste" or any other products before they are "discharged." The mere existence of a product or even a waste does not fall under State Board jurisdiction, based on the mere potential that the product may enter the water.

The Legislature intended to give DTSC, not the State Board, the power to regulate products "pre-discharge":[54]

> The [DTSC] regulations would be required to specify actions that the department may take following the completion of the analysis, including . . . controlling access to or limiting exposure, managing the product at the end of its useful life, . . . restrictions on the use of the chemical of concern in the product, or prohibitions on use.

Contrary to this legislative delegation of authority to DTSC, however, the State Board has proposed, in effect, its own restrictions and prohibitions on use of products such as foam as regulatory source controls in the proposed trash amendments.

The proposed trash amendments' apparent attempt to regulate individual choices of consumer products exceeds the authority of the State Board, may be preempted by the jurisdiction of DTSC, and is otherwise an inappropriate use of the State Board's authority to regulate the protection of water quality of the waters of the state.

* * *

Because of product substitution, product bans are ineffective at removing trash from the receiving waters. In addition, product bans cause unintended environmental and economic consequences that the State Board has not analyzed. The trash amendments should be revised to eliminate their reliance on regulatory source controls and to explicitly prohibit MS4 permittees from relying on product bans as a measure to meet the water quality objective for trash.

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[53] *See 2014 Grey Technical Report*, *supra* note 35, at 3–4.

[54] AB 1879 (Feuer, 2008) (Preamble); *see also* HEALTH & SAFETY CODE § 25253(b) (describing DTSC regulatory authority). The chapter version of AB 1879 is attached hereto as **Exhibit 16**.

EXHIBIT 1

Proposed Polystyrene Foam Food Ware Ban in San Jose Will Not Reduce Trash Loads in Storm Drains and Receiving Waters

Prepared by:
Mark Grey, Ph.D.

August 2013

Presentation of Findings

I. SUMMARY STATEMENT

The City of San Jose's proposed ban of polystyrene foam food ware (PFF) used by restaurants and food vendors will not reduce litter or trash in waterways. Proponents of the ban have asserted that it will have water quality benefits. But this is speculation, unsupported by empirical evidence. Among the data gaps and scientific shortcomings in the proposed ban and the City's asserted justifications for the ban are as follows:

- As described in Exhibit 1 to this report, available data show that bans do not reduce overall litter or trash in water bodies. Rather, substitute products replace banned PFF and are equally likely to be littered and enter water bodies.

- The City of San Jose has not accurately quantified the amount of PFF in litter or in trash in water bodies. This is fundamental baseline data that the City would need before making any empirical claims about a ban.

- The City of San Jose has already implemented a partial ban of PFF, banning the use of PFF at City events. Though the City has claimed a 2% trash-reduction credit under the municipal stormwater permit for this partial ban, there is no evidence that it has reduced litter or trash in water bodies at all. This is further evidence that suggests that a broader ban will not reduce litter or trash in water bodies overall.

- City materials have tried to draw a parallel between the City's plastic-bag ban and a PFF ban. But there is an obvious logical gap in this comparison: there are readily available re-usable (non-disposable) substitutes for plastic bags, while there are not for PFF. Substitutes for PFF are equally likely to be littered and to enter water bodies as PFF. Thus, even if the City's plastic bag ban had been shown to reduce litter and trash overall (which it has not been), this does not support the conclusion that a PFF ban would similarly reduce litter and trash that enters water bodies.

- Effective trash reduction methods exist. In fact, the City of San Jose has had a number of measurable successes employing methods that are demonstrated to be effective in reducing trash in water bodies, including: hot-spot cleanups, the use of full capture devices, and other methods.

- Implementing a PFF ban is expensive, on the order of hundreds of thousands of dollars. By diverting limited municipal funds from proven trash-reduction techniques, adopting a PFF ban is likely to increase the amount of trash that enters water bodies.

II. THE CITY OF SAN JOSE LACKS RELIABLE BASELINE DATA

Valid, reliable baseline data is an essential prerequisite to any claim that a ban of PFF would reduce litter or trash in water bodies. But the City lacks this essential baseline data. Polystyrene foam includes a broad range of materials, one of which is PFF. In addition, only PFF used by food vendors for take-out food would be banned; consumers could still purchase PFF at stores in San Jose or elsewhere and use it in San Jose. Thus, to measure the effect of its proposed PFF ban on litter and on trash in receiving waters, the City would need baseline data on PFF that would actually be covered by the ban. More general information about the amount of polystyrene foam (as opposed to the narrow category of PFF covered by the ban) says nothing about the prevalence of PFF covered by the ban.

My review of available information indicates that PFF is not a significant component of litter (also referred to as trash) in the City of San Jose. Specifically, it is my opinion that the

City's staff reports (authored in 2010, 2011, and 2012)[1] overstate the presence of polystyrene foam (PF) and PFF in litter within the City, and data submitted by the City to the San Francisco Bay Regional Water Quality Control Board (Regional Board) between 2007 and 2012 do not consistently quantify the amount of PFF (or the fraction of PF that is PFF) that is littered in San Jose[2]. Data provided by the City in annual reports between 2007 and 2012, and data from other jurisdictions within the SCVURPPP[3] responsible for urban litter and storm drain management over this same time frame, show that PF has been identified as a component of the litter load on streets, in storm drains, and on water body shorelines, yet the specific types or sources of PF, such as PFF, are inconsistently reported. Even when reported, the amount (count or mass or volume) is not clearly quantified relative to other components of the litter stream.

Moreover, the presence, classification, and accounting of littered PF products in annual reports submitted by the City to the Regional Board have varied over time. In the 2007-2008 and 2008-2009 reporting periods, no PF littered products were identified as elements of litter within the City's storm drain system. Starting in 2009-2010, annual report data have inconsistently identified the type of PF encountered in litter cleanup activities and programs, using such terms as "Styrofoam" (2009-2010), "Polystyrene" (2010-2011), and "Styrofoam" and "Styrofoam (pieces or pellets)" (2011-2012). In other words, while the City has collected some data on the amount of polystyrene foam that is in the waste stream, this is a much larger category than PFF that would be covered by the ban. The City lacks any reliable baseline data on this more narrow category of PFF that would be covered by the ban.

City staff reports prepared for the Transportation and Environment Committee cite to information that they claim supports a PFF ban. However, as detailed below, none of the reports characterizes the component of the urban litter load that specifically consists of PFF and none of the information constitutes adequate baseline data. Even when litter is identified as some type of

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[1] City of San Jose Transportation and Environment Committee Staff Memorandum, November 20, 2012; January 21, 2011, April 16, 2010.

[2] City of San Jose Urban Runoff Management Plan Annual Reports (2007-2012). Submitted to San Francisco Bay Regional Water Quality Control Board.

[3] Santa Clara Valley Urban Runoff Pollution Prevention Program, Annual Reports submitted by City of San Jose, 2007 to 2012.

PF, the specific contribution of that total amount that can be attributed to PFF is generally unreported. And, several data references are made within City staff reports citing the relative contribution of PFF in litter derived from cleanup activities that cannot be verified.

i) Preliminary Baseline Trash Generation Rates for San Francisco Bay Area MS4s (February 2012)[4]

The BASMAA Preliminary Baseline Load Generation Report documents storm drain litter sampling results from portions of the Bay Area MS4 system for the time period of May through September 2011. Sampling done at 143 sites during two separate sampling events found that 6% and 7% of total trash collected (on an uncompressed volume basis) was some type of "Polystyrene Foam." The only distinction that was made among littered foam product types appears within the report text on pages 10 and 11, where "Polystyrene Foam" was identified, and again throughout Appendix C where foam is identified as "Styrofoam Food and Beverage Ware" in a table documenting the presence or absence and volume of foam (and other trash items) at the 143 sampling sites. Of 216 separate sampling events at the sites used in the baseline load generation report, 106 times (49%) the presence of "Styrofoam Food and Beverage Ware" was noted, while on 110 occasions (51%) no "Styrofoam Food and Beverage Ware" was collected. Packaging, packaging peanuts, and other types of PF product litter were not quantified. Inconsistencies and lack of rigor in documenting the specific PF litter types collected means that the BASMAA data cannot be used to draw definitive conclusions concerning the contribution of PFF to the overall litter load in the Bay Area.

ii) City of Santa Cruz River and Beach Litter Cleanup Data, 2007-2012[5]

The City cites data collected by the Santa Cruz NGO Save Our Shores for the proposition that polystyrene foam constituted approximately 12.7% of debris collected at beach cleanups. However, the data provided by Save Our Shores and cited by the City of San Jose in the

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[4] Bay Area Stormwater Management Agencies Association (BASMAA). 2012. Preliminary Baseline Trash Generation Rates for San Francisco Bay Area MS4s. Prepared for BASMAA by EOA, Inc., Oakland, CA.

[5] Save our Shores Litter Clean-up Program Data 2007 to 2012. Accessed from: http://www.saveourshores.org/what-we-do/cleanup-data.php

November 2012 staff report make no distinction between PF litter and PFF litter. Thus it does not provide baseline data for the fraction of PFF that would be covered by a ban.

As described in Exhibit 1, the Save Our Shores data and data from the City of San Francisco litter audits done between 2007 and 2009 demonstrate that bans do not reduce trash or litter overall, but simply result in non-banned products substituting for banned PFF. In addition, the San Francisco litter audits show that PFF is a very small fraction of litter overall, less than 2 %. Even this overstates the fraction of trash that constitutes PFF covered by a ban: a portion, perhaps a significant portion, of the PFF collected could have been purchased at grocery stores, COSCTO, or other outlets, which would not be affected by a ban.

iii) Caltrans Highway Litter Management Pilot Study, 2001[6]

This report was prepared by URS consultants for the California Department of Transportation in 2001 specifically to examine specific litter capture devices in 24 freeway catchments, which varied in size between 0.18 to 0.91 acres and were located in the Los Angeles area of southern California. A paired watershed approach was used for experimental design. Twelve of the catchments were instrumented with one of five best management practices (BMP): increased street sweeping frequency, increased frequency of manual litter pickup, a modified drain inlet, a bicycle grate, and a litter inlet deflector. The remaining twelve catchments were not instrumented with BMPs, and served as paired controls; all treatment and control catchments monitored drained to a single outfall. Increased litter pick up frequency and installation of modified storm drain grates were found to be the most effective control practices. For the litter collected from all catchments, it was found that “Styrofoam” accounted for 15% of total litter by volume, 11% by count, and 5% by mass. No differentiation of PF types was made, and the authors noted that for most litter “origins were not identified because of small size.”

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[6] Lippner, G., J. Johnston, S. Combs, K. Walter, and D. Marx. 2001. Results of the Caltrans Litter Management Pilot Study. Presented in: Transportation Research Record 1743.

iv) City of San Jose Transportation and Environment Committee Staff Reports, 11-20-12, 1-21-11, and 4-16-10

City of San Jose staff reports prepared for the Transportation and Environment Committee make several claims regarding the presence of PFF in litter resulting from storm drain cleanout or monitoring or following installation of hydrodynamic separation units in existing storm drains including: i) that 10.4% of total litter collected was expanded polystyrene in targeted San Jose storm inlets in 2011; ii) that as part of the BASMAA Preliminary Baseline Trash Generation Rates for San Francisco Bay Area MS4s, a device capturing trash from 200 acres in central San Jose was cleaned out and 10.8% of the litter was found to be expanded polystyrene foam; and iii) that a Sunnyvale, CA litter study performed over a six-month period at the Remington outfall showed that 16.2% of total litter collected was "polystyrene." My review of the original citations in the staff reports and various documents produced by the City, SCVURPP, and the City of Sunnyvale validate the existence or occurrence of the project or assessment cited in staff reports, yet the data on PFF (or any data on litter composition) cited by staff is not available using internet searches of publically available documents.

In sum, none of the data the City cites provides baseline data about the amount of PFF covered by the proposed ban (as opposed to the broader category of polystyrene foam in general). Based on available data, the actual presence of PFF in litter appears be less than 2%. The fraction of litter that is PFF that would be covered by the ban is likely even less than that.

III. THE EVIDENCE SUGGESTS THAT THE CITY'S EXISTING PARTIAL BAN ON PFF HAS HAD NO EFFECT ON THE OVERALL LITTER RATE OR TRASH THAT REACHES WATER BODIES

In 2010 by the San Francisco Bay Area Regional Water Quality Control Board adopted a stormwater permit that requires permittees, such as the City, to meet specified trash-reduction targets[7]. As of 2012, the City is claiming that it has reduced trash in receiving waters by 2% by having instituted a prohibition on city purchase of PFF products and vendor use of PFF on City-

[7] *See* Municipal Regional Stormwater NPDES Permit for Phase I communities in the San Francisco Bay Region (Order R2-2009-0074) Monitoring and Reporting Program, Provision C.10.

owned property at certain events[8]. From review of annual reports, it appears that the City claimed a 2% trash reduction credit in 2011-2012 for implementing the foam purchase and use prohibition, and calculated the result to be equivalent to a reduction of 3,346 gallons of PFF. It appears that this value was calculated as approximately 2% of the total preliminary baseline trash load estimate of 168,672 gallons reported by the City. However, there is no evidence that PFF covered by the partial ban ever constituted 2% of the trash in receiving waters, and there is no evidence from the City that the partial ban has reduced litter by 2%. Based on my data review and analysis, I find no evidence that would support any litter reduction credit for instituting a PFF ban.

Exhibit 2 to this report documents City of San Jose storm drain and receiving water trash reduction measures and actions, and efforts to quantify the amount of litter removed from urban areas and receiving waters from 2007 to 2012. Noteworthy is the absence of data documenting the types or amounts of littered PF or PFF.

The lack of data showing that the City's partial ban of PFF has had any effect on overall litter rates or the amount of trash that enters receiving waters further undermines claims that the proposed PFF ban would reduce litter or trash in the receiving waters.

IV. THE CITY'S EXPERIENCE WITH THE PLASTIC BAG BAN DOES NOT SUPPORT A BAN OF PFF

The perceived success of the single use plastic bag ban in San Jose was cited in a November 2012 staff report as a reason for enacting a ban on PFF. However, the City's own data do not show any effect on overall litter found in the City as a result of the plastic bag ban. Furthermore, City residents could substitute reusable bags or other materials for single use carry out plastic bags, such that a change in behavior may occur as a result of a plastic bag ban. By contrast, a business serving food cannot practically offer an option for consumers to use their own packaging (analogous to asking a consumer to bring their own bag) when purchasing food. Thus, the most likely result of a PFF ban is that a carry-out restaurant would substitute single-use containers made of alternative materials, an action that is unlikely to change the behavior of the

[8] City of San Jose. 2012. City Administrative Policy 5.1.13, Prohibition of City Funding for Purchase of Expanded Polystyrene Food Service Ware, effective June 28, 2012.

customer, who is the end user of the product and who will likely dispose of the alternative materials in the same way he or she would have disposed of PFF. Thus, products made of substitute materials can logically be expected to replace the fraction of PFF that is littered in San Jose. Data from Save Our Shores trash cleanups and the City of San Francisco litter audits also provide empirical evidence to support this substitution effect.

The City's experience with the plastic bag ban does not support a ban on PFF.

V. BY DIVERTING SCARCE MUNICIPAL RESOURCES FROM PROVEN TRASH-REDUCTION METHODS, A BAN IS LIKELY TO INCREASE THE AMOUNT OF TRASH THAT REACHES RECEIVING WATERS

While the data indicate that PFF bans do not reduce litter or trash entering water bodies, proven trash-reduction techniques are available and well-known. Full capture trash interception devices are considered the best available control technology for prevention of litter entry into receiving waters, and in southern California, where there are more than 20 trash total maximum daily loads (TMDLs), installation of full capture trash interception devices fully meets the Los Angeles Regional Water Quality Control Board's Trash TMDL receiving water compliance requirement of zero trash[9]. Research and monitoring evaluations conducted in the Los Angeles and San Francisco Bay Area document the performance of these systems under a range of hydrologic and urban litter loading conditions.

Table 1 identifies the actions the City taken since 2007 to install full capture trash interception devices in San Jose. Some actions have been done in cooperation with SCVURPPP, the City of Sunnyvale, and the San Francisco Estuary Institute (SFEI). Exhibit 3 describes a range of full-capture devices available and their performance with respect to trash and litter.

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[9] Los Angeles River Trash TMDL. 2005. Los Angeles Regional Water Quality Control Board.

Table 1. Summary of actions taken by City of San Jose to install full capture devices

Fiscal Year	Actions	Location/Contributing Area
2007-2008	Installed 85 catch basin insert screens (connector pipe screens)	Various locations
2008-2009	Produced "Pilot Trash Structural Treatment Control Study", March 2008; monitored 80 of the devices installed in FY 2007-2008	No new areas instrumented
2009-2010	No actions SFEI receives $5 EPA Grant to support full capture device purchase by Bay Area cities	All 58 SF Bay Area Cities Eligible
2010-2011	Installed 37 connector pipe screens Installed hydrodynamic separator	Various locations; 149 acres Wool Creek Drive; 48 acres with discharge to Coyote Creek
2011-2012	Installed hydrodynamic separator	Bulldog Boulevard; 181.7 acres
Efforts Underway	Install 7 continuous deflection separators Install 25 connector pipe screens	Various locations; 1,016 acres Various locations; 51 acres

Structural best management practices and full-capture devices are not the only trash-reduction techniques that are proven to be effective. Measures such as education, litter cleanup programs, street and storm drain cleanups, river and shoreline cleanups, can also be effective, and result in measurable reductions of trash in water bodies.

Existing litter control programs performed by the City for at least the past six years (beginning in 2007) are reported by City staff to be effective in reducing litter that could be discharged into receiving waters. Existing litter cleanup and storm drain cleanout efforts, begun as early as 2003, provide data that: i) quantify amounts and general type of litter collected, and ii) identify source generation areas.

Between 2007 and 2012, the City of San Jose reported litter reduction actions resulting in collection of 789 tons, 131,192 cubic yards, 45,414 gallons, and 9,445 bags of littered materials (Table 2). Year to year, litter removal actions have generally resulted in increasing amounts (mass and volume) of litter collected.

The City reports that data collected pursuant to the action-oriented elements of the program result in removal of litter from the City on a consistent basis from areas known to produce urban litter, and that these targeted efforts collect an array of litter types. Efforts to comprehensively address “Hot Spot” litter generation areas, and to install full capture litter control devices within the existing storm drain system are also known to be effective in treating known sources of litter and reducing trash volumes (see Table 2). In fact, the City’s hot spot identification program element has been successful in removing “hot spot” areas from the target list of sites, and cleanup efforts are now focused on new areas.

The trash reduction measures and actions taken by San Jose and other SF Bay Area co-permittees and documented in annual reports between 2007 and 2012 have resulted in verifiable, quantifiable reductions in trash loads and volumes.

Table 2. Summary of Litter Collected in San Jose, 2007-2012

	2007-2008			2008-2009			2009-2010			2010-2011			2011-2012			Totals			
Trash Load Reduction Activity	Tons	CY	Bags	Tons	CY	Bags	Tons	CY	Bags	Tons	CY	Bags	Tons	CY	Gal	Tons	CY	Bags	Gal
Problem/Hot Spot Cleanup	28			150				24			130			199		178	353		
Creek/River/Shoreline/ Volunteer Cleanup			1,845			1,987	130		4,213	171		1,400	309		44,076	611		9,445	44,076
Street Sweeping and Storm Drain/Pump Station O&M		30,938			27,751			24,554			23,504			24,445	1,338		131,192		1,338
Data Sources:	City of San Jose Annual Reports, 2007-2012																		
	Santa Clara Valley Urban Runoff Pollution Prevention Program Annual Reports, 2007-2012																		

The city of San Jose reported that annual program costs of up to $190,000 per year are required to enact and support a ban. Even if the cost were much less than this, implementing a ban still uses scarce municipal funds. When a ban is implemented, these funds are used for community and business outreach, on-going education efforts, and conducting day-to-day enforcement activities. Bans are ineffective to reduce litter and trash entering receiving waters. And bans divert scarce municipal resources away from proven trash-reduction techniques—including full-capture devices, hot-spot cleanups, education, and increased enforcement of anti-litter laws. Because cities have finite funds, every dollar spent on a ban is dollar that cannot be spent on these proven trash-reduction techniques. As such, more trash is likely to reach receiving waters if the City enacts a PFF ban than if it does not ban PFF.

Exhibit 1

Technical Memorandum:
Polystyrene Foam Food Ware Substitution Effect Analysis

Technical Memorandum

By: Mark Grey, Ph.D, Mark Grey Consulting

Date: August 9, 2013

Polystyrene Foam Food Ware Substitution Effect Analysis

Summary

Polystyrene foam food ware (PFF) bans have been adopted in more than 60 cities in California, and one of the main arguments stated in support of these bans is that they reduce the amount of litter that reaches water bodies. However, I am not aware of any study done in California in which a jurisdiction analyzed whether bans of PFF actually reduce litter or simply result in non-banned products replacing PFF as litter on land or in water bodies. The results of this analysis using data from two locations in California demonstrate there is a substitution effect after PFF is banned. PFF products have readily available substitutes, and logic suggests that bans could result in this type of litter substitution effect.

Litter is a consequence of humans failing to properly dispose of their waste, and thus can be reduced by changes in human behavior or by reduction in the amount of waste generated; however, PFF products have readily available substitutes, and logic suggests that bans could result in a type of substitution effect in which other products replace PFF in the litter stream. This notion is echoed by CalRecycle, whose regulations provide that a local ban of products may constitute source reduction only when the ban "will result in reduction in waste at the source, rather than substitution by another product or package of equivalent or greater volume." Cal. Code Regs. tit. 14, § 18734.3. Based on the available evidence, PFF bans do not reduce waste at the source, but simply result substitution by other products. Thus, PFF bans should not be considered source reduction.

Substitution Analysis

This technical memorandum reviews available data from the City of San Francisco and the City of Santa Cruz and analyzes whether PFF bans reduce litter and trash overall or whether bans simply result in non-banned products replacing banned PFF in urban litter and in receiving waters. Both cities have enacted PFF bans, and have conducted litter assessments in urban areas and receiving waters before and after the PFF bans came into effect.

San Francisco's data on litter generation were obtained by collecting litter classified by size and type in City streets for three successive years between 2007 and 2009 (including before and after a ban on

PFF was enacted in 2008), while Santa Cruz's data were derived from river and beach cleanup events conducted annually between 2007 and 2011, with a PFF ban enacted in 2007 and enforcement beginning in 2008. The data reported from these two areas suggest that a PFF ban had no clear effect on reducing litter generation overall.

In the case of the City of San Francisco, a PFF ban approved in 2007 did not lead to a reduction of litter in city streets; instead it resulted in product substitution. The count of whole items and fragments of PFF litter and polystyrene foam pieces and pellets (PF) collected during three years of in-street litter audits have remained relatively constant and vary over a relatively small range from year to year. However, substitute products for specific types of PFF increased both in count and in percentage of the overall litter load after the City enacted a PFF ban.

In the City of Santa Cruz, a PFF ban was enacted in 2007 and enforced in 2008. Litter collection data from once per year collection events at beach and river locations near Santa Cruz was compiled by the NGO Save our Shores between 2007 and 2011 and made available for review on their web site. In addition, as part of these annual cleanup events at beach locations, the number (count) of polystyrene foam litter items was recorded, along with other litter types. Polystyrene foam litter counts recorded during annual cleanup events increased between 2007 and 2008, and decreased in the following years through 2011, while the total mass of trash on the beach have remained relatively constant since a ban was enacted in 2007 and enforced in 2008. During the entire period from 2008 to 2011 the amount (mass) of total litter collected during similar river cleanup events exceeded baseline (2007) levels, suggesting that the PFF ban did not have the intended effect of decreasing litter generation.

Based on these two examples, I conclude that banning PFF does not reduce litter on land or in receiving waters. Instead, there is substitution effect; after a ban, PFF may go down in the litter stream and receiving waters, but it is replaced by alternative non-PFF products and the total amount of litter does not change.

City and County of San Francisco

A ban on PFF was enacted by the City of San Francisco in 2008, based on the claim that such a ban reduces litter. The ban prohibits use of PFF within the City and County limits. Before and after the PFF ban was enacted, the City conducted a three-year effort to characterize (audit) the amount and type of litter on City streets. The audit was performed for the City by a consulting team consisting of HDR, BVA, and MGM Management using established urban street litter audit methods. The year 2007 was considered the "baseline" year (pre-ban) for comparison with 2008 and 2009 data (post-ban). Litter collected during the study was classified as large (>4 square inches) or small (<4 square inches), and was then categorized into 89 different types of large or small litter and counted (whole items or a fraction of a larger piece). Large litter originating from PFF was included in the classification scheme as polystyrene cups, clamshells/boxes, plates, and trays, while small polystyrene foam litter was classified as "other polystyrene pieces" and "polyfoam peanuts."

Table 1 summarizes data from 2007 to 2009 and presents a comparison of individual large litter types (11 products within four categories), substitute product data pooled into four use categories, and PFF data for these same four categories. Table 1 also presents audit data from 2007 to 2009 for small litter (<4 square inches), which includes "other polystyrene pieces" and "polyfoam peanuts."

All four large litter product categories that contained a PFF substitute showed an increasing trend from 2007 to 2009. Of the 11 individual litter types documented in three consecutive years of litter audits, nine of the product types show an increasing trend each year in litter count and in percentage of the total number of large litter items collected. The other two types of substitute product litter showed a decrease from 2007 to 2008, followed by an increase over baseline in 2009. Examined collectively, the data indicate that the overall contribution of food service products to urban large litter is increasing (from 2.6 to 4.7 percent in 2007 and 2009, respectively) and that substitution for PFF is occurring for all four food ware categories, and that this trend is recognized in the City's data.

These data also show that PFF (and overall polystyrene product litter) were a small fraction of the litter generated in 2007 and remained a small fraction of the litter generated in the City after the ban. Notably, the count of two types of large litter (plates and trays) and two types of small litter (other polystyrene pieces and polyfoam peanuts) increased over baseline each year, while two types of large litter (polystyrene cups and clamshells) showed a decrease over baseline, with item count stabilizing between 2008 and 2009 (Table 1). This suggests the PFF ban has had only a limited effect on the generation of PFF litter.

City of Santa Cruz, California

The Santa Cruz NGO Save Our Shores conducted litter clean-up efforts on river shorelines and beaches near Santa Cruz in between 2007 and 2011, thus including periods both before and after a PFF ban was adopted in 2007 and became effective in 2008. Save Our Shores collected litter annually and reported litter count and mass in 10 litter categories during these collection events. Specific river reaches or beach areas were not identified in documents reviewed for this analysis, but presumably are in or near the City of Santa Cruz.

The Santa Cruz data show an apparent reduction in "Styrofoam" collected on beaches near Santa Cruz of 44% after the ban on PFF was adopted (Figure 1). This value is potentially misleading, however, as the decrease in number of pieces collected per cleanup has varied over a very small range — ranging from 13 and 6 pieces of beach "Styrofoam" reported for each year's clean-up. Further, there is not enough information to establish that collection and quantification methods were consistent from year to year, and it is likely that environmental variables such as precipitation may have influenced the amount of litter on beaches. When annual precipitation is compared to total litter collected each year, it appears there is a positive correlation between mass of river litter collected and precipitation, such that in wetter years there was generally more trash collected than in drier years. When coupled with other unknowns (e.g., management practices that may have been employed to control litter, potentially including implementation of urban runoff BMPs or increased urban clean-up efforts), this difference in Styrofoam collected pre- and post-ban does not appear to be especially meaningful. Further, the data provided by Save Our Shores and cited by the City of San Jose in the November 2012 staff report make no distinction between other types of polystyrene litter and PFF litter. Thus, there is little evidence to support a claim that the ban materially reduced PFF litter.

The data presented by Save Our Shores also show that the PFF ban had no discernible effect on overall litter generation rates at the two river and beach locations examined. Total litter mass (pounds) collected at beach and river locations has remained relatively constant from 2008 to 2011, suggesting that product substitution is occurring. In the case of river litter, the total mass collected during each of the three years of data collection that followed the PFF ban was greater than the pre-ban amount collected in 2007, with an influence of rainfall on litter collected noted. Ultimately, the data suggest that food ware service products were substituted after the PFF ban was enacted.

Conclusion

Based on data from San Francisco and Santa Cruz, PFF bans have little effect on the amount of polystyrene foam litter. Moreover, PFF bans appear to do nothing to reduce litter or litter found in receiving waters overall. Rather, bans result in the substitution of other non-banned products, which are equally likely to be littered and to enter water bodies.

Table 1. Summary of San Francisco Street Litter Audit Data, 2007 to 2009

	2007		2008		2009	
Litter Category	Item Count	% of Total	Item Count	% of Total	Item Count	% of Total
Large Individual Litter (>4 sq. in.) Product Types--No Polystyrene						
Paper Cups (Hot)	36	0.94%	56.5	1.42%	87	1.94%
Paper Cups (Cold)	32	0.84%	37	0.93%	72	1.61%
Plastic Drink Cups	29.5	0.77%	31	0.78%	51	1.14%
Paper Fast Food Plates	3	0.08%	4	0.10%	18	0.40%
Other Material Trays	0	0.00%	0	0.00%	11.5	0.26%
Other Plastic Shells/Boxes	7.5	0.20%	16	0.40%	10	0.22%
Paper Clamshells	1	0.03%	12	0.30%	6	0.13%
Paper Trays	4	0.10%	0	0.00%	6	0.13%
Plates_Other Materials	0	0.00%	0	0.00%	5.5	0.12%
Other Plastic FF Plates	0	0.00%	4	0.10%	5	0.11%
Other Paper Cups	1	0.03%	3	0.08%	2.5	0.06%
Large Pooled Litter Categories--No Polystyrene						
Cups_All	98.5	2.58%	127.5	3.21%	212.5	4.74%
Clamshells/Boxes_All	8.5	0.22%	28	0.70%	16	0.36%
Trays_All	4	0.10%	0	0.00%	17.5	0.39%
Plates_All	3	0.08%	8	0.20%	28.5	0.64%
Large Individual Polystyrene Foam Foodware Types/Categories						
Polystyrene Cups	43	1.13%	31	0.78%	27.5	0.61%
Polystyrene Clamshells	20	0.52%	7.5	0.19%	7	0.16%
Polystyrene Trays	1	0.03%	2.5	0.06%	7	0.16%
Polystyrene Plates	3	0.08%	4	0.10%	5.5	0.12%
Total # of Items Collected	3812.5		3972.5		4485.5	
Sites	105		130		132	
Small Litter (<4 sq. in.)						
Other Polystyrene Pieces	5	0.21%	6	0.26%	54	1.60%
Polyfoam Peanuts	8	0.33%	2	0.09%	31	0.92%
Total # of Items Collected	2393		2335		3370	
Sites	105		130		132	

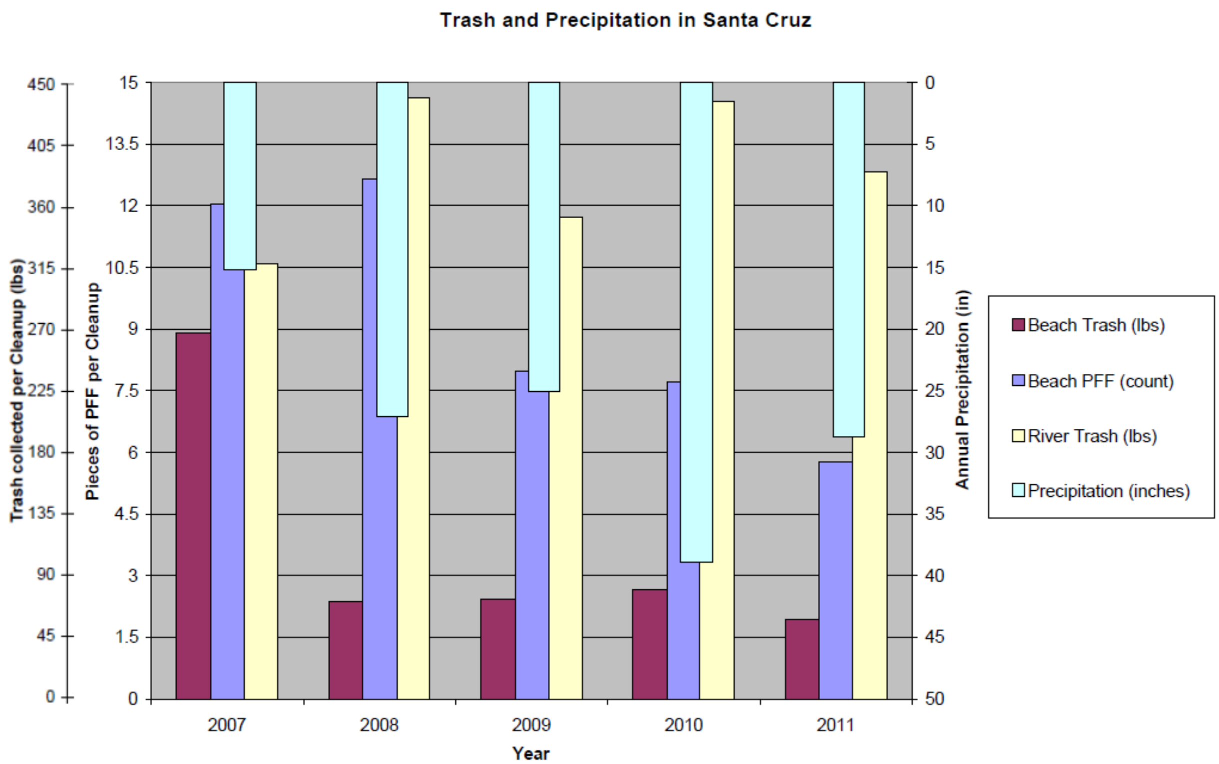

Figure 1. Litter (Trash) mass and count recorded during annual litter clean-up events, and annual precipitation for Santa Cruz, CA, 2007-2011.

Exhibit 2

City of San Jose Trash Management Summary, 2007-2012

City of San Jose Trash Management Program Summary 2007-2012

Summary of Program Elements
San Jose Trash Workplan Evaluation (2007-2012)
San Jose Trash Prevention and Removal Activities 2007 to 2009
Trash Load Reduction Program Results 2007-2008
Trash Load Reduction Program Results 2008-2009
2009-2010 Trash Load Reduction Program Changes
Trash Load Reduction Program Results 2009-2010
Trash Load Reduction Program Results 2010-2011
Trash Load Reduction Program Results 2011-2012

San Jose Trash Workplan Evaluation (2007-2009)

Plan Activity	Findings
1. Inventory, Document, and Evaluation Trash Management Practices	Completed program survey of existing trash management practices
2. Document and Map Known Trash Problem Areas	Identified creek/urban stream problem areas and illegal encampments Used Trash Prevention and Removal MOA
3. Conduct Trash Evaluations	Selected methods and provided training; ID of Coyote Creek and other locations/high priority areas
4. Develop Standardized Documentation and Reporting Format	Process completed 2003-2004; Updated periodically
5. Document and Analyze Evaluation Results; Identify and Prioritize Trash Problem Areas	Problem areas along creeks documented as part of Trash Prevention and Removal MOA—Coyote Creek and Other Locations
6. Identify and Implement Trash Management Practices	Collected trash in some locations Used Trash Prevention and Removal MOA
7. Review and Update Performance Standards and Develop Long Term Strategy for Trash Management	Vague report findings
8. Implement a Pilot Demonstration Project	Started program; collaboration with Santa Clara co-permittees; hired contractor to build 80 inlet screens and install

San Jose Trash Prevention and Removal Activities 2007 to 2009

Activities	Data Collection Opportunity	Description/Actions	# of Times Data Reported
Encampment and Illegal Dumping Activities	6	Trash Prevention/Removal MOA Illegal Encampments 5 Creeks Alternative Work Program Roads City Parcels	2
O&M Activities	5	Neighborhood Cleanups Storm Drain Inlet Street Sweeping Parks Maintenance	1
Clean Up Activities Volunteer-based	6	Hotspot Park/Trail/Street/Creek Cleanup Days	3
Other Activities	None	Collaboration/media	None

Trash Load Reduction Program Results 2007-2008

Program/Action	Result
5 Assessments; 2 protocols used for scoring sites: KAB 1-5) and RTA (1-20); type and sources of trash identified	Documented problem areas; Coyote Creek, Guadalupe River; 28 tons of trash removed; 75% increase from 06-07
City anti-litter program; streets, parks, and waterways; 150 litter hot spots	1,472 bags of litter 373 bags of litter from hot spots
Catch Basin Inserts Structural Trash Pilot Project	Installed 85 catch basin inserts (screens)
Trash Prevention and Removal Activities	Trash Prevention and Removal MOU
<u>**Polystyrene or Styrofoam presence/absence not noted**</u>	-Illegal encampments on waterways -Weekly encampment cleanup -10 monthly cleanups of large and active illegal encampments -5 per year City-District partnered cleanups

Trash Load Reduction Program Results 2008-2009

Program/Action	Result
Trash Prevention and Removal MOU + Additional Cleanups outside MOU	Documented problem areas; Coyote Creek, Guadalupe River; 60 tons of trash removed; 184.6 tons; 5.5 tons
City anti-litter program Juvenile Weekend Detention	572 bags of litter 1,415 bags of litter
Catch Basin Inserts Structural Trash Pilot Project	No new installations Sizing difficulties noted
<u>Enacted smoking ban within 25 feet of City property</u> **<u>Polystyrene or Styrofoam presence/absence not noted</u>**	Trash Prevention and Removal MOU -Illegal encampments on waterways -Weekly encampment cleanup -10 monthly cleanups of large and active illegal encampments -5 per year City-District partnered cleanups

2009-2010 Trash Load Reduction Program Changes

- New, 4th Term MS4 Permit Reporting Structure
- Began collaborating on Short-term Trash Loading Reduction Plan (TLRP)with SCVURPPP
- Worked with SCVURPPP to develop baseline Load and Trash Load Reduction Tracking Method
- Monitoring 84-87 previously installed full capture devices; stated plan to expand monitoring to include additional data to inform Baseline Trash Load assessment and tracking methodology
- Finalized technical report detailing results of pilot trash structural treatment control study

Trash Load Reduction Program Results 2009-2010

Program Element	Data Collected
Trash Hot Spot Assessment	6 sites selected; reported volume of material collected = 23.72 CY 4 sites reported “Styrofoam” present
Trash Load Reduction Actions (17 actions listed) Anti-Litter Volunteer Program Anti-Litter Juvenile Program SJ-SCVWD MOU Creek Connection Action Group	Trash load quantification given for four programs: 1,230 bags of litter 2,983 bags of litter 110.9 tons of trash 38,732 pounds of trash (estimated)
New Trash Load Reduction Reporting Format:	i. Short Term Trash Loading Reduction Plan ii. Baseline Trash Load and Trash Load Reduction Method iii. Minimum Full Trash Capture iv. Trash Hot Spot Assessment v. Summary of Trash Load Reduction Actions

Trash Load Reduction Program Results 2010-2011

Program Element	Data Collected
Trash Hot Spot Assessment	32 site cleanups in 2010; 80.78 CY 16 sites reported "Polystyrene" present 12 site cleanups in 2011; 49.2 CY 5 sites reported "Polystyrene" present
Trash Load Reduction Actions: Anti-Litter Volunteer Program SJ-SCVWD MOU Street Sweeping/Storm Drain O&M/Pump Station O&M	Trash load quantification given for five programs: 1,400 bags of litter 170.45 tons of trash 23,504 cubic yards of material No polystyrene noted
Minimum Full Trash Capture **Enacted ban of City-purchase of polystyrene foam foodware; enacted single use bag ban**	Installed HDS unit on Wool Creek Drive 48 acre catchment area Installed 37 small full capture trash devices (connector pipe screens) 118 total devices installed thru 2011, with total area treated = 342 acres (estimated)

Trash Load Reduction Program Results 2011-2012

Program Element	Data Collected
Trash Hot Spot Assessment	32 site cleanups in 2011; 160.5 CY 16 sites reported “Styrofoam” present 12 site cleanups in 2011; 38.9 CY 7 sites reported “Styrofoam (pieces or pellets)” present
Trash Load Reduction Actions On-land Trash Cleanup Full capture treatment devices Creek/Channel /Shoreline Cleanups; (SJ-SCVWD MOU and Creek Connection Action Group activity)	Trash load quantification given for four programs: 22,628 gallons 1,338 gallons 21,448 gallons (66.7 tons and 242.7 CY of trash also reported)
Minimum Full Trash Capture	Installed HDS unit on Bulldog Boulevard 181.7 acre catchment area No new small full capture trash devices (connector pipe screens--CPS) installed 116 total devices installed thru fiscal year 2011-2012; total area treated = 149.3 acres (differs from area reported in 2010-2011) 7 CDS units/25 small CPS units planned

Exhibit 3

Full Capture Trash Interception System Operating Principles and Performance Data

Exhibit 3

Full capture trash interception system operating principles and performance data

The San Francisco RWQCB and the Los Angeles RWQCB have certified several stormwater treatment technologies, and specific products that use these technologies, as "full capture systems." The San Francisco Regional Water Quality Control Board defines a full capture device as "any single device or series of devices that traps all particles retained by a 5 mm mesh screen and has a design treatment capacity of not less than the peak flow rate Q resulting from a one-year, one-hour storm in the subdrainage area."[1] The Los Angeles Regional Water Quality Control Baord elaborates on the definition of the peak flow rate, stating that, "The rational equation is used to compute the peak flow rate: Q = C x I x A, where Q = design flow rate (cubic feet per second, cfs); C = runoff coefficient (dimensionless); I = design rainfall intensity (inches per hour), and A = subdrainage area (acres)."[2] The fact that a treatment unit is certified as a full capture system means that it has been proven to be effective in both the laboratory and the field settings. Thus, these systems represent an efficient way to remove trash, including EPS, from stormwater and to prevent trash from reaching receiving water bodies.

The discussion below outlines various treatment mechanisms and specific products that utilize those mechanisms.

Swirl Concentration Technology[3]

Commercial Examples:

- KriStar Enterprises, Inc. – Downstream Defender
- KriStar Enterprises, Inc. – FloGard Dual-Vortex Hydrodynamic Separator

Description of Device

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[1] California Regional Water Quality Control Board, San Francisco Bay Region. Municipal Regional Stormwater NPDES Permit (Order R2-2009-0074), October 14, 2009. Page 85.

[2] California Regional Water Quality Control Board, Los Angeles Region. Attachment to Resolution No. R11-XXX: Basin Plan Updated September 2011. Chapter 7—TMDLs (Total Maximum Daily Loads)

[3] Brueske, Christopher C. *Technology Review: Ultra-Urban Stormwater Treatment Technologies*. Department of Civil and Environmental Engineering, University of Washington. September 1, 2000. pp. 12-25.

There are two general designs that use this technology. In the first, water enters a "grit chamber" through a tangential inlet and initiates the swirling fluid field. Water flows downward and towards the center of the grit chamber, and settleable solids are removed and deposited in the center of the chamber. Effluent then exits through an orifice outside of the grit chamber wall, and oil, grease and other floatables collect at the surface and are prevented from exiting by an underflow baffle.

The other general design consists of two concentric annular spaces; stormwater enters the outer space through a tangential inlet and again flows downward in a rotating fluid field. Floatables accumulate on the surface, while water exits this outer chamber by passing under a dip plate into the inner annular space. In this space, it flows upwards, while settleable solids are deposited; a center cone directs flow in the inner annular space to protect against re-entrainment.

Treatment Mechanism

Solids are removed from stormwater by two mechanisms: 1) gravity settling, which draws settleable solids to the floor of the unit and floatable materials to the top of the unit; and 2) secondary currents, which concentrate settleable solids in the center of the unit. These secondary currents are the primary removal mechanism, making swirl concentration technology significantly more efficient than purely gravitational treatment units. These secondary currents are generated by conservation of vorticity (a vector quantity that describes a local spinning motion) near the floor of the treatment units. The non-uniform vertical velocity profile, created by friction at the bottom of the unit, generates a transverse (perpendicular to flow) component of vorticity. As the fluid moves around a curve, this vector rotates in one direction; in order to conserve vorticity, the transverse vorticity vector must rotate in the opposite direction, resulting in a streamwise (parallel to flow) component of vorticity. Note that this is the same phenomenon that causes river flow to scour sediment from the outside bend of a river channel and deposit it onto the inside bank. Figure 1, below, illustrates this process.

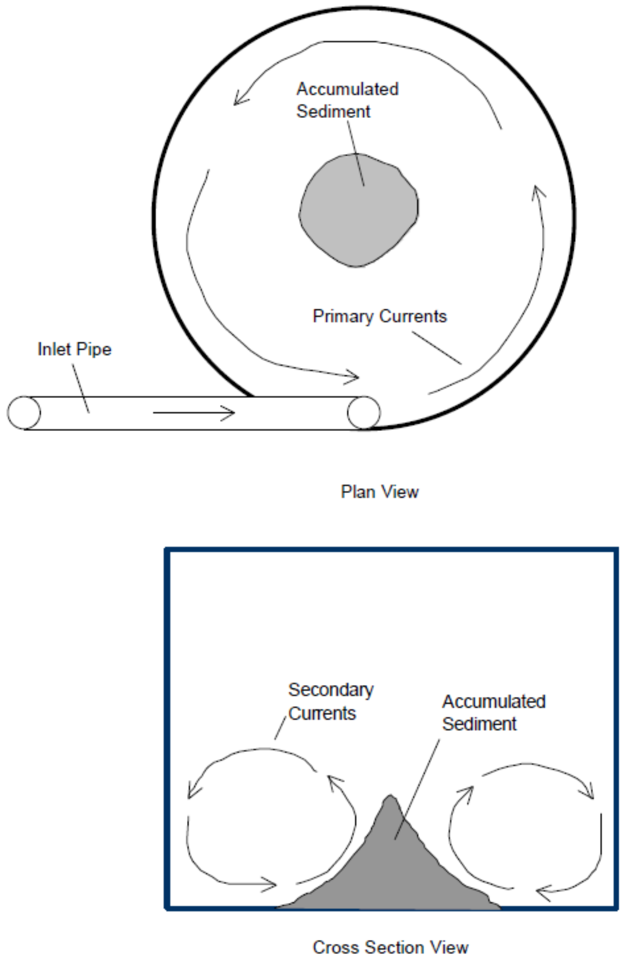

Figure 1. Schematic of the development of secondary currents in swirl concentration full-capture devices. Image from Brueske, Christopher C. *Technology Review: Ultra-Urban Stormwater Treatment Technologies*, p. 20.

Because the primary current is continuous, these secondary currents are maintained, and sediment concentrates in the middle of the treatment units. Accumulated sediment and floatable contaminants need to be removed by a vacuum truck.

<u>Trash Removal Performance</u>

This technology has been proven to be extremely efficient for low flows and for large particles. However, particles with a slow settling velocity (less than 0.1-0.14 cm/sec, generally particles smaller than 10-20 μm) may persist in the effluent if they do not settle into the zone of influence of the secondary current or if they become re-suspended during high flows. At very low flow rates (and thus increased residence time), a decline in removal efficiency is not observed even for large particles, as gravity separation becomes the primary removal mechanism. Figure 2, below, shows removal efficiency as a function of particle size and flow rate:

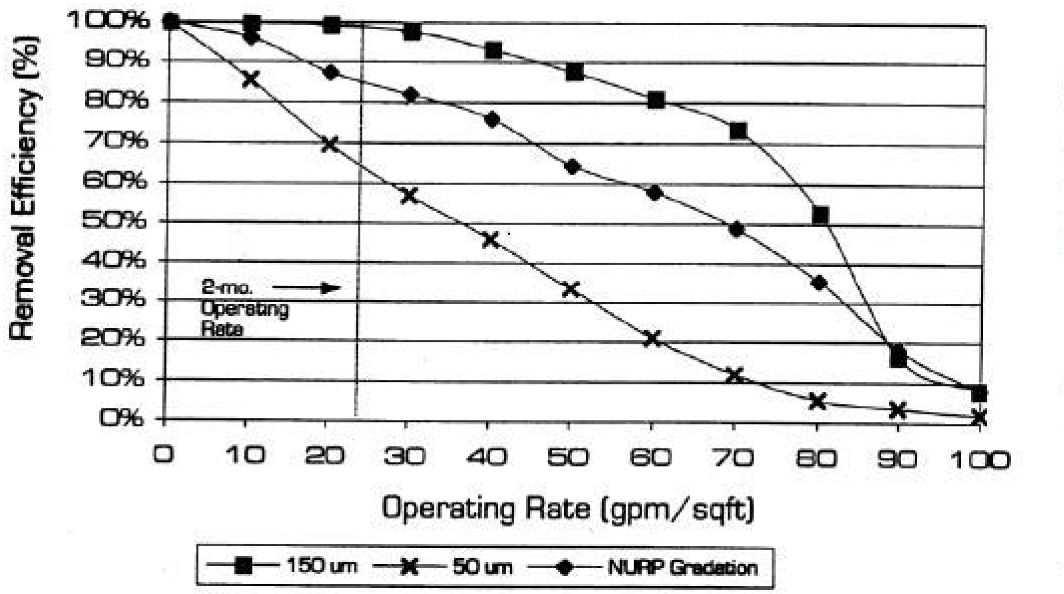

Figure 2. Removal efficiency of swirl concentration full capture devices. Image from Brueske, Christopher C. *Technology Review: Ultra-Urban Stormwater Treatment Technologies*, p. 21.

Connector Pipe Screen[4]

Commercial Examples:

- Advances Solutions Inc. – Stormtek ST3
- Bio Clean Environmental Services, Inc. – Gate Inlet Skimmer, Modular CPS
- United Stormwater, Inc. – Connector Pipe Screen
- West Coast Storm, Inc. – Connector Pipe Screen
- G2 Construction, Inc. – Collector Pipe Screen

Description of Device:

[4] West Coast Storm, Inc. *West Coast Storm Screen Connector Pipe Screen (CPS) Equipment Design and Specification Report*. http://www.docstoc.com/docs/116063313/West-Coast-Storm-Screen-Connector-Pipe-Screen-_CPS_-Equipment

A Connector Pipe Screen (CPS) is a vertical screen with 5 mm openings, installed directly upstream of the connector pipe in such a manner that all water entering the basin must pass through the device. It is constructed of a box-like, structural frame whose walls are composed of 5 mm mesh screen. The bottom and sides of the unit are securely fabricated to conform to the catch basin with a maximum gap of 5 mm. A vertical opening is provided around the perimeter at the top of the screen to allow storm water to bypass in the event of a large storm or if the screen becomes clogged.

Treatment Mechanism:

Particles are intercepted by the screen as stormwater enters the connector pipe; when flows are small enough such that the water level is below the flood bypass, CPS units retain all particles larger than 5 mm in the catch basin. Because the American Society of Civil Engineers (ASCE) defines litter as human derived trash *greater than* 4.75 mm in size[5], all litter will be removed via a CDS full capture unit.

Trash Removal Performance:

The capacity of trash that can be captured is determined by the dimensions of the catch basin, which stores trash and debris. Maintenance must be performed regularly to remove trash from the catch basin and from the mesh screen. If maintenance does not occur frequently enough, organic material and articles of trash can be trapped in the screens; this causes the mesh to be clogged, reduces the flow capacity through the device, and thus increases the likelihood of flow through the flood bypass.

Continuous Deflective Separation[6]

Commercial Examples:

- Contech Construction Products – Continuous Deflective Separator
- KriStar Enterprises Inc – FlowGard Swirl-Flo Screen Separator

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[5] Allen, Vaikko and James, Roger. *Effectiveness of Trash Control Measures*. Presentation, CASQA 2012.

[6] Brueske, Christopher C. *Technology Review: Ultra-Urban Stormwater Treatment Technologies*. Department of Civil and Environmental Engineering, University of Washington. September 1, 2000. pp. 26-32.

Description of Device and Treatment Mechanism:

Continuous Deflective Separation (CDS) involves the removal of solids from stormwater by an indirect, non-blocking, and non-mechanical screening mechanism. Stormwater enters the treatment unit through a tangential inlet and flows in a circular path across a stainless steel screen; screen apertures range from 0.6-4.7 mm (generally 4.7 mm for stormwater treatment). All particles larger than the screen apertures are restricted from passing to the outlet.

The screen surface area is large relative to the inlet pipe area, resulting in a radial flow velocity though the screen that is an order of magnitude slower than the inlet pipe velocity; the tangential velocity is highest adjacent to the separation screen, and maintains a constant shear force across the screen. Because the radial velocity of water through the screen is slow, the pressure differential—forcing particles into the screen—is much less than tangential shear force, which pushes particles in a direction tangent to the screen. This mechanism prevents particles from blocking the screen, and allows them to eventually settle into a sump below the unit. Particles smaller than the screen aperture size are also removed, although the mechanism is not well understood.

Trash Removal Performance:

Table 1, below, states the removal efficiency as a function of screen aperture and particle size. As the numbers illustrate, this device removes all particles larger than the screen aperture, and a high percentage of smaller particles. Based on ASCE's definition of litter as being greater than 4.75 mm in size, all litter will be removed via a CDS full capture unit.

Table 1. Screening Efficiencies as a Function of Particle Size (S.G. = 2.65) for 1.2 mm and 4.7 mm Screen Apertures for a CDS Unit.

4.7 mm Screen		1.2 mm Screen	
Average Particle Size (µm)	Particle Removal Efficiency (%)	Particle Size Range (µm)	Particle Removal Efficiency (%)
>4,700	100	>1,200	100
2,350	100	420-600	93
1,567	93	300-420	85
940	50	144-300	30
		84-144	22

Reproduced from Brueske, Christopher C. *Technology Review: Ultra-Urban Stormwater Treatment Technologies*, p. 30.

Trash Nets[7]

Commercial Examples:
- KriStar Enterprises, Inc. – Nettech Gross Pollutant Trap—End of Line
- Fresh Creek Technologies, Inc. – End of Pipe Netting Trash Trap

Description of Device and Treatment Mechanism:

These modular units consist of disposable, 5 mm mesh nets that face the direction of flow; all particles larger than the aperture size of the mesh are retained in the net. These nets are held in place by a steel framework fabricated specifically for the site; depending on the height above grade, the nets are either installed directly to the steel framework (called the "fixed frame" installation) or are held within a removable "basket" (the "basket" installation) to facilitate maintenance. A fixed bypass screen above the nets is provided when 100% screening of the flow is required; this provides additional flow capacity to prevent surcharging of the storm drain.

Trash Removal Performance:

Because of their scalable design, these systems can be matched exactly to the outfall size and flow requirements. End of pipe trash nets have been documented by the EPA as achieving a capture efficiency of 95%. The city of Signal Hill tested a pilot program at the Hamilton Bowl, which confirmed the effectiveness of the system. Frequent maintenance is required to maintain high flows through the devices.

Linear Radial Gross Solids Removal Devices

Commercial Examples:
- Roscoe Moss Company – Storm Flo Screen

Description of Device and Treatment Mechanism:

A Linear Radial Gross Solids Removal Device consists of a circular stainless steel pipe with 5 mm louvers that is contained in a concrete vault. Stormwater enters through the interior steel pipe and exits through the other end of the concrete vault, into another pipe; pollutants are

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[7] Fresh Creek Technologies, Inc. website

filtered by the louvers and accumulate within the stainless steel pipe. These devices can also be installed at the end-of-pipe; under this type of installation, the effluent exits directly to receiving water. Accumulated litter and organic matter can be removed from within the stainless steel casing by a vacuum truck.

Trash Removal Performance:

Based on ASCE's definition of litter as being greater than 4.75 mm in size, all litter will be removed by a Linear Radial Gross Solids Removal Device. The capacity of trash that can be captured and retained is determined by the dimensions of the internal stainless steel pipe, which stores the trash and debris. Frequent maintenance (removal of debris) is required to allow high flows through the device, to prevent the device from overflowing, and to prevent localized flooding elsewhere in the system. A pilot project by the California Department of Transportation confirmed the performance of these devices.[8]

Full Capture Trash Removal Device Economic Data (capital and annual O&M costs)

The cost to install and operate and maintain various types of full capture litter interception practices is documented in various technical reports and other sources. In Table 2 below Regional Water Quality Control Board approved full capture devices are listed, and capital and annual O&M costs presented. The data shows some range in costs for the various devices, and this range is a function of differences in the sizing of each device for a given contributing catchment area and its physical, hydrological and trash/pollutant load characteristics. Most of the devices except for trash nets, are sized at a minimum to capture litter greater than 4.75 mm up to the peak flow produced by a one-year, one-hour storm intensity before bypass would occur. Costs shown in Table 4 are unadjusted for inflation.

[8] California Department of Transportation. Phase 1 Gross Solids Removal Device Pilot Study: 2000-2002. Final Report October 2003. pp. 55-56.

Table 2. Capital and O&M Costs for Full Capture Trash Interception Devices

Technology	Device Manufacturer	Cost: Capital Installation ($/unit)	Cost: Annual O & M ($/unit/yr)	Source
Swirl Concentration	--	4,000[a]-332,000[b]: treatment capacity dependent	2,000[c]	a) USEPA. Innovative Technology Inventory (ITI) KriStar FloGard® Dual-Vortex Hydrodyanmic Separator (DVS). November 20, 2006. (2006 Dollars) b) Larry Walker Associates, Inc. 1999. Investigation of Structural Control Measures for New Development. Final Report. Sacramento Stormwater Management Program. (1999 Dollars) c) LARWQCB. Trash Total Maximum Daily Loads for the Los Angeles River Watershed. (1999 Dollars)
Connector Pipe Screen	--	300	330	Hildebrand, Gary. LA Trash TMDL: Achieving Compliance. www.lawatersheds.org (2011 Dollars)
Continuous Deflective Separation	Contech Construction Products	65,471		City of Los Gatos. NPDES compliance, Project 10-17. March 27, 2012 (2012 Dollars)
Continuous Deflective Separation	Contech Construction Products	95,857[d]	5,000-20,000[e]	d) City of Palo Alto. NPDES compliance, Park Blvd Project. July 23, 2012 (2012 Dollars) e) SCVURPPP Trash Evaluation and Management Fact Sheet, April 2008 (2008 Dollars)
Continuous Deflective Separation	--	10,000-80,000: treatment capacity dependent	2,500-30,000	Hildebrand, Gary. LA Trash TMDL: Achieving Compliance. www.lawatersheds.org (2011 Dollars)
Trash Nets	Fresh Creek Technologies -- Trash Trap	75,000-300,000: depends on site conditions. Typical two-net system for 50 cubic feet, 500 lbs of trash would be $125,000.	25,000-75,000	USEPA: Combined Sewer Overflow Technology Fact Sheet: Netting Systems for Floatables Control. Spetember 1999. (1999 Dollars)
Trash Nets	Fresh Creek Technologies -- Trash Trap		32,600	Department of Environmental Programs, Metropolitan Washington Council of Governments. DC-WASA Combined Sewer Overflow Anacostica River Trash Reduction Demonstration Project: Fresh Creek Netting TrashTrap System. October 2001 (2001 Dollars)
Linear Radial Gross Solids Removal Device	Roscoe Moss Company -- Storm Flo Screen	10,295-25,905: size dependent	7,752	Letter from Kevin McGillicuddy, Roscoe Moss Company, to Ziad Mazboudi, City of San Juan Capistrano. June 11, 2012 (2012 Dollars)

EXHIBIT 2

COMMENTS ON BAY AREA STORMWATER MANAGEMENT AGENCIES ASSOCIATION'S

PRELIMINARY BASELINE TRASH GENERATION RATES FOR SAN FRANCISCO BAY AREA MS4s

AND

TRASH LOAD REDUCTION TRACKING METHOD

Prepared by:

Michael V. Harding, CPESC

20 March 2012

This report offers my critique of the following Bay Area Stormwater Management Agencies Association (BASMAA) Documents:

1. *Preliminary Baseline Trash Generation Rates for San Francisco Bay Area MS4s – February 1, 2011.* Prepared by EOA, Inc. Oakland, CA
2. *Trash Load Reduction Tracking Method – February 1, 2012.* Prepared by EOA, Inc. Oakland, CA

Specifically, the purpose of this report is to comment on the validity of the BASMA studies and whether or not the BASMAA reports contain adequate scientific evidence to support the proposition that banning polystyrene foam will result in a quantifiable (8%) reduction of trash in the storm drains of the San Francisco Bay area jurisdictions that adopt such bans.

As described in my attached curriculum vitae, I have over 35 years experience in erosion and sediment control, resource management, mined land reclamation, wildlife habitat development, and nonpoint source pollution control both in the United States and overseas.

The purpose of the EOA/BASMAA studies - as I understand them to be - is to assist the Municipal Regional Stormwater NPDES communities in the San Francisco Bay area in the development of plans to reduce trash from their Municipal Separate Storm Sewer Systems (MS4s) by forty percent (40%) by July 14, 2014.

I have also reviewed:

1. *Technical Assessment – 2012 BASMAA Reports* prepared by Environmental Resources Planning, LLC. March 2012
2. "Chapter 3: Water Quality Objectives" from the Regional Water Quality Control Board Basin Plan
3. Assessing and Monitoring Floatable Debris, USEPA, August 2002

All documents that I have reviewed included extensive references. Except as noted, I have not reviewed these references in preparing my comments.

Document Review

As I understand it, the purpose of the study, ***Preliminary Baseline Trash Generation Rates for San Francisco Bay Area MS4*** is to establish a baseline from which Permittees (communities) can demonstrate progress towards trash load reduction goals. The approach is "intended to be cost-effective and consistent, but still provide an adequate level of confidence in estimating trash loads from MS4s, while acknowledging that uncertainty in trash loads still exists."

Two monitoring events were conducted; one representative of the dry season and one representative of the wet season in the Bay area. Results from the collections were characterized based on monitoring site land use classes (e.g. high density residential, commercial and services, heavy industrial, K-12 schools, etc.) and by the relative percentage volume of various trash types (e.g. plastic, paper, plastic grocery bags, polystyrene foam, etc.). From this information a comparison of trash generation by land use class was presented.

The BASMAA ***Trash Load Reduction Tracking Method Technical Report*** sets forth two methods to track trash load reductions: 1) trash load reduction quantification formulas; and load reduction credits. Quantification formulas were developed for those trash control measures that were "feasible and practical to quantify load reductions over time". Load reduction credits were developed for "all other control measures" identified in the report.

Permittees propose to be able to chose and implement any number of these trash control measures to reach the 40% trash load reduction goal. Table 1.1 in the BASMAA Trash Load Reduction Method Report identifies the trash control measures for which load reduction credits or load reduction quantification formulas were developed to track progress towards trash load reduction goals:

Load Reduction Credits:

Single-Use Carryout Plastic Bag Ordinances
Polystyrene Foam Food Service Ware Ordinances
Public Education and Outreach Programs
Activities to Reduce Trash from Uncovered Loads
Anti-Littering and Illegal Dumping Enforcement Activities
Improved Trash Bin/Container Management Activities
Single Use Food and Beverage Ware Ordinances

Quantification Formulas:

On-land Trash Cleanups (Volunteer and/or Municipal)
Enhanced Street Sweeping
Partial-Capture Treatment Devices
Enhanced Storm Drain Inlet Maintenance
Full Capture Treatment Devices
Creek/Channel/Shoreline Cleanups (Volunteer and/or Municipal)

Observations

From my interpretation of the data presented, some things stand out:

- From the BASMAA reports it appears that K-12 Schools exhibit the widest range of trash generation rates and also seemed to have an average rate equivalent to Retail and Wholesale source categories but slightly above that of Commercial and Services and Industrial categories
- In the BASMAA reports there is no accounting for cigarette butt litter which in previous studies has been shown to constitute up to 34% of solid waste entering a storm drain (Caltrans District 7 Erosion Control Pilot Study-2000)
- Section CR-2 of the *Trash Load Reduction Tracking Method,* dealing with a ban of polystyrene, listed one reference—"Assessing and Monitoring Floatable Debris", USEPA, August 2002. This document provides examples of various strategies concerning monitoring and assessment of floatable debris - as well as some state and/or municipal-specific prevention and mitigation programs – but appears to offer no support for the proposition that banning polystyrene foam food ware would result in a quantifiable (8%) reduction of trash delivered to storm drains.

Opinion

Based on the BASMAA reports, I do not believe an outright ban of polystyrene foam will actually result in a substantial reduction of trash/litter contribution to storm drains. I conclude that neither the BASMAA reports nor the referenced USEPA "Assessing and Monitoring Floatable Debris" report contain evidence supporting a quantifiable reduction of 8% litter to storm drains if a ban is imposed.

The source of all categories of trash and litter is anthropogenic, meaning that if one particular type of container, bag or food ware is banned (i.e., plastic/polystyrene) whatever material takes its place will in all likelihood be discarded and introduced into the storm drain unless public education programs, improved collection management, anti-littering enforcement programs are proportionally increased. The BASMAA reports do not account for this substitution effect. Regardless of its chemical or physical makeup, trash/litter – once it gets into the storm sewer - will never meet the Water Quality Objectives in the Basin Plan because trash in the storm drain will always either be floatable, suspendable or settleable.

I think that BASMAA and the cities have an opportunity to revise their recommendations and propose a more effective combination of both structural best management practices (BMPs) and institutional/administrative practices (IAPs) – including education, enforcement of anti-litter ordinances, improved collection devices and procedures and structural best management practices such as full- and partial-capture devices - to reduce trash in the storm drains.

The ***Technical Assessment of BASMAA 2012 Reports*** prepared by Environmental Resources Planning, LLC focuses on public education, anti-littering enforcement and improved containment practices backed up by operation and maintenance best management practices (BMPs) to achieve the same credits (88%) as the BASMAA Credit Allocations. I believe that the credit allocations proposed in the ***Technical Assessment of BASMAA 2012 Reports*** represent a more diverse, broad-based, equitable and cost-effective allocation of practices to resolve the water quality aspects of trash and litter in storm water runoff.

Respectfully submitted,

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Michael V. Harding is one of the leading technical experts in the erosion control industry. A graduate from Purdue University, Michael has over 35 years experience in erosion and sediment control, resource management, mined land reclamation, wildlife habitat development, and nonpoint source pollution control both in the United States and overseas. Michael specializes in the evaluation, research, development, and application of cost-effective erosion control materials and techniques, and is a Certified Professional Erosion and Sediment Control Specialist (CPESC). He has contributed significantly to the body of knowledge related to the effectiveness of alternative approaches to erosion control through field and laboratory testing programs.

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Michael is three times past President of the International Erosion Control Association (IECA). He has published numerous articles on erosion and sediment control, resource management, and post-fire hazard mitigation in national publications, and frequently teaches seminars and workshops. He has taught continuing education courses for the American Society of Civil Engineers on “How to Prepare an Effective Erosion and Sediment Control Plan,” and is the principle instructor for the IECA course “Practical Approaches for Erosion and Sediment Control.” He has been the invited speaker at the National Academy of Sciences, the National Transportation Research Board, and was a contributing author to the book *Environmental Restoration, Science and Strategies for Restoring the Earth,* edited by John Berger (Island Press).

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Oregon Department of Transportation (ODOT. Co-developer of Erosion and Sediment Control classes and field days for Engineers, Designers and Inspectors (2009)

Oregon Department of Environmental Quality (ORDEQ). Erosion and Sediment Control Manual and Construction Site Inspector's Booklet (April 2005) and accompanying statewide workshops and field training

USEPA/IECA Short Course on Best Management Practices for Storm Water Pollution Prevention Planning– Course Co-Developer and National Instructor

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International Erosion Control Association (IECA). "Fundamentals of Erosion Control" Short Course, "Steep Slope Erosion Control" Short Course.

University of California - Santa Barbara. Extension Course on Post Fire Hazard, Planning-Mitigation

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Federal Energy Regulatory Commission (FERC). Erosion and sediment control short course. San Francisco, CA.

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Resource Conservation District of Greater San Diego, CA. Sweetwater Watershed Workshop

City and County of Honolulu, HI – Erosion and Sediment Control Workshops

Hawaii Coastal Zone Management - Erosion and Sediment Control Workshop (3)

EXHIBIT 3

Use and Disposal of Polystyrene in California

A Report to the California Legislature

December 2004

INTEGRATED WASTE MANAGEMENT BOARD

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They also thank all of the many stakeholders that invested their time and energy providing valuable information and comments to this report.

Executive Summary

In 1999, California disposed of over 3.3 million tons of plastic in landfills, and that amount may well be increasing. (Source 25) That is roughly equivalent to the weight of the nearly 36 million Californians (averaging 185 pounds) being buried in California landfills every year. Plastics represent 8.9 percent (by weight) and perhaps twice as much (by volume) of the material disposed of in California landfills. Polystyrene (PS) is estimated at 0.8 percent (by weight) of the materials landfilled. However, due to its lightweight nature, its volume is much greater. In general, plastics rank behind paper as the second-largest category (by volume) of material being landfilled in California.

The two main types of PS are “general-purpose” (also known as “crystal”) PS and “high-impact” (also known as “rubber-modified”) PS. When a blowing agent is added to general purpose PS, it is referred to as “expandable (or “expanded”) polystyrene” (EPS). Approximately 57 percent of the PS consumed in the U.S. in 1999 was general-purpose.

The total California share of PS production and sales in 2001 is estimated at 377,579 tons. Of this amount, approximately 77,006 tons were for packaging and 156,829 tons were for consumer/institutional applications. The total amount of PS for packaging and food service for California is estimated at 166,135 tons.

Due to changes in PS formulation and improved production processes, PS has achieved significant source reduction benefits. Unfortunately, industry officials claim there are limited opportunities for increased source reduction, especially in transportation packaging and food service. However, the CIWMB believes replacing single-use food service PS, that cannot be effectively recycled, with compostable alternatives may provide additional source reduction potential.

The Plastic Loose Fill Council (PLFC) coordinates reuse of PS loose fill, or “peanuts.” Reuse of PS in California is estimated at between 20 and 30 percent, a total of 500 tons. (Source 14)

There are reportedly sufficient end markets available for all the clean EPS collected. PS recycling/reuse consists primarily of the reuse effort by the PLFC, some limited recycling of non-foam PS products (such as CD cases, videocassettes, and agricultural trays), and recycling of transportation packaging. There is no meaningful recycling of food service PS. Recycling of transportation packaging is estimated at 12 percent nationally, with California recycling 19–23 percent (2,500 tons).

In 1999, an estimated 300,000 tons of PS (0.8 percent of total waste) was landfilled, with a total disposal cost of $30 million.

However, not all PS is disposed of legally. The primary environmental impact of PS relates to litter and improperly disposed PS. According to a California Department of Transportation study during 1998–2000, PS represented 15 percent of the total volume of litter recovered from the storm drains. Other significant items include: plastic moldable, (16 percent), plastic film (12 percent), and paper (14 percent).

The CIWMB does not believe that a separate PS initiative is warranted. However, in an effort to minimize some of the side effects of PS, the CIWMB does recommend:

1. Increasing litter education efforts through more effective coordination between all State entities

that spend money on anti-litter education and/or cleanup.

2. That the State conduct a statewide litter study to identify the types and respective amounts (volume and weight) of litter and to quantify the environmental and societal impacts of litter.

3. That the Legislature consider making litter a civil offense, to facilitate issuing litter tickets.

4. That the State perform appropriate studies and testing (including demonstration projects) to determine the effectiveness of compostable and biodegradable plastics as alternatives to nondegradable polystyrene.

5. That the State continue to work with manufacturers and other stakeholders to promote additional manufacturer responsibility and product stewardship of polystyrene.

Introduction

California is faced with the significant challenge of safely and effectively managing the solid waste generated by nearly 36 million people in one of the largest economies in the world. Plastics are a major part of the California economy. In 2001, the California plastics industry employed more workers (152,335) than any other state and was ranked second in the nation in the value of shipments ($27.8 billion). California also leads the nation in the number of people employed and the value of polystyrene products produced. (Source: 1) Ironically, one of the most difficult materials in the state to manage is plastic, especially certain types of PS.

Expanded polystyrene (EPS) transportation packaging represents approximately 3 percent of PS produced nationally and it can be, and to some degree is, recycled. EPS transportation packaging is currently being recycled at 13.1 percent nationally and an estimated 19 percent in California. (Source: 2, p. 3) That is much better than the 6 percent national recycling rate for all plastics. However, additional opportunities exist to work with the EPS transportation packaging industry to voluntarily increase recycling to a much higher level.

Commercial and institutional PS products (including food service PS) represent 42 percent of PS production. Unfortunately, food service PS presents unique challenges in its management due in part to contamination from food residue. Because of these challenges and economic factors, no meaningful recycling of food service PS occurs currently. Food service PS, by its nature, has a useful life that can be measured in minutes or hours. Yet, it takes several decades to hundreds of years to deteriorate in the environment or landfill. Food service PS also represents a significant challenge as litter. Not only does the food service PS break into smaller pieces that may be ingested by wildlife, but materials may also be contaminated with food that decays, creating a health hazard.

PS that is illegally released through various means, including human behavior, as litter may also find its way through the storm drain system and into the marine environment. As an example, the Los Angeles Regional Water Quality Control Board issued a trash total maximum daily load (TMDL) order for the Los Angeles River requiring zero measurable trash in the storm drain system within 10 years. The County of Los Angeles and the cities affected by the TMDL estimate having to spend $373 million or more, over a 10-year period, to reduce the amount of trash in the storm drains in an effort to partially comply with the order. (Comment: 3)

An estimated 0.8 percent (by weight) of the material disposed of in California's landfills is PS. However, because of its light weight, the volume of PS disposed of in landfills is much higher than the weight amount would tend to indicate. For example, weight/volume estimates range from 9.6 pounds per cubic yard for expanded polystyrene (EPS) packaging to 22.2 pounds per cubic yard for other forms of PS. This compares to 100 pounds per cubic yard for cardboard and 2,160 pounds per cubic yard for broken glass. (Source: 4) However, because of the minimal amount of PS disposed of, additional management efforts may have only a minimal impact on the available space at California's landfills.

Legislative Requirement

In September 2001, Governor Gray Davis signed into law a bill requiring the CIWMB to study the use and disposal of PS in California (SB 1127, Karnette, Chapter 406, Statutes of 2001—referred to as "SB 1127" in this document, unless specific Public Resources Code [PRC] sections are cited). This report, required by the legislation to be submitted to the Legislature, presents findings and recommendations from the study.

SB 1127 required that the report must:

1. Analyze how consumers are using PS before it enters the waste stream, including, but not limited to, food service and transport packaging. The report must cover the amount of PS being landfilled annually in the state, the amount being reused and recycled, and the related environmental and public health implications, if any.
2. Recommend methods for source reducing, reusing, and recycling, and for diverting PS from the state's landfills.
3. Address the cost of disposing of PS in volume and weight terms.
4. Examine and identify current and potential markets for recycled PS products.

Concurrent with the legislative process for SB 1127, the CIWMB and DOC initiated a plastics white paper project to define current California plastics issues and provide a menu of policy options. The CIWMB and DOC were interested in (1) increasing the plastics recycling rate, (2) increasing the use of recycled plastics, and (3) promoting plastics resource conservation. Information on plastics, including PS, was obtained from a variety of sources and a wide range of stakeholders (including the plastics industry, environmental community, local and State government, waste haulers, processors, and others). Stakeholders have reviewed both the plastics white paper and this PS report.

The information in this report also considers other statutory requirements, including the California Integrated Waste Management Act (AB 939, Sher, Chapter 1095, Statutes of 1989 as amended [IWMA]). The IWMA requires the CIWMB and local agencies to promote the following priorities in managing solid waste: (1) source reduction, (2) recycling and composting, and (3) environmentally safe transformation and environmentally safe disposal.

Approaches to Managing Plastics

While the direction of the Legislature was to study PS, the CIWMB would be remiss if it did not also provide the larger context of plastics in general. CIWMB believes that California should develop a comprehensive approach to managing all plastics, not just PS. Development of this comprehensive and cohesive solution should be a collaborative process of all stakeholders, led by the State. However, it may be more practical to collaborate with a segment of the plastics industry as a pilot program and then modify the process to be more comprehensive.

This effort may contain elements found in approaches used in other countries, such as Australia, Canada, the European Union, previously proposed California legislation, and a new plastics industry-initiated coalition.

However, it should contain elements in at least the following four areas:

1. Product stewardship and financial responsibility.
2. Collection and market development.
3. Public information, public relations, and education.
4. Research and development of technologies.

These activities should use a shared-responsibility approach and be directed toward a "zero-waste" goal, with interim objectives for making progress toward that goal.

Should Certain Plastic Products or Packaging Be Banned?

Bans on the sale of plastic products are sometimes proposed as a means to solve plastic issues. Two potential plastic bans are most often mentioned: PVC containers, which are a contaminant in PET recycling, and PS food service containers, which are not currently recycled due to economics and food contamination. Food containers are a major component of litter in storm drains.

While bans may help solve immediate problems, they are generally not an effective long-term solution. Implementing a processing fee that covers the extra costs of recycling PS products and containers that are not effectively recycled might be more effective than banning the materials.

Encouraging and promoting alternatives could be more effective than bans in solving problems posed by plastic materials. These alternatives could include biodegradable food service containers—used in conjunction with food composting—and increasing litter reduction efforts. Bans are narrow in scope, addressing a very specific problem with a very specific solution. This narrow approach is an ineffective means of addressing a material with the global applications and ramifications of plastics. While bans have, in some cases, been effective in bringing about change, policy makers should use them only as a last resort.

Should Plastic Manufacturers Be Assessed Additional Plastic Payments?

Some members of the plastics industry have already made significant contributions to plastics recycling in California. However, industry could provide increased funding support, especially as part of a broad collaborative initiative. Such an effort is likely to be more successful than the independent and more discrete industry efforts of the past.

Industry could expand its support of plastics initiatives in a number of ways. These could include funding specific earmarked programs or supporting mandatory fees or deposits. Another option would be voluntary deposit systems paid into a plastics fund based on sales in California, with the payment amount to be determined. Mandatory fees may be unpopular among industry groups and complicated to implement for both government and industry. Mandatory deposits could be complicated if they are not blended into the existing California Beverage Container Recycling and Litter Reduction Bill ("Bottle Bill") system, currently administered by DOC. A voluntary deposit system may be appropriate for some products or packages, and industry should consider these systems. Two examples of potential voluntary deposits are the Alberta Plastic Milk Jug Recycling Program (www.plasticsrecycling.ab.ca) and deposits on car batteries to encourage returns to the retailer.

Industry groups may also choose to self-fund initiatives for their products and packaging, such as the PLFC's recycling program for loose-fill packaging "peanuts." However, these programs all provide funding for fairly specific products and packaging.

For more generalized industry support of plastics recycling and resource conservation, one alternative would be to establish a payment based on sales of plastic packaging, products, and resin in California. Exemptions could be allowed for packaging and products with a certain level of postconsumer material and for postconsumer resin.

The CIWMB-led collaborative process could develop specific criteria for uses of the funds generated through one of the above mechanisms. Companies could choose to contribute to the fund voluntarily, or the fee could be mandatory. This type of fee would be much simpler to implement than an advance disposal fee on individual products or packages sold in the state.

Plastics White Paper

Most would agree that while there are many advantages to the use of PS, there are also some drawbacks. While there can be some improvements in the effective management of PS in California, what is needed is a comprehensive approach to managing all plastics, not just PS.

Plastics are the fastest-growing segment of the waste stream, often replacing other materials. Plastics represent an estimated 8.9 percent (by weight) of materials disposed of in landfills and perhaps twice that amount by volume. That ranks plastics as the second largest category of material (by volume) being landfilled, behind paper. Plastics recycling is stalled at approximately 5 percent, much lower than the recycling rate for many other materials. Most of the current plastics recycling is from beverage containers.

With some exceptions, the plastics industry is not adequately addressing plastics shortcomings on its own. Currently, there is no comprehensive policy to effectively manage plastics and plastics waste in California. The two existing CIWMB plastics recycling programs combined (pertaining to regulated plastic trash bags and non-exempt rigid plastic packaging containers) address only a small percentage of the materials disposed of in landfills. Additionally, the Beverage Container Recycling Program at DOC targets various beverage containers, including plastic, sold in the state.

The Board, in partnership with DOC, recognized the need to address the above issues and contracted with NewPoint Group, Inc. (NPG). NPG assisted the Board, DOC, and stakeholders in identifying and analyzing the manufacturing and use cycle of plastics and in creating and developing innovative solutions to (1) conserve resources, (2) increase the plastics recycling rate, and (3) increase the use of recycled plastics. A Plastics White Paper (PWP) was developed and accepted by the CIWMB at its June 2003 meeting. (Source: 5) The PWP presented a solid background for understanding the many issues related to plastics. The PWP also presented numerous options for policymakers to consider to more effectively manage plastics in California.

National Packaging Covenant

An approach used to reduce packaging waste in Australia and New Zealand is the National Packaging Covenant (NPC). Initiated in 1999 by the Australian and New Zealand Environment & Conservation Council, the NPC is a collaborative approach between state government, local government, and the entire packaging supply chain (and relevant industry associations). The NPC is a voluntary, self-regulatory approach to provide improved management of used packaging based on the principles of product stewardship and shared responsibility.

The NPC system has two main components:

- The Covenant serves as a framework or umbrella document. As the primary document, it sets broad parameters, covers the entire packaging supply chain, is self-regulatory, not prescriptive (does not mandate how companies comply), and has a limited lifespan (five years).
- The Regulatory Safety Net or National Environment Protection Measure (NEPM) is designed to support the NPC and, in an effort to ensure consistency, include those who did not sign the Covenant. The NEPM includes "take back" requirements with the focus on "brandowners" (such as large grocery chains). Brandowners' participation is necessary due to their position as key decision-makers and their ability to influence the supply chain as customers of packaging manufacturers.

The NPC includes action plans for each participant that set forth specific measures and activities. Associations may prepare plans for an industry group or local governments. There are also provisions for funding the operation.

While the NPC is still relatively new, early indications are encouraging. It is favorably received by the packaging industry because it allows them to develop their own action plans and method of compliance. It also avoids potentially more onerous laws and regulations. It is also supported by most of the environmental community and government sector.

Rates and Dates

Another approach was proposed in SB 1069 (Chesbro, 2001-02 Legislative Session). If passed, the bill would have, among other things, imposed a plastic pollution fee on manufacturers of containers for every plastic container of a resin type that does not achieve a 50 percent recycling rate by a future date. The fee would not have applied to beverage containers as defined by the Bottle Bill.

The fee would have been the difference between the average cost of recycling and the average scrap value of each resin type. The monies would have been used to promote the recycling of plastic containers, including payments to recyclers and local governments to offset the cost of recycling plastic containers.

If the 50 percent recycling rate goal were not met, the proposed law would have imposed an economic transfer from manufacturers to recyclers to reduce the cost of recycling. That would have decreased the cost of recycled plastic and, presumably, increased its use.

Proponents of this “rates and dates” approach claim it is needed to motivate responsible parties and would allow flexibility in how to achieve the recycling goals. Opponents argue that it sets arbitrary and political goals with little, if any, economic or environmental rationale and without considering the numerous technical and logistical issues.

California Bag and Film Alliance

The California Bag and Film Alliance (CBFA) is a coalition of stakeholders representing the national Film and Bag Federation (FBF), which is a business unit of the Society of the Plastics Industry (SPI), the California Film Extruders and Converters Association (CFECA), and other plastics interests. The CBFA represents approximately 80 percent of the manufacturers supplying plastic film and bags to California.

Most of the CBFA members acknowledge that while their products serve a consumer need, their products can also have unintended consequences that should be addressed, including introduction into the litter and marine debris stream. The Plastic Film Industry Environmental Resolution (PIER) marks the first substantive proposal to advance recycling, biodegradability, and comprehensive management of plastic discards from any segment of the California plastics industry. The PIER provides a framework for collaborative solutions that address the environmental impacts associated with plastic products. Detailed action plans will be developed in a collaborative process.

Zero Waste

In its 2001 Strategic Plan, the CIWMB determined that it will “Promote a ‘zero-waste California’ where the public, industry, and government strive to reduce, reuse, or recycle all municipal solid waste materials back into nature or the marketplace in a manner that protects human health and the environment and honors the principles of California’s Integrated Waste Management Act.” The Zero Waste philosophy focuses on the most efficient use of natural resources in order to maximize the reduction of waste and protect the environment.

It also includes, but is not limited to, maximizing recycling and ensuring that products are designed for reuse or repair or are recycled back into the environment. Zero Waste involves utilizing the most effective industry processing or manufacturing practices to efficiently conserve the use of raw materials, including front-end design for efficiency, while educating consumers.

It includes promoting technology to encourage source reduction on the front end and recycling and other technologies on the back end, while harnessing the energy potential in “waste” by using new and clean technology to convert materials directly into green fuel or gas for the production of electricity.

Types and Amount Produced

PS comes in many types and forms and is used in a variety of applications. However, the two major types are “general-purpose” (also known as “crystal”) PS and “high-impact” (also known as “rubber-modified”) PS. When a blowing agent (usually pentane) is added to general purpose PS, the material is referred to as “expandable (or “expanded”) polystyrene” (EPS). Approximately 57 percent of the PS consumed in the U.S. in 1999 was general-purpose. Table 1 summarizes various PS types and typical products. Examples of general-purpose PS include CD jewel cases, salad “clamshells,” and cutlery. Examples of high-impact PS (HIPS) include horticultural trays, yogurt containers, business machine housings, and office supplies. Examples of EPS, sometimes incorrectly referred to as “Styrofoam®,” include beverage cups, packaging for electronics, and loose-fill “peanuts.”

PS’s two major types and four major production methods are reflected in Exhibit 1: extrusion, extrusion foam, injection molded, and expandable bead. Extrusion PS includes agricultural trays, clamshells, meat trays, dairy containers, and decorative panels. Molded PS products include products such as appliance housings, CD jewel cases, tumblers, flatware, and some EPS packaging. Expanded PS includes cups, shape-molded packaging, and loose-fill packaging peanuts.

Exhibit 1. Polystyrene Types and Production Methods

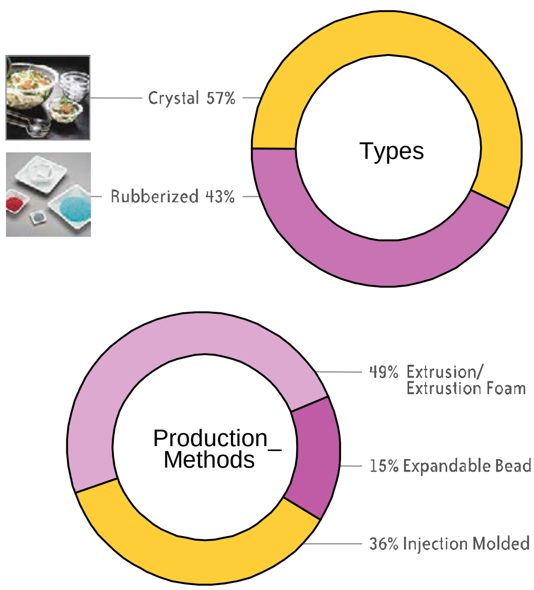


Exhibit 2 illustrates the percent of PS used in each of six major markets. Consumer and institutional products, including PS food service, is the largest category, with 41 percent of the total. Packaging is second, with 19 percent of the total use. (Source: 6, p. 73) PS sales in the US increased fairly steadily from 1991 to 1999. Sales peaked in 1999 and have declined since then, as shown in Exhibit 3. (Source: 8, p. 59)

California production figures for PS must be estimated from national figures, since no data collected specifically for states is available. Table 2 illustrates the estimated California share of PS sales calculated based on population, according to U.S. Census data. The total California share of PS production and sales are estimated at 377,579 tons.

Exhibit 2. Major Markets for Polystyrene

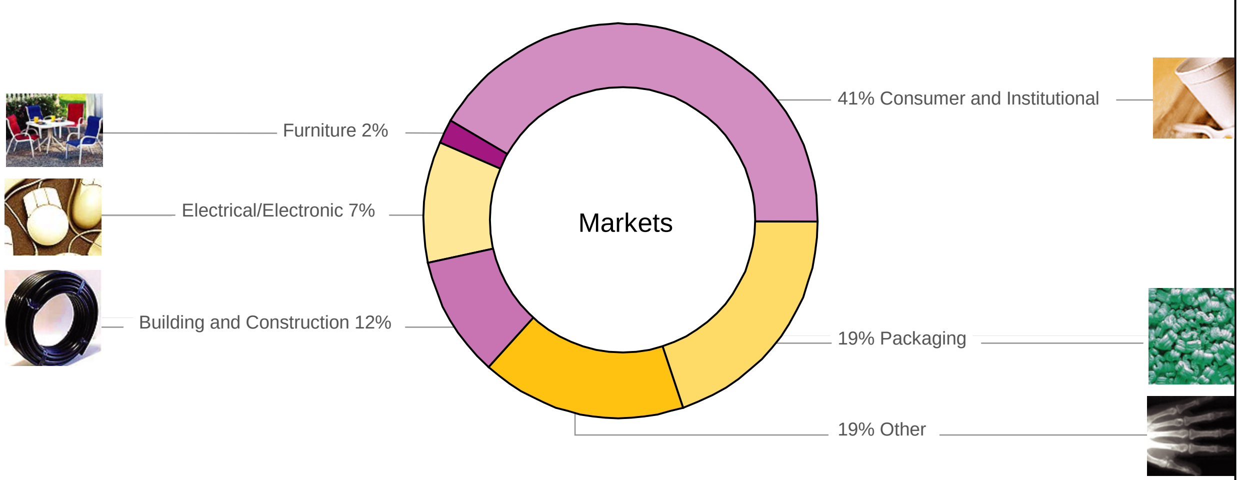


Table 1: Polystyrene Types and Typical Products

Polystyrene Type	Description	Typical Products
Crystal (rigid)	Transparent, can be injection molded or extruded, rigid, good clarity and stiffness.	Audio equipment, dust covers, clear audiotape cassette, and CD jewel cases; office supplies, computer disk reels, tumblers, flatware, housewares, display cases, petri dishes, pipettes, bottles.
Impact (rubberized)	Opaque, higher strength, less clarity and stiffness than crystal PS	Electronic appliance cabinets, business machine housings, video cassettes, small appliances, smoke detectors, furniture, refrigerator door liners, luggage, horticulture trays, and dairy and yogurt containers.
Non-foamed PS sheet	Extruded or oriented, melted plastic is forced through a flat-faced die, extruded sheet is then thermoformed. Can use impact PS or crystal PS (for clear).	Glazing, decorative panels, cookie trays, document wrap, blister pack, salad containers, lids, plates, and bowls.
Foamed PS sheet	Extruded, thermoformed, made by extruding crystal PS with a foaming agent (usually pentane), material is extruded through an annular die and foamed as the material exits the die, sheet thickness and density is varied to meet end-use requirements, has excellent thermal insulation qualities.	Egg cartons, meat and poultry trays, food service trays, fast food packaging, insulation, protective covers for glass bottles, plates, hinged containers, cups.
Expanded PS (EPS)	Made from PS resin granules impregnated with a blowing agent (typically pentane). Expanding beads fuse together to form the finished product, which is white, and 90 to 95 percent air (99.6 percent for loose fill). Small beads are used for cups and containers, medium beads for shape-molded packaging, and large beads for the expanded loose-fill packaging (peanuts). It insulates, is lightweight, and resists moisture. Loose-fill peanuts sold in California that contain recycled material are often colored green.	Insulation board, molds for metal casting, flotation devices, packaging (molded shapes, peanuts), cups, and containers.

Applying the market share information to the California estimate, 77,006 tons is packaging, and 156,829 tons are consumer/institutional applications. The packaging and food service PS for California was an estimated 166,135 tons in 2001.

According to the Alliance of Foam Packaging Recyclers Association, 16 manufacturers of EPS foam packaging are in California operating at 22 locations. These facilities use an estimated 11,000 to 13,000 tons of resin per year, and employ more than

1,000 workers. The total number of firms in California manufacturing all types of PS is about 125. These firms employ more than 11,600 people, although some may be involved with other resins as well.

Markets for Recycled Polystyrene

Several markets are available for EPS in both closed- and open-loop recycling. Sufficient end markets are available for all the clean EPS collected. Almost half of the EPS packaging recycled—both molded and loose-fill—is remanufactured back into EPS packaging.

Other applications for EPS recycling include building applications such as siding and deck board, ceiling texture, molding, electronic products, auto products, agricultural products, office supplies, egg cartons, and beanbag filler. Markets for non-foam PS include coat hangers, picture frames, waste baskets, videocassettes, flowerpots, and nursery trays.

Companies that produce non-foam rigid PS products consume about 25 percent of the EPS packaging recycled. EPS molders consume about 50 percent, and loose fill manufacturers purchase the remaining 25 percent. The amount of material currently available limits the recycled-content level in molded EPS to about 2 percent post consumer material. (Source: 10, p. 4)

Recycled-content levels in EPS molded packaging can be as high as 25 percent, but they are typically much lower. (Source: 10, p. 3) These levels could increase in the future. One manufacturer of EPS recycling equipment recently obtained acceptable ASTM standards with EPS made with 20 percent and 40 percent regrind (recycled content). (Source: 11, p. 3) Applications with higher cushioning requirements may need to use a lower recycled-content level.

Molders typically incorporate recycled content into their products by blending in used expanded beads from products they take in and grind down to bead levels. Because the recycled EPS is not reblown, it has a different shape and can only be used in limited quantities.

This material serves primarily as “dead filler” material because it lacks a blowing agent to make it into foam. Due to design restrictions, molded EPS—especially thin material—can tolerate 5 to 10 percent recycled EPS without a loss in quality characteristics. Less demanding applications, such as EPS block manufacturing, can tolerate higher levels. (Source: 12, p. 3)

Another primary market for recycled EPS molded packaging is the production of loose-fill packaging. Loose fill packaging manufacturers are active in EPS collection programs. Loose fill typically ranges from 25 percent to 100 percent recycled content (depending on producer), although the content is not 100 percent postconsumer.

Table 2: Estimated California Share of PS Production

Market	Tons
Packaging	77,006
Building and Construction	36,249
Electrical and Electronics	33,376
Furniture	5,885
Consumer and Institutional	156,829
Other	64,234
Total	377,579

More than 65 percent of the EPS one California manufacturer (FP International) uses is postconsumer. If loose fill continues to be reused in the take-back program, material could potentially be diverted from the landfill for many cycles of use.

The building and construction industry, including several companies located in California, provides a number of markets for PS. Rastra Building Systems produces a concrete form made of 85 percent recycled PS. The material is produced at two locations in California that have a combined capacity of 156 tons per year.

RING Industrial Group, an Oakland, Tennessee, company, uses an EPS bead for an aggregate substitute in a variety of drainage applications, including septic tank drain fields. This business, and its sister company Rapac, Inc., set up densifiers at qualifying locations across the United States, including California. These companies collect approximately 5,000 tons of modified or fire retardant EPS each year, including approximately 500 tons from California. (Source: 13)

Timbron, a Stockton based company, densifies EPS to produce interior moldings and other similar products that can be sawed and nailed like wood. Timbron products are sold at Home Depot stores. EPS constitutes 75 percent of the company's finished products, with demand at more than 18 million pounds annually.

Timbron provides large suppliers of recycled EPS with a $60,000 densifier, as well as support for labor in collecting and densifying the material. Suppliers include HP, Epson, Sony, Panasonic, Marko Foam Products, and Tatung America. Timbron uses both postconsumer and post-industrial EPS. The company received a $1 million loan from the CIWMB's Recycling Market Development Zone loan program in 1999.

High impact PS (HIPS) is used in various electronic devices, such as casings for televisions, computers, and telephones. It is also used for office products such as file trays and rulers, horticultural trays, and many other products. While there are currently no reliable figures for the potential market, the CPRA operation reportedly does not have any problem selling its production of approximately 20 tons per day in the open market.

Source Reduction

According to Public Resources Code section 40196, source reduction is any action that causes a net reduction in the generation of solid waste. This can include reducing the use of nonrecyclable materials, replacing disposable materials and products with reusable materials and products, reducing packaging, and increasing the efficiency of the use of plastic. The IWMA recognizes that source reduction is the highest priority in managing solid waste.

Depending on the application, PS can be as much as 95–99 percent air, representing a significant opportunity for source reduction. Additionally, the materials replaced by PS are often heavier, further demonstrating the source reduction benefits of PS.

In its 1999 report, *Waste Management and Reduction Trends in the Polystyrene Industry, 1974-1997*, Franklin Associates quantified many aspects of PS, including the impact of using resins more efficiently and substituting PS for other packaging materials. In its 1996 report, prepared for the Polystyrene Packaging Council—a business unit of the American Plastics Council—Franklin Associates surveyed companies on their use of PS from 1974-1994. Franklin Associates found that during that period, source reduction increased 204,000 tons through more efficient use of resins and by reducing the amount of resin used. This source reduction saved an estimated 17.8 trillion British thermal units (Btu) of energy over the life cycle of the products. The life cycle includes the energy used to extract and process the raw material and to produce a pellet, as well as transportation of the PS through various levels of manufacturing and distribution and to its ultimate disposition (disposal, reuse, or recycling).

Source reduction for PS can include down gauging and product redesign to use less material. It may also include reducing the use of nonrecyclable materials with recyclable materials and replacing disposable products with recyclable or compostable products.

Source reduction opportunities for manufactures of PS products include:

1. Designing products and packaging in such a manner that less material is used in production and/or transportation.
2. Increasing the useful life of products (including making products reusable).
3. Replacement of single-use products that cannot be recycled effectively with recyclable or compostable alternatives.

PS product manufacturers have argued that competitive business pressures to use materials more efficiently have already driven most production methods to their optimum level. Accordingly, there are few opportunities to further change product design or packaging to use less material. Opportunities for reuse are discussed later in this report. Substituting a compostable material for a nonrecyclable material would be most effective in situations where the material was included in a food-waste composting program.

Biodegradable and Compostable Products

Biodegradable and compostable plastics are a technological innovation that may eventually serve as a replacement for some PS food service products—cups, "clamshells," plates, and cutlery. These items are often found in litter. Several companies have developed or are developing compostable and/or biodegradable alternatives, while others are testing products.

There are several products and processes that claim to be compostable or biodegradable. While these materials may not be currently competitive in terms of price or some quality characteristics, they appear to hold significant promise.

The value of biodegradable food service packaging is two-fold, in that (1) institutional users can incorporate the packaging into new small-scale food composting collection systems without the labor and expense of separating the container from the food and (2) if the material is improperly disposed or blows out of trash cans, the negative impact on wildlife and storm drain systems is minimized when the material biodegrades.

The CIWMB has formed a diverse working group of stakeholders to identify the issues and responses that may be necessary for decision-makers to form sound public policy based on facts and science. In addition to developing information to educate and inform decision-makers, the group will identify additional testing and pilot programs, recommend the use of existing biodegradable specifications (such as ASTM 6400), and take other actions that may be needed for decision-makers to determine whether the State should support such efforts and what form that support may take.

Table 3: National Postconsumer PS Types and Recycling Rates

PS Type	Tons Recycled (1999)	Tons Recycled, (2000)	Recycling Rate (2000)
Bottles and Containers	100	100	0.1%
Protective Packaging	10,100	12,450	12.4%
Food Service Packaging	3,250	2,250	0.2%
Other Applications	10,250	11,350	0.6%
Total Recycled	23,700	26,150	0.8%

We must realize that using biodegradable food service products alone will not eliminate litter problems. Some have argued that it may even increase litter if consumers believe that it no longer poses an environmental problem.

Reuse

Recycling and Reuse of Loose-Fill Packaging and Other Recycling

A second major area of PS recycling and reuse is loose-fill packaging, or peanuts. In 1991, the nation's four major EPS loose-fill packaging manufacturers established the PLFC. (Source: 14) Loose-fill packaging customers, such as mail order companies, established the reuse program in part because of environmental concerns.

Two companies, FP International and Storopack, Inc., operate plants that produce and recycle EPS loose-fill packaging in California. FPI locations include Redwood City, and Commerce. Storopack locations include Anaheim, Downey, and San Jose. Since its inception in 1991, industry has paid over $650,000 in program infrastructure costs. These costs include the toll-free 800 number, a Web site, and staffing for administration and fulfillment functions. (Source: 15, p. 6)

The PLFC operates a national manufacturer-sponsored postconsumer EPS packaging take-back program. The program provides a toll-free Peanut Hotline* to provide callers with the nearest location that accepts loose-fill packaging for reuse. The hotline receives about 4,000 calls a month.

In addition, more than 200 mail order and other companies include information on the program with their packaging. Many communities list information on the program in recycling guides. More than 375 locations in California, and more than 1,500 nationwide, participate in the program. Take-back locations primarily include The UPS Store, Mail Boxes Etc., and other similar packaging stores.

The program has broad benefits to all participants. Collection sites provide improved customer service, and businesses are able to reduce their purchase of new packaging peanuts by 50 percent by reusing returned peanuts. Industry reuse of peanuts is estimated at 30 percent of the 22,500 tons of loose-fill packaging manufactured each year. (Source: 16[b], p. ES-3) The reuse rate for EPS in California is estimated at between 20 and 30 percent, a total of about 500 tons per year. This does not include home and business reuse of loose-fill packaging from received packages.

Recycling

While there is no meaningful food service recycling in the United States, several established recycling programs are available for non-food service PS. Three primary categories of materials are recycled:

Transport packaging (EPS) is collected at manufacturing facilities across the United States, including 12 in California (see Table 6).

Loose-fill packaging is also collected at these facilities as well as at packaging and mailbox locations across the country. This was discussed previously in the report under *Reuse*.

Other types of PS recycling make up about 43 percent of the total PS recycled. Materials recycled include insulation board, audio- and VHS cassettes, CD jewel boxes, and nursery trays and containers. Most of these materials are recycled through commercial sources, not curbside programs.

In addition, a very small amount of PS food container recycling, as well as post-industrial PS scrap recycling, is collected from some institutional locations.

National PS recycling quantities are shown in Exhibit 4 and Table 3. (Source: 16[a], p. 1; 16[c], p. 2)

Table 4 illustrates the California share (by population) of PS recycled. (Comment: 17) These estimates may be conservative, since California likely has a greater percentage of PS recycling due to the larger number of EPS recycling facilities statewide. Table 5 illustrates typical recycling costs compared to recycled and virgin resin prices. (Source: 18[a]; 18[b]) The margin between recycled resin prices and recycling costs is relatively small.

Table 4: California PS Production and Recycling Estimates, 2001

	Calif. Tons Produced	Recycling Rate	Tons Recycled
Bottles and Containers	7,552	0.1%	6
Protective Packaging	11,327	12.4%	1,405
Food Service Packaging	154,808	0.2%	310
Other Applications	203,893	0.6%	1,223
Total	377,580	0.8%	2,944

Table 5: Typical PS Recycling Costs and Resin Prices

Type of PS Recycling	Cost or Price per Pound
Food Service Recycling Cost	$.10 to .50
Recycled Resin Price	$.38 to .45
Virgin Resin Price	$.40 to .70

*Peanut Hotline number: (800) 282-2214

EPS Protective Packaging Recycling

The Alliance of Foam Packaging Recyclers (AFPR) was established in 1991 to help support foam packaging recycling. This is a trade association of more than 80 EPS protective-packaging manufacturers, equipment manufacturers, and resin suppliers. More than 110 member plant locations nationwide—as well as many other non-member locations (such as loose-fill packaging manufacturers)—collect EPS. The AFPR also accepts EPS packaging consumers send in the mail.

Most EPS recycling in California (and nationwide) occurs through EPS manufacturing facilities. Twelve facilities in California accept EPS packaging, as shown in Table 6. (Source: 19) These facilities take-back primarily molded EPS packaging. One of these companies, FP International, was the first company to recycle EPS packaging, starting in 1989. In California since 1990, FP International has recycled over 17 tons of molded EPS packaging from California, including 9.8 tons of postconsumer material. (Source: 20)

The estimated recycling rate of these California companies is 19 to 23 percent, significantly higher than the national rate of 12 percent. California EPS manufacturers collected an estimated 2,500 tons of postconsumer EPS in 2000, again significantly more than the estimated California share. (Source: 21, p. 4)

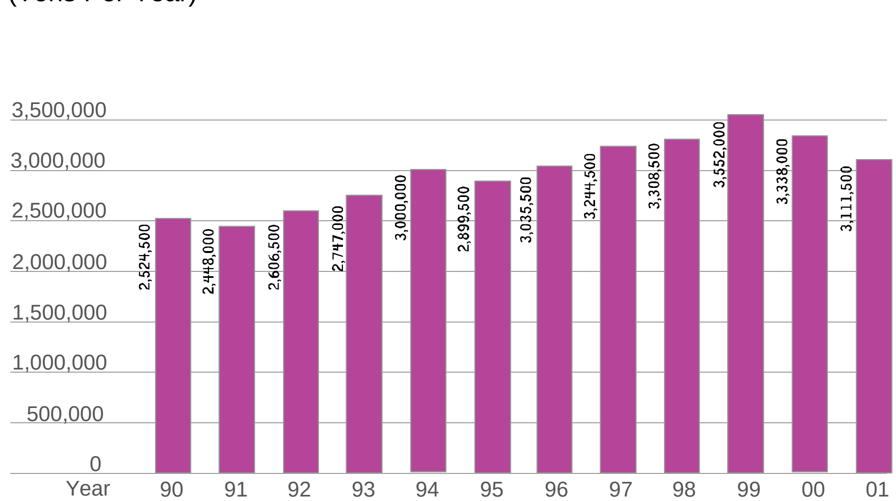
Table 6: EPS Packaging Collection Sites in California

Company	Location
1. Astrofoam Molding	Camarillo
2. Foam Fabricators	Modesto
3. Foam Fabricators	Compton
4. FP International	Commerce
5. FP International	Redwood City
6. Marko Foam Products, Inc.	Corona
7. Storopack, Inc.	Downey
8. Storopack, Inc.	Anaheim
9. Storopack, Inc.	San Jose
10. Styrotek, Inc.	Delano
11. Topper Plastics	Covina
12. Tuscarora Incorporated	Hayward

Most EPS packaging is returned from larger manufacturers and distribution centers such as furniture and automobile manufacturers. For example, Ethan Allen is developing a collection system that could incorporate up to 300 stores and 26 distribution centers (two in California). To make the program economical, trucks backhaul EPS to the distribution centers, where the EPS is collected and sent to a manufacturing facility. Transporting loose EPS by truck is economical within a 100-mile radius. If a backhaul vehicle is not available, costs range from $85 to $450 per shipment.

Larger manufacturers can densify the PS before shipping it to reduce costs. EPS collection programs from retailers are limited. Retailers are resistant to establishing collection systems, even with

Exhibit 3. U.S. Polystyrene Production Over Time
(Tons Per Year)



EPS industry support. The retailers do not want to give up valuable warehouse or parking lot space.

A few local governments provide drop-off programs for EPS. One EPS manufacturer, FP International, supports drop-off facilities in Palo Alto and San Mateo County. Contamination is more of an issue with these programs than the manufacturer take-back systems. Standards for EPS recycling are quite high. Manufacturers require material that is not contaminated with substances or materials such as adhesives, film plastic, cardboard, and dirt.

Materials that have been collected through a curbside program, or even left in a drop-off bin or outside in a storage yard, are usually too contaminated for end users. This contamination limits the amount of EPS material that can be recycled. As with other plastics recycling, the key to successful EPS recycling is obtaining sufficient quantities of clean material.

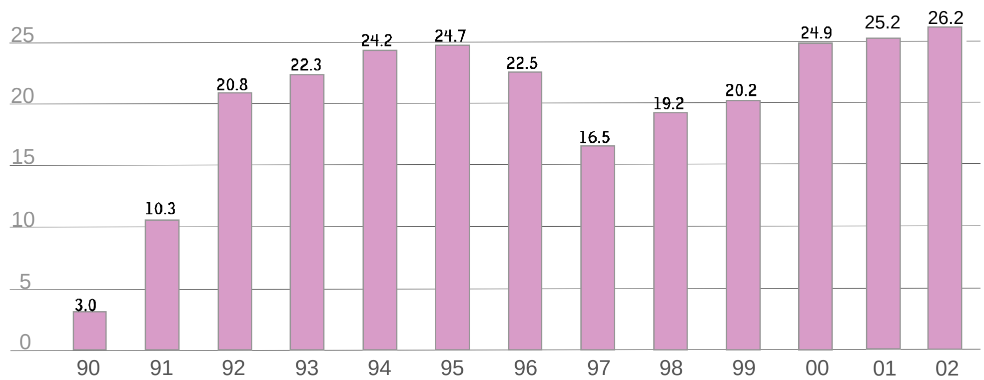
National Polystyrene Recycling Company

In the late 1980s, responding to growing consumer pressure and concern about landfill space in the United States, the PS industry initiated postconsumer recycling programs. In 1989, industry established the National Polystyrene Recycling Company (NPRC) to recycle PS food service and molded packaging. The NPRC was a $16 million startup effort funded by the eight resin supplier companies existing at the time in the U.S. (Source: 22, comments pertaining to p. 9 of draft report) The five recycling facilities (and one affiliated facility) had a goal of a 25 percent recycling rate for food service and packaging PS by 1995.

While technically feasible, food service PS is difficult to recycle due to being contaminated with food. It also experiences transportation challenges due to its light weight and other collection difficulties. Industry found that there was reluctance among organizations, businesses, and consumers to collect food service PS for recycling. As with other resin types, it was difficult for the recycled resin to compete with virgin PS on both a cost and quality basis. The corporations involved with the NPRC invested $85 million between 1989 and 1997 to operate the recycling facilities, yet never achieved profitability. (Source: 23, p. 3)

There is virtually no recycling of food service PS in California. However, since 1990, Michigan-based Dart Container has assisted companies wanting to recycle food service PS by leasing them a densifier for $295 per month and backhauling the material to a recycling facility. Although there were a limited number of California facilities participating, none are currently participating. According to Dart Container representatives, fewer customers were

Exhibit 4. National EPS Postconsumer Recycling Rates and Quantities
(Millions of Pounds)



Recycling Rates (Percent)	1.7	5.9	9.5	10.5	10.2	12.7	10.4	7.4	9.5	9.6	12.1	13.1	13.0

willing to pay for the densifier or allocate the labor necessary to sort and process the material.

Canadian Polystyrene Recycling Association

About the same time that NPRC was starting in the United States, a similar effort was started in Canada for similar reasons. However, the Canadian Polystyrene Recycling Association (CPRA) is still in operation, while the NPRC is not. In an August 2003 interview, CPRA President John Roulston provided an insight into CPRA's operation and why it is successful.

CPRA processes 20–25 tons of material per day, five to six days per week. It receives material primarily from three areas: (1) approximately 20–25 percent of its material comes from the horticultural industry (trays and flats), (2) a significant (undetermined) percentage comes from commercial packaging and graphic industrial signs, and (3) about 5–10 percent comes from the government-run curbside collection program (referred to as the Blue Box), which serves approximately one million households.

CPRA pays materials recovery facilities approximately $50 (U.S. dollars) per ton, F.O.B. CPRA's facility. The manufacturing operation provides approximately 96 percent of revenues, with membership fees providing the remaining four percent. The membership fees roughly cover the cost of the educational outreach program. Although CPRA's operations were subsidized for the first

Holiday EPS Collection Project

The challenges of EPS collection from consumers after Christmas were demonstrated in Long Beach in December 2002. The goals for the one-day event were to increase awareness of plastics recycling and to offer a special event in which EPS material generated over the holidays could be collected and recycled. The Alliance of Foam Packaging Recyclers (AFPR), the City of Long Beach, the American Plastics Council (APC), FP International, Tuscarora Incorporated, and the CIWMB organized the program. AFPR has 10 years experience in facilitating EPS Christmas collection programs, and the City of Long Beach has a long-standing reputation of being successful and innovative with recycling.

After considering a variety of alternatives, it was decided to conduct the EPS collection in conjunction with the city's Christmas tree collection program. This provided an opportunity to leverage a long-standing post-holiday recycling activity (recycling Christmas trees) for consumers. Several different approaches were taken to advertise the program. Advertisements in the local paper for the Christmas tree collection were edited to include information about dropping off EPS at the same locations. Where existing ads could not be edited, new ads were placed next to the Christmas tree announcements. Approximately 72,000 flyers were distributed to area school children to take to their parents and approximately 5,000 paycheck stuffers were provided to City of Long Beach employees. Press releases were issued to local TV, radio, and print media in addition to distribution of flyers at local Circuit City and Wal-Mart stores. Additionally, EPS recycling posters were distributed to schools and city government buildings. Organizers estimate that over 50,000 households were informed of the collection event.

The EPS collection took place at 11 locations on Saturday, December 28, 2002. A total of approximately 200 pounds of EPS was collected from all 11 locations. Costs for the project totaled over $22,000, including promotion/advertising, the trailer to haul the EPS, and other costs. This $110 per pound collection cost is in addition to an estimated 1,200 man hours contributed to the project.

The results were consistent with most other efforts undertaken by the participants in large metropolitan areas. However, the holiday collection program has been successful in smaller cities when heavily promoted by local media and PS producers.
(Source: 24)

If this type of promotion is planned in the future, it would need to have significant consumer interest and cooperation in order to provide a better opportunity for success.

decade, the association has not required a subsidy for plant operations since 2000. It also received tax incentives from the province.

CPRA produces a single product, a 100 percent postconsumer black high-impact PS (HIPS). Approximately half the sales are to the horticultural industry with the balance being used in non-critical application, such as office products. Part of CPRA's success can be attributed to its management style. The corporate culture is more similar to that of a recycling entrepreneur rather than a large corporate bureaucracy. Although governed by a Board of Directors, CPRA's management team is given the authority and responsibility to efficiently run the operation.

Conversion Technology

A new form of plastics recycling that holds significant potential is "feedstock recycling" or "chemical recycling." This process is often referred to as "conversion technology." Conversion technology (CT) refers to the processing of solid waste through non-combustive thermal, chemical, or biological processes, other than composting, to produce products such as electricity, fuels, or chemicals that meet quality standards in the marketplace. CT includes, but is not limited to, catalytic cracking, gasification, and pyrolysis.

Basically, plastic is processed through one of the methods to produce a marketable product, such as fuel or gas. These products can be used to fuel vehicles or power generators as a form of "green," or renewable, energy. Some methods can also produce the original polymer or resin. While CT processes hold significant long-term potential, it is unclear at this time how much PS can be recycled using CT. It is also unclear whether projects can be economically self-sufficient or what kind and/or level of subsidy, if any, may be needed to support the activity. The price of oil is one of the primary factors in considering the economic feasibility of the conversion of plastics.

Generally, curbside programs are not able to generate adequate quantities or quality for use by EPS manufacturers. Contamination issues with PS suggest that conversion of the PS into fuel or other products may be a potential alternative for diverting PS that is not readily recyclable.

CT is considered "cutting-edge" technology, and there are only a few operating facilities in the world. One such facility under construction is the Plastic Energy, LLC facility located at the Kings County Material Recovery Facility. This facility intends to use post-recovered plastics (after recyclable materials have been removed) to produce an ultra-low sulfur diesel fuel. Waste Management, Inc. has already agreed to provide post-recovered plastics and use the resulting diesel in its vehicle fleet. The CIWMB provided a $2 million low-interest equipment loan through its Recycling Market Development Zone loan program for the facility.

Legislation (AB 2770, Matthews, Chapter 740, Statutes of 2002) allocated $1.5 million for the CIWMB, in consultation with other federal and State entities, to prepare a report to the Legislature on new and emerging conversion technologies (CT). The report will include technologies that can process plastics, including PS. This may provide an alternative to the current practice of disposing of plastics in landfills.

Disposal

In 1999, an estimated 300,000 tons of PS was landfilled in California. This amount is relatively small in terms of overall waste generation—only 0.8 percent (by weight) of the total waste landfilled in California. (Source: 25[a], p. 42; 25[b], p. 11; Comment: 25[c]) Even considering volume rather than weight, PS in the waste stream does not appear to pose significant problems related to landfill capacity.

PS disposal is no different than any other material. If users do not recycle their PS, they dispose of it with other solid wastes. EPS is a very bulky material, so a consumer who purchased a new appliance with EPS protective packaging could fill a trash can with foam that week. Another potential PS disposal problem, discussed below, results when fast-food containers (cups, plates, clamshells) either spill over or blow out from trash receptacles. Because the EPS material is so light, it can blow away, becoming litter. This release into the environment is one of the key concerns with food service PS.

The cost of PS disposal can be calculated from typical disposal cost figures, since it will be collected with other solid waste from both commercial and residential sources. Typical solid waste collection costs in California are $100 per ton, including collection and an average tipping fee of $30 per ton. Total disposal costs for PS are estimated at about $30 million per year. (Source: 26) These costs are covered through solid waste fees paid by residential and commercial users, like all other solid wastes. This does not take into consideration the cost of collection and disposal of litter, which can result in a significantly higher cost (see "Environmental and Health Impacts" section below).

Environmental and Health Impacts

The three key areas discussed in this section are life-cycle impacts, health impacts, and environmental impacts. When compared to many alternatives, the lifecycle impacts of PS products that are properly disposed or recycled are positive and should be recognized. The health impacts of PS have been controversial at times but appear to be minimal. The primary environmental impact of PS relates to litter and improperly disposed PS, particularly in the marine environment. This is the key issue of concern for PS, and it should be addressed in future industry deliberations and policy-making. Each of these areas is summarized briefly, below.

Life-Cycle Impacts

Life-cycle impacts are often calculated by performing a life-cycle assessment/analysis (LCA). An LCA, sometimes referred to as "cradle to grave" analysis, determines the environmental impacts of products, processes or services, through production, usage, and final disposal. In general, PS protective packaging is light, strong, and effective in protecting a wide range of products. It reduces breakage and the total weight of waste disposed as compared to other alternatives. PS containers used to ship produce and fish provide insulation, and they have demonstrated the ability to keep food fresher than typical wood or cardboard containers.

One study found that EPS boxes were more effective than corrugated cardboard boxes for shipping fresh fruits and vegetables. The benefits of EPS included controlling acidity, maintaining solid content, reducing pigment loss, reducing vitamin loss, and extending freshness. (Source: 27, pp. 45–46)

An LCA comparing foam PS and bleached paperboard plates, cups, and hinged containers found that the PS containers require 30 percent less energy than the paper containers. PS containers contributed 29 percent more to solid waste volume, and they have 46 percent lower atmospheric emissions. They contributed 42 percent less waterborne wastes. (Source: 28, pp. 4-16, 4-27)

Martin B. Hocking of the University of Victoria, British Columbia, Department of Chemistry, observed similar findings. With respect to overall energy costs during fabrication and use, reusable cups have energy consumption similar to single-use PS foam cups after 500 uses. (Source: 29, p. 889) Polystyrene cups were found to have the lowest energy consumption. Hocking also notes that paper cups result in additional chemical use and emissions as compared to PS cups. (Source: 30, pp. 28–29)

After an extensive environmental impact assessment, the Danish Environmental Protection Agency determined the burdens various packaging materials place on the environment. Packaging materials were reviewed in terms of their main environmental pressure in life-cycle phases. The agency ranked various materials from highest to least impact in various categories. In the categories of energy consumption, greenhouse gas effect, and total environmental effect, EPS's environmental impacts were the second highest, behind aluminum. Materials studied include: aluminum, steel, polyvinyl chloride, EPS, PS, polyethylene terephthalate (PET), high-density polyethylene (HDPE), low-density polyethylene (LDPE), polypropylene, glass, and cardboard. (Source: 31)

These life-cycle studies identify trade-offs of various products systems but may not reflect the environmental and societal costs associated with illegal disposal (litter). In many cases, PS is superior in a variety of ways to several alternative products. Provided PS is used appropriately and reused, recycled, or disposed of properly, it appears to have net positive impacts. High costs arise when PS products, like any other products, are disposed of improperly: either through littering or by being accidentally knocked out of, or blown out of, overflowing trash receptacles. These problems are discussed below.

Health Impacts

The most commonly raised health concern related to PS is the migration of the monomer (styrene) used in the production of PS from PS food containers into food and drinks. There are many reports on the issue that support a study conducted by the Harvard Center for Risk Analysis that found, "Styrene's carcinogenicity in humans cannot be ruled out at this time. However, styrene exposure levels among the general population and among most workers are for the most part very low." The study also concluded, "… that occupational exposure to styrene does have a subtle effect on color vision." (Source: 32, p. 3) Additionally, the California Office of Environmental Health Hazard Assessment does not include styrene on the list of chemicals known to cause cancer or reproductive toxicity. (Source: 33)

Environmental Impacts

An often-mentioned environmental impact from PS results from the improper disposal (primarily littering of PS containers.) The California Department of Transportation conducted a litter management pilot study during 1998–2000. That study found that PS foam (referred to in the study as "Styrofoam") represented 15 percent of the total volume of litter recovered from storm drains. Other significant items include moldable plastic (16 percent), plastic film (12 percent), and paper (14 percent). This does not include larger items that did not enter the storm drain system. (Source: 34, p. 12)

Table 7: U.S. Coastal Cleanup Results—Foam, 1999

Foamed Plastic	Pieces	Foam Percent	Total Percent
Buoys	13,609	3.0%	0.3%
Cups	84,652	18.4%	2.0%
Egg cartons	3,503	0.8%	0.1%
Fast-food containers	26,880	5.8%	0.6%
Meat trays	8,688	1.9%	0.2%
Packaging materials	48,329	10.5%	1.2%
Foamed PS pieces	214,960	46.6%	5.1%
Plates	17,997	3.9%	0.4%
Other foamed plastic	42,506	9.2%	1.0%
Total Foamed Plastic	**461,124**	**100.0%**	**11.0%**
Total Pieces	**4,191,169**		

PS is also a significant component in coastal litter collection programs and monitoring studies. In the 1999 U.S. Coastal Cleanup Day (a one-day nationwide cleanup event held each fall), foamed PS pieces were the fourth-largest amount of all materials collected. This represents more than 5 percent of the total number of pieces collected. (Source: 35) Only cigarette butts, plastic pieces, and plastic food bags and wrappers were collected in amounts higher than foam pieces. As shown in Table 7, the nine categories of foam—including fast-food containers, cups, egg cartons, and plates—accounted for 11 percent of the total number of pieces collected, a total of 461,124 pieces of foam products. (Source: 36)

California accounted for 20 percent, by weight, of the total tonnage of material collected in the U.S. Coastal Cleanup Day in 1999. A study conducted from August to September 1998 quantified Orange County, California, beach debris from 43 random sites from Seal Beach to San Clemente. (Source: 37) The most abundant item was pre-production plastic pellets, followed by foamed plastic, shown in Table 8. (Source: 38, p. 116)

Even studies measuring plastics found up to 5 kilometers (km) off the Southern California coast have found high levels of small plastic pieces from land-based sources, especially after storm events. (Source: 39, p. 1037) These small plastic pieces, similar in size to plankton and more abundant than plankton, represent a particular risk to filter feeders.

PS in the marine environment results in significant problems for wildlife. Worldwide, people have reported entanglement for at least 143 marine species, including almost all of the world's sea turtles. At least 162 marine species, including most sea birds, have been reported to have eaten plastics and other litter. (Source: 40)

PS is of particular concern because it is light, it floats, and it is highly visible. In addition, PS foam breaks into small pieces, increasing the chance of ingestion by wildlife and increasing the difficulty and cost of collection. Ingestion of polystyrene pieces, which look like food to many species, results in reduced appetite, reduced nutrient adsorption, and starvation for wildlife.

Marine debris also creates problems for fishermen and recreational boaters, particularly when plastics get into boat engines and cause damage.

Scientists have identified new areas of concern related to floatable plastic litter. One problem is the adsorption of toxic substances in sea water into plastic resin pellets. Another is the transportation of invasive species such as barnacles, mollusks, sea worms, and corals that travel on plastic litter "boats" to islands and other sensitive ecosystems. (Source: 41)

Finally, PS litter has negative impacts on tourism in California. The state has more than 1,000 miles of coastline, so maintaining clean beaches and coastal areas is important to its tourism industry.

The nature of the EPS and PS use—for disposable single-use consumption, often at fast-food restaurants—may increase the likelihood that the material will be illegally discarded by individuals. Also, because of their light weight, even properly disposed containers in full trash receptacles may end up blowing away and becoming litter.

EPS and PS are not the only materials entering storm drains as trash, but are highly visible and have attracted unwanted attention. EPS and PS are some of the most commonly found items in storm drains in Los Angeles County. (Source: 42) Cities in this area began focusing efforts to eliminate trash in storm drains during the next 10 years as part of the TMDL requirements. Each city in Los Angeles County recently agreed to jointly pay the consultant costs to determine the best option to comply with the TMDL requirements. Initial indications are that the cost of TMDL compliance is estimated at $168 million or more.

Trash from Long Beach and Signal Hill storm drains accumulates in a particular location during the summer. An estimated one-fifth to one-third of this trash was estimated to be white PS cups and clamshell containers (followed by plastic water bottles and plastic bags). (Source: 43)

Litter is a pervasive problem involving diffuse sources and human behavior with no easy solutions. Specific materials such as EPS and PS do not cause the litter problem; rather, it is caused by human behavior. Whatever the cause, the high costs of litter cleanup and collection are a significant economic externality of plastics. This is especially true of EPS, which has a tendency to break into smaller pieces making cleanup more difficult. The problem should be addressed in public policy and/or industry-led initiatives.

Litter is pervasive and different methods are used to collect it. It would be impractical to assign an "average" cost to clean up litter in all areas. However, there have been studies documenting the cost to clean up litter in different areas and situations.

A Seattle Times article estimated the cost of collecting litter at $1.11 per pound. (Source: 44) In Orange County, the cost of collecting litter on 6 miles of beach for one summer is $350,000.

Table 8: Estimated Total Abundance and Weight of Trash on Orange County Beaches

August to September, 1999

Debris Type		Number	Weight (pounds)
1.	Pre-production plastic pellets	105,161,101	4,780
2.	Foamed plastics	742,296	1,526
3.	Hard plastics	642,020	7,910
4.	Cigarette butts	139,447	344
5.	Paper	67,582	870
6.	Wood	27,919	4,554
7.	Metal	23,500	3,015
8.	Glass	22,195	1,944
9.	Rubber	10,742	817
10.	Pet and bird droppings	9,388	17
11.	Cloth	5,949	1,432
12.	Other	10,363	401

(Source: 45) The total litter collection costs for cleaning up 19 beaches along 31 miles in Los Angeles County was more than $4 million in 1994.

The City of Long Beach and Los Angeles County currently spend about $1 million a year on litter collection in Long Beach Harbor, at the mouth of the Los Angeles River. (Source: 46) Using a figure of about 3,000 tons collected from 1998 to 1999, the collection cost is more than $300 per ton. (Source: 47, p. 16) The Los Angeles County Department of Public Works also contracts out the cleaning of more than 751,000 catch basins for a total cost of more than $1 million per year. (Source: 47, p. 35)

While aggressively enforcing State and local litter laws is a good first step, this effort alone is unlikely to achieve the Trash TMDL mandated zero-tolerance levels in the Los Angeles area.

Recommendations

The CIWMB does not believe that a separate PS initiative is warranted. However, the CIWMB does recommend the following to assist in minimizing the environmental impacts of illegally discarded PS and exploration of source reduction alternatives:

1 The State should increase litter education efforts through more effective coordination between all State entities that spend money on anti-litter education and/or cleanup. This effort could be led by the CIWMB and include non-profits such as Keep California Beautiful, and other involved parties (local government, environmentalists, food service packaging producers, fast-food restaurants, and others). The effort should leverage resources and deliver a consistent message whenever possible.

2 The State should conduct a statewide litter study to identify the types and respective amounts (volume and weight) of litter and to quantify the environmental and societal impacts of litter. The study should also review the effectiveness of various approaches to reduce litter (human behavior, product stewardship, and best management practices) and other areas, as appropriate.

3 The Legislature should consider making litter a civil offense, to facilitate issuing litter tickets. Legislation could authorize financial incentives, perhaps from proceeds of violation tickets, to individuals and/or organizations that identify violators with appropriate proof (such as videotape or witness testimony) that results in tickets being issued.

4 The State should perform appropriate studies and testing (including demonstration projects) to determine the effectiveness of compostable and biodegradable plastics as alternatives to nondegradable polystyrene.

5 The State should continue to work with manufacturers and other stakeholders to promote additional manufacturer responsibility and product stewardship of polystyrene.

Source References and Comments

1. Society of the Plastics Industry, "California Leads Nation in Plastics Industry Employment," news release, Washington, D.C., April 10, 2003.

2. Alliance of Foam Packaging Recyclers, Crofton, Md., "Polystyrene Recycling Report," presentation to California Integrated Waste Management Board staff, July 25, 2001.

3. The Federal Clean Water Act (Title 33, Chapter 26, U.S. Code) requires states to establish a priority ranking for impaired waters and to develop and implement total maximum daily loads (TMDL). A TMDL specifies the maximum amount of pollutant that a water body can receive and still meet water quality standards. A consent decree between the U.S. Environmental Protection Agency, the Santa Monica BayKeeper, and Heal the Bay, Inc., represented by the Natural Resources Defense Council (NRDC), prescribed schedules for TMDLs, requiring the trash TMDL to be approved before March 2002.

4. California Integrated Waste Management Board, Diversion Study Guide, Appendix I, Conversion Factors: Glass, Plastic, Paper, and Cardboard <www.ciwmb.ca.gov/LGLibrary/DSG/Irecycl.htm>.

5. California Integrated Waste Management Board, Plastics White Paper Project, <www.ciwmb.ca.gov/Plastic/WhitePaper02/>.

6. American Plastics Council, *The Resin Review: The Annual Statistical Report of the U.S. Plastics Industry—2002 Edition*, Arlington, Va., August 2002.

7. Alliance of Foam Packaging Recyclers, *Final Report—1998 Resin Use Study*, prepared by R.W. Beck, Crofton, Md., June 1999.

8. American Plastics Council, *The Resin Review: The Annual Statistical Report of the U.S. Plastics Industry—2002 Edition*, Arlington, Va., August 2002.

9. Alliance of Foam Packaging Recyclers, Crofton, Md., "Polystyrene Recycling Report," presentation to California Integrated Waste Management Board staff, July 25, 2001.

10. Alliance of Foam Packaging Recyclers, "Recycled Content in Expandable Polystyrene Foam Protective Packaging," *Technical Bulletin*, Crofton, Md., Fall 2001.

11. Alliance of Foam Packaging Recyclers, "Profoam International Offers Recycling Solutions," *Molding the Future*, Crofton, Md., Winter 2000.

12. Alliance of Foam Packaging Recyclers, "Properties, Performance and Design Fundamentals of Expanded Polystyrene Packaging," *Technical Bulletin*, Crofton, Md., January 2000.

13. Ken Adams, Rapac, Inc., Oakland, Tenn., e-mail to Board Staff, February 2, 2004.

14. Karen Joffe, Plastic Loose Fill Council, Oakland, Calif., Letter to California Integrated Waste Management Board, the Department of Conservation, and NewPoint Group, July 8, 2002.

15. Alliance of Foam Packaging Recyclers, Crofton, Md., "Polystyrene Recycling Report," slide presentation to California Integrated Waste Management Board Staff, July 25, 2001.

16. (a) American Plastics Council, *2000 Post-Consumer Polystyrene Recycling Statistics Summary*, Arlington, Va., October 2001. (b) Polystyrene Packaging Council, *Waste Management and Reduction Trends in the Polystyrene Industry*, *1974–1997*, prepared by Franklin Associates, Ltd., Arlington, Va.,

August 1999. (c) Alliance of Foam Packaging Recyclers, *2002 EPS Recycling Rate Report*, Crofton, Md.

17. California figures are calculated from national totals using population. The 2000 recycling rates are applied to 2001 production estimates.

18. (a) Raymond J. Ehrlich, *The Economic Realities of Recycling*, Polystyrene Packaging Council, Arlington, Va., <www.polystyrene.org/environment/econ.html >; (b) Virginia Lyle, FP International, Redwood City, Calif., personal communication with the contractor, August 26, 2002.

19. Alliance of Foam Packaging Recyclers, "Expanded Polystyrene—Expanded Polystyrene (EPS) Packaging Collection Recycling Collection Sites" <www.epspackaging.org/info.html> August 24, 2002.

20. Virginia Lyle, Manager of Environmental Affairs, FP International, Redwood City, Calif., e-mail communication with California Integrated Waste Management Board Staff, December 16, 2003.

21. Alliance of Foam Packaging Recyclers, Crofton, Md., "Polystyrene Recycling Report," presentation to California Integrated Waste Management Board staff, July 25, 2001.

22. Tim Shestek, Director of State & Local Public Affairs for American Chemistry Council, Arlington, Va., Michael Levy, Executive Director of Polystyrene Packaging Council, "Comments to the California Integrated Waste Management Board's Draft Report—*Use and Disposal of Polystyrene in California, A Report to the California Legislature"* [October 2003 version of draft report], November 20, 2003.

23. "By the Numbers," *Plastics Recycling Update*, Vol. 14, No. 1, January 2001, pp. 2–3.

24. Alliance of Foam Packaging Recyclers, "Expanded Polystyrene (EPS) Christmas Collection Demonstration Program—December 2002," Crofton, Md., n.d.

25. (a) U.S. Environmental Protection Agency, *Municipal Solid Waste in the United States—1999*, Washington D.C., 2000, prepared by Franklin Associates, Ltd.; (b) California Integrated Waste Management Board, *Statewide Waste Characterization Study: Results and Final Report*, pub. #340-00-009, Sacramento, Calif., December 1999, prepared by Cascadia Consulting Group. (c) California's annual polystyrene disposal of 300,000 tons was calculated by multiplying the state's 2000 total waste stream tonnage (36,954,946 tons), obtained from source 25b, by the percentage of the national waste stream composed by polystyrene, 0.8 percent, obtained from source 25a.

26. CIWMB average tipping fee statistics and NewPoint Group files.

27. Hyung Woo Park, *Effects of EPS Packaging Boxes on the Freshness Extension of Agricultural Produce*, Korea Food Research Institute, Sungnam City, Korea, April 17, 1997.

28. The Council for Solid Waste Solutions (now American Plastics Council), *Resource and Environmental Profile Analysis of Foam Polystyrene and Bleached Paperboard Containers*, Prairie Village, Kans., June 1990, prepared by Franklin Associates, Ltd.

29. Martin B.Hocking, "Reusable and Disposable Cups: An Energy-Based Evaluation," *Environmental Management*, Vol. 18, No. 6, pp. 889–99.

30. Martin B. Hocking, "Is Paper Better than Plastic?" *Consumers' Research*, October 1991, pp. 28–50.

31. "Paper And Glass Packaging Impacts Least On The Environment" November 19, 2003, <www.miljoestyrelsen.dk/homepage/>.

32. Joshua Cohen, Ph.D., “Risk in Perspective: Evaluating the Risk to Workers and the Public from Styrene Exposure,” *Harvard Center for Risk Analysis*, Vol. 10, Issue 3, May 2002, pp. 1–6.

33. Office of Environmental Health Hazard Assessment, “Chemicals Known to the State to Cause Cancer or Reproductive Toxicity—November 14, 2003” <www.oehha.ca.gov/prop65/CRNR_notices /list_changes/pdf/111403lsta.pdf>, December 12, 2003.

34. Lippner, Gary, J. Johnston, S. Combs, K. Walter, D. Marx, *Storm Water Program: Results of the Caltrans Litter Management Pilot Study*, California State University Sacramento, Office of Water Programs, 2001.

35. “Center for Marine Conservation, International Coastal Cleanup” <www.cmc-ocean.org/cleanupbro/>.

36. Ibid.

37. Moore, Shelly L., D. Gregorio, M. Carreon, S.B. Weisberg and M. Leecaster. March 2001. “Composition and distribution of beach debris in Orange County, California,” *Marine Pollution Bulletin* Vol. 42, Issue 3, pp. 241–245. Online version via Southern California Coastal Water Research Project Web site (links to follow: Publications, Annual Reports, Years 1990-2002, 1999-2000 Annual Report) available at <ftp://ftp.sccwrp.org/pub/download/PDFs/1999ANNUALREPORT/09_ar10.pdf >

38. Ibid., online version.

39. C.J. Moore, S.L. Moore, S.B. Weisberg, G.L. Lattin, and A.F. Zellers. “A Comparison of Neustonic Plastic and Zooplankton Abundance in Southern California Coastal Waters,” *Marine Pollution Bulletin*, Vol. 44, No. 5, May 21, 2002, pp. 1035–1038.

40. United Nations Environment Program Global Program of Action, “Effects of Marine Life on Wildlife,” *Global Marine Litter Information Gateway*, <http://marine-litter.gpa.unep.org/facts/effects-wildlife.htm#entanglement>.

41. Patricia Reaney, “Marine Organisms Ride Plastic, Threaten Ecosystems,” Reuters News Service, April 25, 2002. <www.enn.com/news/wire-stories/2002/04/04252002/reu_47028.asp>.

42. City of Los Angeles Department of Public Works, “Los Angeles Stormwater Trash Removal Project,” California Integrated Waste Management Board grant application, November 28, 2001.

43. Ken Farfsing, City Manager of City of Signal Hill, Calif., personal communication with the contractor, August 26, 2002.

44. Don Duncan, “Litter’s Bugging Washington,” *Seattle Times*, August 13, 1989, p. A-1. Cited in “Plastic Trash and Wildlife—Activity E.k,” Tennessee Solid Waste Education Project, <http://eerc.ra.utk.edu/tnswep/activitiesPDFs/ek.pdf>.

45. United Nations Environment Program Global Program of Action, “Effects of Marine Litter on Economy and People,” *Global Marine Litter Information Gateway*, <http://marine-litter.gpa.unep.org/facts/effects-people-economy.htm>.

46. Ken Farfsing, City Manager of the City of Signal Hill, Calif., personal communication with contractor, August 26, 2002.

47. Los Angeles Regional Water Quality Control Board, “Trash Total Maximum Daily Loads for the Los Angeles River Watershed,” Los Angeles, September 19, 2001.

EXHIBIT 4

California Green Chemistry Initiative

Final Report

California Green Chemistry Initiative

Final Report

December 2008

State of California
Arnold Schwarzenegger, Governor

California Environmental Protection Agency
Linda Adams, Secretary

Department of Toxic Substances Control
Maureen Gorsen, Director

Foreword

By Linda S. Adams
Secretary for Environmental Protection

I am pleased to present the California Environmental Protection Agency's (Cal/EPA) Green Chemistry Initiative (GCI) policy recommendations for strengthening the protection of public health and our environment and moving toward a sustainable California. The GCI proposal presents a new way to look at chemicals in our society, unleashing the creativity and innovation of our scientists and engineers to design and discover the next generation of chemicals.

Policy Recommendations

The six recommendations developed through the California Green Chemistry Initiative constitute a far-reaching, market-driven strategy with an ambitious aim—the launch of a new chemicals framework and a quantum shift in environmental protection. These landmark policy options will continue California's environmental leadership and foster a new era in the design of a new consumer products economy – inventing, manufacturing and using toxic-free, sustainable products. They are:

1. **Expand Pollution Prevention** and product stewardship programs to more business sectors to refocus additional resources on prevention rather than clean up.

2. **Develop Green Chemistry Workforce Education and Training, Research and Development and Technology Transfer** through new and existing educational programs and partnerships.

3. **Create an Online Product Ingredient Network** to disclose chemical ingredients for products sold in California, while protecting trade secrets.

4. **Create an Online Toxics Clearinghouse,** an online database of chemical toxicity and hazards populated with the guidance of a Green Ribbon Science Panel to help prioritize chemicals of concern and data needs.

5. **Accelerate the Quest for Safer Products,** creating a systematic, science-based process to evaluate chemicals of concern and alternatives to ensure product safety and reduce or eliminate the need for chemical-by-chemical bans.

6. **Move Toward a Cradle-to-Cradle Economy** to leverage market forces to produce products that are "benign-by-design" in part by establishing a California Green Products Registry to develop green metrics and tools (e.g., environmental footprint calculators, sustainability indices) for a range of consumer products and encourage their use by businesses.

Implementation

Governor Arnold Schwarzenegger demonstrated his leadership on green chemistry policy by signing ground-breaking laws that will put into place two of the six recommendations in this report. AB 1879 (Chapter 559, Statutes of 2008) by Assemblymembers Mike Feuer, Sam Blakeslee and Jared Huffman requires DTSC to adopt regulations by January 1, 2011 to identify and prioritize chemicals of concern, to evaluate alternatives, and to specify regulatory responses where chemicals of concern are found in products. SB 509 (Chapter 560, Statutes of 2008) by Senators Joe Simitian and Ron Calderon requires an online, public Toxics Information Clearinghouse to be created that includes science-based information on the toxicity and hazard traits of chemicals used in daily life.

A critical foundation for green chemistry policy has been established by the enactment of these important laws. We are ready to begin the considerable amount of work that is needed to implement these laws and develop the other meaningful recommendations in this GCI report.

Over the past several decades, the Cal/EPA BDOs and other state agencies have successfully implemented numerous programs intended to reduce pollution and impacts to humans associated with the manufacture and/or use of specific chemicals and industrial or consumer products. Some programs require businesses to address industrial waste and pollution during the product's manufacture. Other regulatory programs evaluate potential impacts on the environment and human health and develop mitigation measures to address those impacts before the product is approved for use in the state. Some of these existing foundational programs include the Pesticide Evaluation and Mitigation Programs at the Department of Pesticide Regulation; the Toxics in Products Program at the Air Resources Board; and many other existing, successful regulatory programs across state government.

I recognize the importance of these programs and environmental, human health and economic benefits associated with existing programs that advance the goals and objectives of green chemistry and the need to avoid duplication. Therefore, in implementing the recommendations, the Cal/EPA BDOs will focus on those products, and more specifically, the chemical ingredients within those products that currently are not subjected to environmental and human health analysis and mitigation prior to their introduction into the marketplace. Products and chemical ingredients that are the subject of such existing scrutiny are not intended to fall under the purview of the GCI.

I will establish an external economic and technology advisory group, similar to the Economic and Technology Advancement Advisory Committee (ETAAC) formed under the California Global Warming Solutions Act of 2006. Like ETAAC, I would like to see this group advise me on activities that will facilitate investment in technological research and development and funding opportunities.

Education is vital to advancing California's well-being and, as highlighted by this report, is a cornerstone to developing a green chemistry workforce. I would like to seek the assistance of leaders from California's postsecondary institutions to integrate green chemistry principles into the curricula for chemistry, engineering, environmental science, and other disciplines. By working together, we can prepare our future workforce to meet the public's demand for safer, less toxic consumer products. This report complements the newly enacted, California Green Collar Jobs Act of 2008 (AB 3018, Chapter 312, Statutes of 2008) by Speaker Emeritus Fabian Nuñez. This law requires the California Workforce Investment Board (CWIB) to establish the Green Collar Jobs Council to develop programs, strategies and resources that promote workforce training and job opportunities in California's emerging green economy. I look forward to partnering with the CWIB to develop green collar jobs for California.

California is not only a national leader in environmental programs, but an international leader as well. Green chemistry is integral to a chemically safer global economy. Therefore, building upon our successful international partnerships on climate change, I intend to engage other nations in our GCI efforts through agreements or memoranda of understanding. The establishment of a toxics clearinghouse is a key example of a GCI outcome that will be mutually beneficial.

The California Green Chemistry Initiative builds on Governor Schwarzenegger's leadership in environmental protection, climate change and natural resource preservation. Under his leadership, we can establish the six recommendations as official policy for the State of California and continue building the framework for a sustainable California.

Department of Toxic Substances Control
Maureen F. Gorsen, Director
1001 "I" Street • P.O. Box 806 • Sacramento, California 95812-0806

Linda S. Adams
Secretary for Environmental Protection
Office of the Secretary
1001 I Street, Suite 25-66
Sacramento, CA 95812

Dear Secretary Adams,

I am pleased to transmit to you the final report of the California Green Chemistry Initiative. The report recommends six policy strategies which will strengthen the protection of public health and our environment and move toward a sustainable California.

Last year, you called upon us to develop a comprehensive approach for assessing potential hazards from chemicals in consumer goods and products. The Department of Toxic Substances Control (DTSC) collaborated with other state agencies and departments to gather input from experts and stakeholders worldwide. During this initiative, more than 57,000 comments and 800 options were received. We have distilled this input into six policy recommendations.

Green Chemistry is a systematic scientific and engineering approach that seeks to reduce the use of hazardous chemicals and the generation of toxic wastes by changing how society designs, manufactures, and uses chemicals in processes and products. Rather than managing wastes after end-of-product life (or "cradle to grave"), Green Chemistry shifts our focus to designing chemicals, processes, and goods that have less or no adverse effects—throughout their lifecycle ("cradle to cradle")—on California's people and our environment. Stakeholders told us that this new green chemistry approach offers substantial opportunity for the state—through better information; innovation and new technology; new high-skill, high-wage jobs; stronger worker and consumer protection; and a cleaner, healthier environment. They further told us that the Schwarzenegger Administration and California are uniquely and well positioned to realize these opportunities.

As a state, the most important thing we can do is give all our children the chance to fulfill their dreams, achieve their potential, and work together in productive and sustainable jobs and communities. The six recommendations in the attached report reflect this obligation. The report sets forth new ideas to protect our children's health from toxic chemicals in products; enhance the education and training they will need; offer them more opportunity and better choices in a burgeoning global market; and, build their capacity to create a clean, green California for present and future generations. The California Green Chemistry Initiative builds on Governor Schwarzenegger's leadership in environmental protection, climate change and natural resource preservation.

Under your direction, we can establish the attached six recommended actions as official policy for the State of California and work with the Legislature to establish the framework for a sustainable California.

Sincerely,

Maureen Gorsen, Director
Department of Toxic Substances Control

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1. Executive Summary


California Green Chemistry Initiative
Final Report

1. Executive Summary

Why Green Chemistry?

Green chemistry represents a major paradigm shift that focuses on environmental protection at the design stage of product and manufacturing processes. It is an innovative way to deal with chemicals before they become hazards, with the goal of making chemicals and products "benign by design." Green chemistry is a preemptive strategy that reduces the use of toxic substances before they contaminate the environment and our bodies. It is a marked departure from the past where society managed industrial and municipal wastes by disposal or incineration. Green chemistry seeks to dramatically reduce the toxicity of chemicals in the first place, rather than merely manage their toxic waste after use and disposal.

Green chemistry focuses on improving the building blocks of manufacturing—the feedstocks and the catalysts used to make things—so products can be engineered to be safer, easily reused and not persist in the environment. The use of fewer hazardous substances means healthier air quality, cleaner drinking water and a safer workplace. Green chemistry changes the design of products and industrial processes so they do not threaten human health or the environment.

Green Chemistry is...
The utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical products.

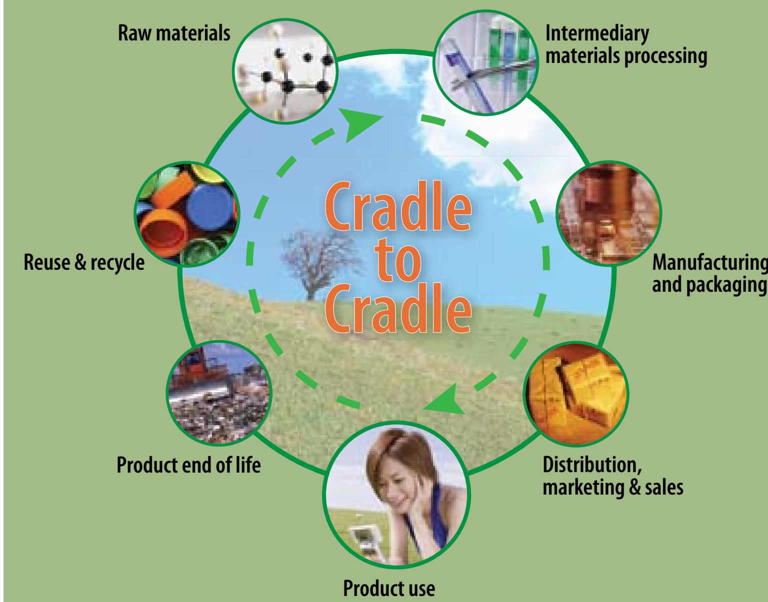
Anastas and Warner
Green Chemistry: Theory and Practice (1998)

For example, "green chemists" are presently working on road and construction materials that sequester carbon dioxide while simultaneously making those materials harder and more durable over time. Green chemists are developing lighting that contains no mercury or other toxic materials and is 50 times more energy efficient than the fluorescent light bulb. Solar cells are being developed at the nano-scale that can become ingredients in paints, coatings and clothing. This innovation will help advance distributed energy generation. Green chemists are also developing substances and materials for everyday consumer products that contain less toxic ingredients and are based on lifecycle thinking and cradle-to-cradle design which avoids costly waste management and regulatory regimes.

Every week, headlines reveal consumer products with suspected toxic substances. There are tens of thousands of chemicals in use today, but we know very little about how they affect people or the environment. This information gap prevents the free market from working properly to stimulate the innovation of safer, healthier substitutes.

Consumers are not the only ones who lack information about ingredients and their effects. Businesses along the supply chain also lack this basic information, which could lower the costs and liability arising from goods that contain toxic substances.

Large, desirable markets in India and the European Union are demanding less toxic products. California has the opportunity to lead the nation in creating the safer substitutes that these global markets will continue to demand in the coming decades. California also does not want to become a dumping ground for toxic products prohibited elsewhere.



Cradle-to-Cradle is an innovative and sustainable industrial model that focuses on design of products and a production cycle that strives to produce no waste or pollutants at all stages of the lifecycle.

Braungart and McDonough
Cradle-to-Cradle: Remaking the Way We Make Things (2002)

Chemistry has fueled remarkable medical, agricultural and industrial advances over the past half century and has improved every facet of life. The chemical industry estimates it contributes $635 billion to the nation's gross domestic product (GDP). Green chemistry is an opportunity to spur the next industrial revolution through human ingenuity and creativity. Advancing green chemistry is an opportunity to make a safer and more efficient world with less waste. California can lead with a green chemistry program to harness the power of the market, unleash innovation to increase competitiveness and build better products.

Although California has made tremendous progress in cleaning up its air, water and land over the last 40 years, existing laws and regulations focus primarily on the pollutants generated from a cradle-to-grave industrial system (what we throw out as a society). Today we confront new challenges from toxics in the consumer goods and products we use and discard daily. These challenges include:

- Uncertainty about the safety of chemicals in products which are manufactured around the world
- Little or no information about chemical ingredients and potential hazards
- Poorly conceived actions like bans that do not consider alternatives and often create new problems when substitutions are made
- Billions of dollars in state taxpayer costs for long-term stewardship of a burgeoning hazardous waste stream

Cradle-to-Grave assumes waste and pollution comes at the end of a product's lifecycle and is a byproduct of its production. Many environmental laws are based on this industrial production model. For example, the Resource Conservation and Recovery Act (RCRA) enacted in 1976 established a complex set of regulations governing the management of hazardous waste from "cradle-to-grave."

With globalization and growing population, these challenges have become complex and more pressing. A comprehensive new approach and policy framework is needed to provide state government with new tools to address these challenges.

Governor Arnold Schwarzenegger recognized this opportunity and the need to advance green chemistry in California. In 2005, he signed the nation's first law requiring disclosure of chemical ingredients in cosmetics. In September 2006, he signed landmark biomonitoring legislation that makes California the first state to measure and catalogue human exposure to chemicals.

In April 2007, Linda Adams, Secretary for Environmental Protection, launched the California Green Chemistry Initiative in collaboration with California Environmental Protection Agency (Cal/EPA) boards, departments and offices, as well as other state agencies. The Secretary asked the Department of Toxic Substances Control (DTSC) to lead the initiative and conduct a broad public process to generate ideas, develop overall policy goals and make recommendations. In signing AB 1108 (Chapter 672, Statutes of 2007) to ban phthalates in toys, Governor Schwarzenegger reaffirmed that "[a] comprehensive and unified approach [to chemicals] is needed to ensure good accountable policy." This report provides the results of that process and makes specific recommendations for implementing a comprehensive green chemistry policy framework in California.

"I am looking forward to the recommendations being developed as part of the Green Chemistry Initiative led by my Secretary for Environmental Protection. I encourage the Legislature and all California stakeholders to participate in this important initiative so that we can develop policies that will again allow California to lead the nation and the world in health and environmental protection."

Governor Arnold Schwarzenegger October 2007

The six policy recommendations in this report build upon present environmental protection laws, shift the focus from end-of-pipe cleanup to up-front design and prevention, foster innovation and prompt market changes toward a sustainable economy. They include:

- **Expand Pollution Prevention** to assist California businesses to lead the world in greener design and production
- **Develop Green Chemistry Workforce Education and Training, Research and Development, and Technology Transfer** to meet global demand for greener materials and products
- **Create an Online Product Ingredient Network** to disclose chemical ingredients in products sold in the state to allow consumers and businesses to make safer choices
- **Create an Online Toxics Clearinghouse** to increase our knowledge about toxicity and hazards for chemicals
- **Accelerate the Quest for Safer Products** to make the transition to more sustainable, safer products more quickly using science-based alternative analysis and lifecycle thinking
- **Move Toward a Cradle-to-Cradle Economy** to leverage market forces to produce products that are "benign-by-design"

These policy recommendations build the capacity in the future workforce and in businesses for green chemistry innovation and economic growth. They provide the information (on ingredient data and toxicity data) needed to identify opportunities and select safer materials in products. They provide the tools and metrics to make the transition to safer, more sustainable products.

As our population grows and our economy expands, more chemicals will be used, more products will be consumed and more wastes will be generated. California must move toward a more sustainable economy. Green chemistry and lifecycle approaches will accelerate this necessary transition, promote development of clean and green technology, reduce our consumption of energy and natural resources, create high-skill, high-wage employment and increase California's competitiveness in the global arena of innovative green technology.

The California Green Chemistry Initiative is an opportunity to accelerate technological innovation in materials science. It can catalyze research at California universities. It can help create the solutions needed to curb global warming and meet the goal of a 30% reduction in greenhouse gas emissions by 2020. Consumers would be protected against adverse effects of toxic substances in the products they use. Less floating non-biodegradable debris would help marine life and make our beaches cleaner. Fewer landfills and hazardous waste sites would be passed on to future generations.

"The six recommendations developed through the California Green Chemistry Initiative constitute a far-reaching, market-driven strategy with an ambitious aim—the launch of a new chemicals framework and a quantum shift in environmental protection."

Linda S. Adams, Secretary for Environmental Protection

II. The Initiative Process: A Year of Exploration, Study and Collaboration

Science Advisory Panel

II. The Initiative Process: A Year of Exploration, Study and Collaboration

In response to Cal/EPA Secretary Adams' directive in 2007, DTSC Director Maureen Gorsen launched the California Green Chemistry Initiative. DTSC, with other state agencies, boards and departments, organized teams for the initiative, hosted an extensive, innovative public process, created a Scientific Advisory Panel and oversaw the work of key element teams. DTSC conducted this monumental, year-long effort in two phases. This Final Report culminates that process and makes six recommendations for a new chemicals policy framework for California.

The goal of the California Green Chemistry Initiative was to develop policy recommendations to stimulate "green" design of products so that the manufacturing, use or disposal of products generates, uses and releases less hazardous chemical substances.

To provide leadership and guidance to this initiative, DTSC formed the Green Chemistry Leadership Council. The Council included the chief executives of the Cal/EPA boards, departments and offices; the Department of Public Health; the Department of Conservation; the Department of Homeland Security; the Department of General Services; the California Occupational Safety and Health Administration (Cal/OSHA); and, other state agencies and departments.

During Phase One, which began in April 2007, DTSC and collaborating departments:

- Sponsored scientific symposia
- Invited experts from around the world to discuss green chemistry options
- Facilitated stakeholder workshops around the state to solicit the best thinking from industry, community groups, environmental organizations, academia and the public
- Hosted an online blog, "A Conversation with California," that generated 57,000 web hits and 818 potential policy options

DTSC compiled all that was learned in the first phase and, in January 2008, submitted the information to Secretary Adams in a "Phase One Options Report" (see Appendix A).

During Phase Two, beginning January 2008, DTSC culled, compiled and synthesized the leading options from what had been learned in Phase One. Continuing to seek out the best policy thinking, DTSC, participating state agencies and stakeholders explored how leading options might be implemented, by whom, in what way and how those actions might be funded. The department organized three distinct "tracks" to analyze the potential options. These tracks were:

Track 1: Public workshops, discussion forums, consultations and web-based input
Track 2: Science Advisory Panel
Track 3: Key Element Teams

Public Workshops and Forums

The first track included interactive focus group meetings, public presentations and public workshops around the state where options were discussed and explored in more detail. Stakeholders included environmental groups, health organizations, manufacturers, industry associations, government, academia and others. After each meeting, the nature of the options and the framework were revised to reflect the input. The recommended framework represents an iteration of efforts that considered, sorted, aligned, summarized and integrated stakeholder input. Appendix C organizes the options presented in both phases, by each policy recommendation.

During this track, stakeholders helped develop the following goal and objectives:

Goal:

California is a leader in the innovation, manufacture and use of safer, more environmentally benign products and processes and in the protection of public health and the environment from toxic harm.

Objectives:

1. Reduce the presence of hazardous substances in products and processes.
2. Drive technological innovation and development of safer, healthier, more environmentally benign products and processes across their lifecycles.
3. Train a new generation of chemists, engineers and knowledgeable workers who will develop and produce safer products.
4. Motivate and support new investments in more benign chemistries, products and processes.
5. Move from a system where materials are on a one-way trip from the cradle to the grave to a system where materials are recovered for reuse in new products and processes, with reduced potential for harming human health and the environment.
6. Stimulate consumer demand for greener products through improved information.

Science Advisory Panel

A second track was the Science Advisory Panel, consisting of leading experts on green chemistry, green engineering, technological innovation and regulatory policy from around the country. These experts met extensively and, through teamwork, arrived at a final collection of 38 options for DTSC Director Gorsen in May 2008. Thirty-five of the options are consistent with the six policy recommendations. The other three were not included. The Science Advisory Panel report is presented in Appendix B.

Science Advisory Panel

Key Element Teams

In the third track, representatives of state agencies and departments explored, developed and drafted proposed initial plans to align related existing state governmental programs with the overall objectives of the California Green Chemistry Initiative.

These "key element teams" developed initial plans for:

- Disseminating information on toxic chemicals; empowering consumers to make informed choices; and forging strategic partnerships
- Strengthening consumer protection laws
- Expanding California's pollution prevention program
- Training a new generation of scientists and engineers
- Including green chemistry principles in Cal/EPA's Education and the Environment Initiative (EEI)
- Accounting for chemical toxicity and impacts in state and local government procurement decisions

The key element team reports and initial plans are compiled in Appendix D.

Phase Two Workshop, Sacramento, California

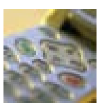
III. Policy Recommendations

III. Policy Recommendations

From the year-long process of compiling, discussing and analyzing the multitude of ideas presented, six major policy recommendations were developed. Each recommendation is a synthesis of the comments, ideas and suggestions from the many experts and stakeholders who participated in the initiative. The description of each policy recommendation begins with the overall vision that will result from the described policy actions. To help understand how each of the recommendations will work conceptually, the steps associated with the policy actions are included along with the basis and rationale. An overview of funding options, compliance options and brief information about related activities in other states and governments also helps with envisioning the policy concepts. Rounding out the discussion of each policy recommendation, suggested metrics are provided to gauge, monitor and adjust the progress of the recommended activities as they are implemented.

The funding section under each recommendation outlines possible approaches in concept only. As policy makers consider each policy action further, they will decide how and in what way the recommended action will be implemented in more detail. After those details evolve in the next phase of the initiative, the associated costs, savings, benefits and appropriate funding options can be better determined and evaluated. At a minimum, these future discussions must include development of a funding structure to support the state's responsibilities in program implementation.

The six major policy recommendations are described in the following pages.



Policy Recommendation One

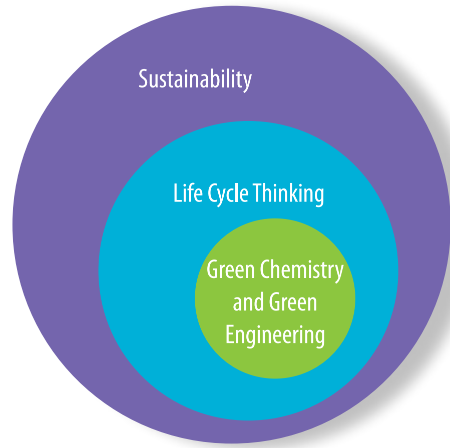
Expand Pollution Prevention

Vision: An expanded and modernized DTSC Pollution Prevention (P2) Program helps California's businesses become leaders in green chemistry and engineering and use "lifecycle thinking" to reduce the environmental footprint of their facilities, manufactured products and services.

Improved pollution prevention at participating California facilities protects neighboring communities from public health impacts, protects the environment and improves worker and consumer safety (for examples see illustration on page 16). California businesses that adopt green practices enhance revenue with increased consumer demand for cleaner products and substantially reduce costs through more efficient resource use, reduced energy consumption, reduced liability and insurance payments, reduced regulatory burdens and reduced hazardous waste management costs.

Lifecycle thinking, also called lifecycle approaches or lifecycle management, is the application of lifecycle principles to business practices. **Lifecycle thinking** involves examining the environmental sustainability over the product's entire life – from raw materials selection, manufacturing, transportation, use and end of life disposal or reuse and waste management. Tools, metrics and approaches using lifecycle thinking are often used to determine a product's "environmental footprint."

Figure 1. ***Green Chemistry: An Essential Component of Sustainable Production.*** *Both green chemistry and green engineering rely upon lifecycle thinking to bring their concepts to fruition. All three serve to achieve the ultimate goal of a sustainable economy and society. Source: California Green Chemistry Initiative Science Advisory Panel Report, May 2008.*



Expansion of DTSC's pollution prevention program should include:

- Increasing the scale to assist specific small and large business sectors in reducing chemical hazards
- Bolstering the capacity of local Green Business Programs to serve all small and medium size businesses statewide, in all business sectors
- Increasing investment in the development of safer alternatives to toxic chemicals and offer incentives to help overcome cost and performance barriers that prevent some businesses from going green

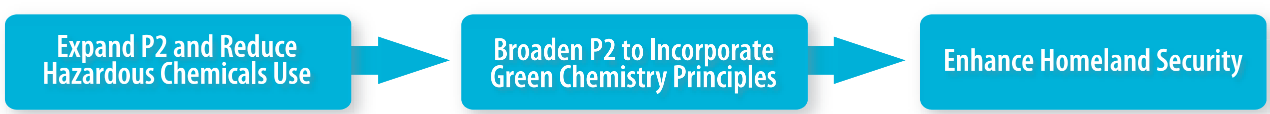
Modernization of DTSC's pollution prevention program should include:

- Broadening the program to incorporate a green chemistry and engineering design approach in evaluating the comparative environmental and energy impacts of different chemicals and processes, as opposed to the current focus on end-of-pipe hazardous waste generation.

Lastly, improvement of DTSC's pollution prevention planning at California facilities should include:

- Adding a new dimension to California's Accidental Release Program (Cal/ARP) which works to prevent accidental release of regulated substances. By adding a pollution prevention planning component, the Cal/ARP program can increase its effectiveness for emergency response preparedness. By adding green chemistry and engineering capabilities, the Cal/ARP program can reduce the risks of use and storage of hazardous chemicals and thereby reduce the risk of catastrophic loss of life. Emergency responders, workers and the neighboring community would be safer in the event of a natural disaster, accidental release, or act of terrorism at a chemical-using facility subject to the Cal/ARP program.

Figure 2. Expand Pollution Prevention (P2)

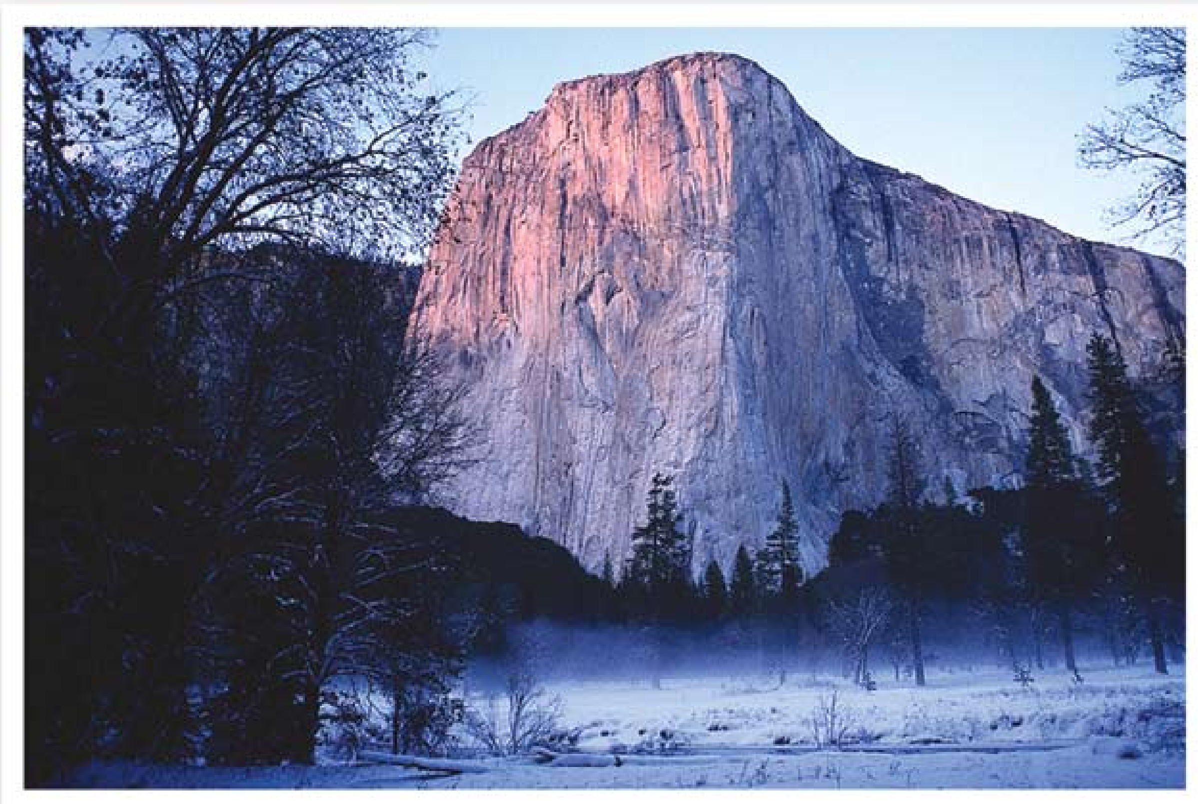


Description: For nearly two decades, industry sectors such as vehicle service and repair shops, auto body and paint shops, and hospitals have partnered with DTSC to implement pollution prevention measures that reduce the potential for hazardous waste generation. In doing so, these businesses have decreased toxic risks to California's people and the environment, and also have saved money.

Extensive experience gained in the DTSC pollution prevention program across multiple business sectors has demonstrated that program effectiveness can be increased if the state:

- Revises state law governing DTSC's source reduction program to include lifecycle and green engineering processes (such as chemical input substitution) rather than focusing only on hazardous waste generation and disposal

- Enhances support for local green business programs to create a statewide network with sufficient capacity to recognize and reward all businesses meeting program criteria
- Makes state government a pollution prevention leader by adopting environmentally preferred technologies and practices (supplementing the state's green product procurement efforts) to guarantee a market for green technologies
- Develops and evaluates data on the extent of voluntary adoption of pollution prevention measures to drive regulatory priorities
- Enhances designated state agencies' roles in prevention planning through the Cal/ARP program, to enhance public safety in the event of a catastrophic accident



How: Expand the existing DTSC pollution prevention program to maximize participation and environmental benefit. More specifically, engage stakeholders and policy makers to: add green chemistry and green engineering principles to the existing hazardous waste reduction elements; provide technical assistance to businesses that implement green chemistry; invest in safer green chemistry processes and technologies; and, assist small businesses with cost barriers to move toward becoming a green business. Pursue program changes to develop and disseminate information on safer alternatives which will encourage wider adoption. Work with the Certified Unified Program Agencies and policy makers to identify chemical substitutions and process changes that reduce the potential for catastrophic impacts from accidental releases at Cal/ARP facilities. Please see the Pollution Prevention Key Element Team Report in Appendix D-3 for a detailed discussion of how these program enhancements could be implemented.

POLLUTION PREVENTION CASE STUDIES: The Environment and the Economy Win!

Auto Repair Shops

A voluntary pollution prevention partnership between DTSC and auto repair shops from 2000 through 2008 resulted in the following environmental gains:

- 800 lbs of hazardous waste reduced
- 19 tons of wastewater runoff eliminated
- $9,000 annual costs savings per auto repair shop

One hundred and fifty auto repair shops participated in the voluntary program. If all 30,000 auto repair shops participated in the program, California could reduce the amount of hazardous waste generated by 630 tons and provide a savings of $230 million for the industry statewide.

Hospitals

In a voluntary pollution prevention partnership with hospitals to eliminate mercury – a toxic metal – used in hospital equipment, California led the nation in reducing toxic mercury risks at hospitals. Fifty percent of the nation's reductions in mercury occurred in California. From 2002 through 2005, seventy-nine hospitals received a HELP (mercury Hospital Elimination Leadership Program) for removing two tons of mercury from its hospitals, avoiding the health risks, tort liability and costly waste management.

Why: The existing DTSC pollution prevention and source reduction program is effective but limited to a small number of industrial sectors (only two every two years) and only to those California facilities within each sector which are subject to hazardous waste source reduction planning requirements. There are far greater numbers of businesses that could see triple bottom line profits (see Figure 3, page 17) and would volunteer to participate in a broader DTSC pollution prevention program. With the recommended program changes, more businesses can participate. They will implement green chemistry approaches, develop safer alternative inputs and processes, and share best practices with more industry sectors. These increased efforts will help ensure the success of local green businesses and enhance public health and environmental quality.

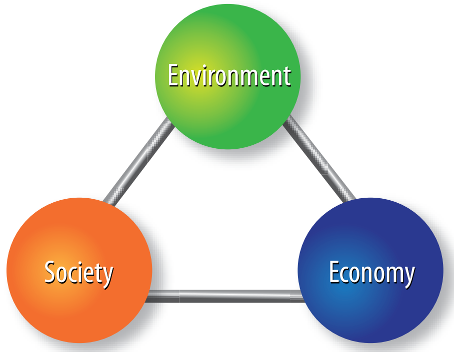


Figure 3. ***Triple Bottom Line.*** *When economic, social and environmental benefits are integrated and balanced, sustainability can be maintained. Some businesses refer to this goal as the triple bottom line.*

Funding: Like the existing DTSC pollution prevention program, state government costs could be supported from fee-based special funds. State government could approach specific industry sectors to co-fund alternatives research with broader application to the sector as another funding option. Grants and loans can help businesses overcome cost barriers to new, better technologies. For example, the Carl Moyer Memorial Air Quality Standards Attainment Program (Carl Moyer Program) provides grant funding to encourage the voluntary purchase of cleaner-than-required engines, equipment and emission reduction technologies. Since 1998, the State Air Resources Board (ARB) has distributed state bond and fee-based funds to participating air pollution control/air quality management districts for specific clean air projects in the local districts. This program now funds $141 million in statewide emission reduction projects annually. A similar financial assistance program could be developed to assist California businesses in implementing cleaner, green chemistry technologies and achieving environmental quality and public health benefits.

Other States and Governments: Massachusetts and several other states have programs to reduce the use of toxic substances or minimize hazardous waste generation. Many of these state-based programs collaborate with academic and research institutions. Several are operated in conjunction with the respective state's economic development programs.

Metrics: Progress toward reductions in toxic substance use and life safety hazards at facilities in California could be measured by:

- Industry cost savings through design and process changes that reduce toxics use and hazardous waste generation
- The number of facilities and industrial sectors participating in an expanded DTSC pollution prevention program
- Reduction in the volume of toxic chemicals used at facilities in California
- Reductions in the environmental footprint of facilities

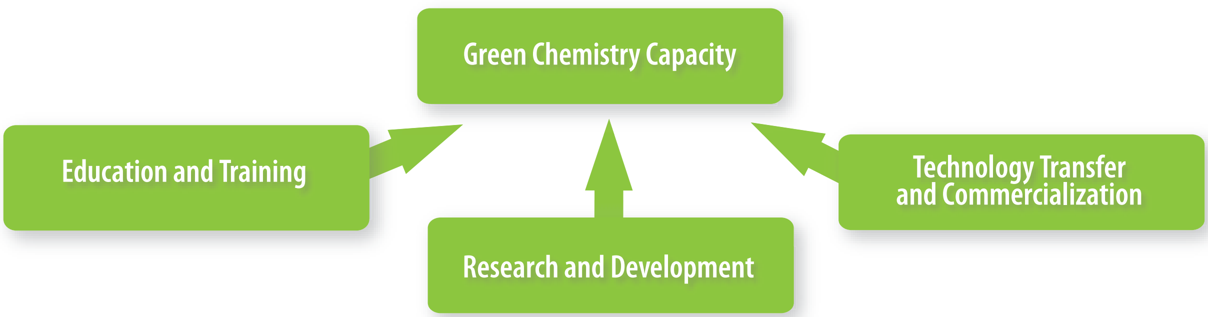
Compliance: Participation in the expanded and enhanced DTSC pollution prevention program would be voluntary. To encourage broader voluntary participation, various incentives, such as grants, loans, relief from certain regulatory reporting, or fee reductions should be considered.

Policy Recommendation Two

Develop Green Chemistry Workforce Education and Training, Research and Development, and Technology Transfer

Vision: California positions itself as a global leader for new ideas, green technologies and industries and a well-informed workforce through green chemistry and green engineering curriculum in primary and secondary schools, community colleges, career technical education, universities and research institutions. Californians lead the world in inventing, developing and commercializing new green chemistry engineering and materials science processes and products. Our next generation of scientists, engineers and consumers are the "knowledge capital" for new and expanded global markets. California exports its green chemistry-driven innovations and supplies safer, greener products to the world.

Figure 4. Develop Green Chemistry Workforce Education and Training, Research and Development, and Technology Transfer



Description: As the Science Advisory Panel and others strongly recommended, California should build green chemistry capacity through specific actions: (a) in primary, secondary and higher education, (b) in research and development, and (c) in technology transfer and commercialization.

Educational curriculum, teaching materials and instructor training should incorporate green chemistry concepts for California's primary, secondary and career technical education schools, colleges and universities and research institutions. Research and development in new green materials and product design should be increased. The state should improve technology transfer and commercialization so California's green innovations fuel economic growth.

To do so, California should:

- Through education, cultivate an understanding of basic principles of chemistry, environmental sciences, toxicology and sustainability
- Foster interest in careers in science, chemistry, engineering and other related disciplines
- Develop career technical training programs—through community colleges and trade schools—to train green laboratory and green manufacturing technicians
- Build, through academic teaching at institutions of higher learning, a workforce equipped with the scope and breadth of knowledge and skills to advance green chemistry and an intellectual environment that catalyzes the development of new ideas and technological innovations
- Establish multidisciplinary opportunities for students, international exchange programs for students and professionals, scholarships, internships and fellowships in green chemistry

- Stimulate innovation of product and technology development through public-private collaborations, including California's colleges, universities and national laboratories
- Establish research grants, financial incentives, intellectual property assistance and challenge programs to develop and commercialize green chemistry technologies and processes
- Develop a well-informed citizenry capable of actively engaging in demanding and supporting green products and processes and avoiding unsafe chemical use and disposal practices

More detailed descriptions of the specific actions to integrate green chemistry and engineering into the educational curriculum are included in Science Advisory Panel's report in Appendix B and the Education and the Environment Initiative Key Element Team report in Appendix D-5. The specific actions for career technical training are described in Train the New Workforce Key Element Team report in Appendix D-4.

How: California can increase green chemistry capacity in education and training, in research and development, and in technology commercialization and transfer.

Through California's landmark Education and the Environment Initiative (EEI) program, green chemistry principles can be incorporated into the state's curriculum and teaching materials now being developed for primary and secondary schools.

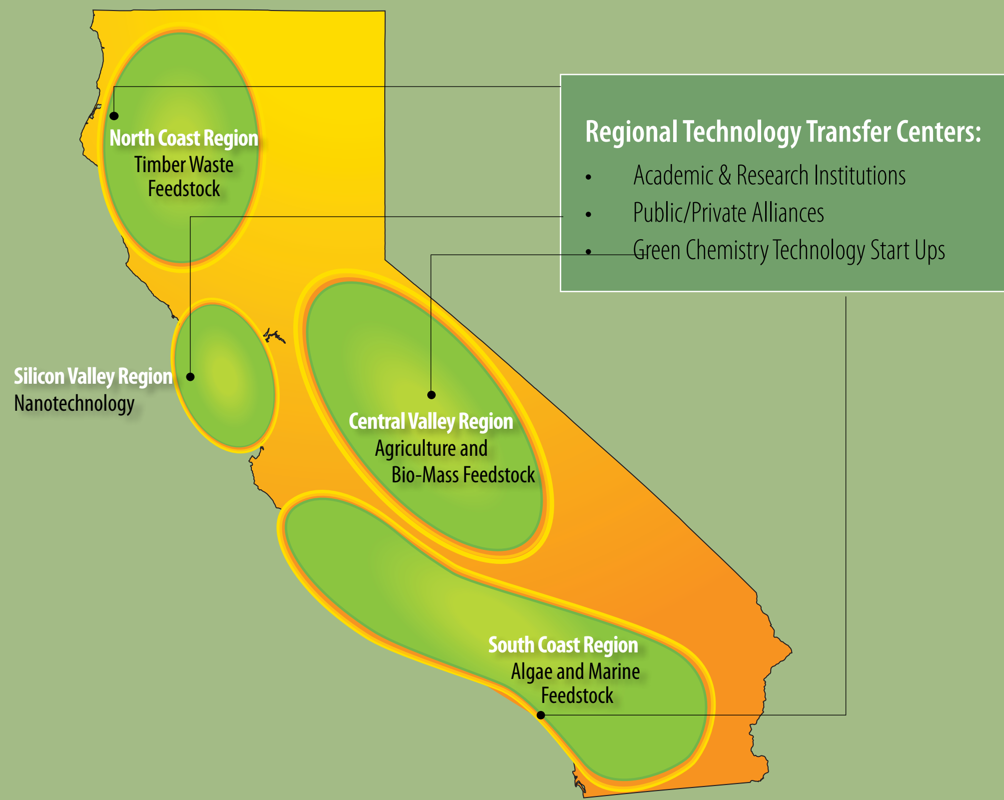
California's **Education and the Environment Initiative (EEI)** is the first program of its kind in the nation. EEI integrates environmental themes—such as climate change, air and water pollution and human effects on natural systems—into the state's academic curriculum. While learning science, mathematics and language arts, school children from kindergarten to high school develop environmental literacy. The **EEI program** partners with the state's education leaders, environmental regulators, Heal the Bay and the National Geographic Society in this innovative effort.

Green engineering is the design, commercialization and use of processes and products which are feasible and economical, minimize the generation of pollution and reduce risk to human health and the environment.

California's colleges and universities can align their curriculum and teaching with green chemistry and green engineering principles. The state's university systems—the California State University (CSU) and the University of California (UC)—can re-evaluate accreditation and degree requirements to ensure that students in chemistry, engineering, environmental science and other disciplines have coursework involving green chemistry principles. College students can learn green chemistry through new course curriculum, multidisciplinary studies, exchange programs, internships and research fellowships. When hiring new faculty in science, engineering, business and other academic positions, the state's colleges and universities can expand academic qualifications to include knowledge, skills and research in green chemistry.

California Golden Opportunity in Green Chemistry

Incubators of Green Chemistry Technology Transfer



Technology Transfer Centers (Incubators)

Technology transfer centers—or incubators—could be established to develop green chemistry products using new feedstocks. For example, products that currently are made from chemicals that persist in the environment, such as plastic bags and bottles, could be made from agricultural wastes, timber and wood wastes. New incubators could be established in the respective regions of the state to transform the bench-scale ideas into commercial applications and new clean green industry growth sectors.

Expanding career technical training is crucial so California can increase the number of technicians, laboratory workers and skilled post-secondary graduates who are needed in the burgeoning green materials, clean technology, nanotechnology, and related fields. (See Appendix D-4 for more detailed information about developing the technical workforce for green chemistry.)

As California firms adopt green chemistry applications or start new ventures based on green chemistry solutions, trained workers are needed to operate these new production systems and technologies. Along with community colleges, community-based training programs have successfully equipped workers for high-skill jobs in information technology, biotechnology and similar fields. These programs can help prepare California's new green chemistry workforce.

Science and technology are at the heart of green chemistry and green engineering. California has natural advantages historically in "bootstrapping" research into new entrepreneurial ventures. For green chemistry, scientific research, technology development and commercialization, and technology transfer have tremendous potential to build a strong, healthy economy and state.

For example, additional tools are needed to generate chemical hazard and toxicological information. Scientists said that the development of analytical and laboratory tools for quantitative structural activity relationship (QSAR) analysis, high through-put methods and read-across methods will increase our ability to make better informed comparisons of chemicals when designing new products or evaluating existing ones. More investment through industry/university partnerships, challenge grants for targeted research, direct grants for green chemistry science and technology, patent and intellectual property assistance and similar actions can catalyze this economic growth. (For a more detailed discussion, see the Science Advisory Panel report in Appendix B). Additionally California can establish technology transfer centers—or incubators—for rapid commercialization of green chemistry solutions.

"Advances in sustainable agriculture, medical and industrial processes are emerging all around us. This initiative by the Schwarzenegger Administration is aimed at embracing the science of our time and blending it with innovations to expand the greening of our nation and world. As a result of this convergence, California agriculture is uniquely positioned to participate in this exciting new green chemistry economy."

A. G. Kawamura, Secretary of the California Department of Food and Agriculture

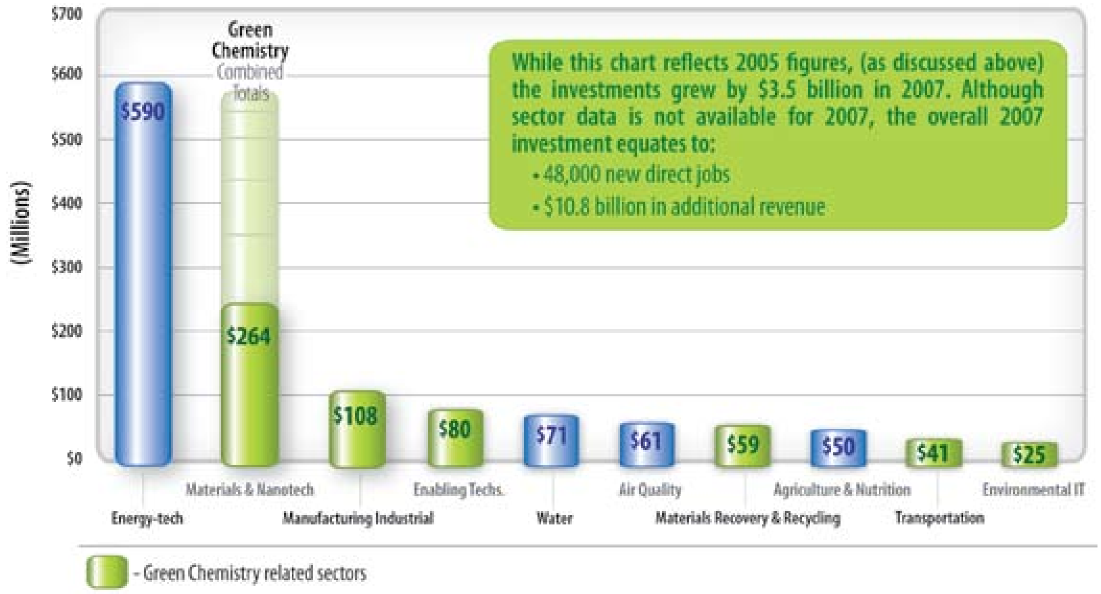
Why: Increase California's capacity to develop an educated, trained workforce; conduct green chemistry research and develop new ideas; and commercialize those ideas to offer substantial gains for the state's economy and environmental quality.

Education is vital in advancing California's environmental, economic, social and cultural well-being. Primary and secondary education gives students the basic knowledge and skills to prepare for technical training, higher education and employment. Adding green chemistry to this curriculum through the EEI program fosters interest in technical fields and develops a well-informed society.

The Community College System and career technical education also are vital in training a new generation of "green collar" workers. The scientific and technical workforce needed for the global green chemistry economy requires highly-skilled technicians, laboratory workers and other employees who can apply green chemistry principles in their jobs.

The California university systems and, in particular, the university-operated national laboratories, are a focal point for new research and technology development. Increased collaboration between academia, government and industry will enhance the exchange of new ideas and emerging technologies, offset research and development costs and train a new generation of specialized workers. These partnerships could expedite the development and commercialization of new, environmentally preferable technologies. It will create a new green sector—clean technology—for green materials inventors, designers and manufacturers. It will also help create, attract and fill new high-skill, high-wage jobs—boosting California's economy. Additional investment in research, development and commercialization of green chemistry solutions is crucial to restore California as a leader in technology and innovation-driven economic growth. Together, building green chemistry capacity in education, training, research, development and commercialization will create new global market opportunities for California businesses.

Figure 5. ***Cleantech Venture Capital Investment by Sector in the U.S. ($ million).*** *While energy and renewable technology companies receive the lion's share of venture capital investment, green chemistries, including materials science and nanotechnology, when combined garnered the second largest share (see green chemistry light green combined bar).*



At the Florida Climate Change Summit in June 2008, Governor Schwarzenegger hailed the coming of "California's new Gold Rush, because billions of dollars in clean technology investment are flowing into our state." In 2007, the clean technology sector grew to $3.5 billion nationally.[2] This investment equates to 48,000 new direct jobs and additional revenues of $10.8 billion. While energy and renewable technology companies received the lion's share of that investment, green chemistries, including materials science and nanotechnology, garnered the second largest share. California can do more to create the capacity in its workforce and educational system to include a green chemistry and materials science infrastructure. And, California can capture a greater share of the growing global market for green materials and technologies.

The Milken Institute[1] recently ranked California fourth among the 50 states in generating economic growth from technological and scientific innovation, behind Massachusetts, Maryland and Colorado. By embracing policies that stimulate green chemistry, California can regain its position as a leader of technological innovation and economic growth by developing new clean materials and safer substitutes for consumer products. Worldwide, chemical usage is increasing every year as markets grow and demand increases (see Figure 6). California can be a leader in providing green chemistry technologies and products for the burgeoning chemicals and materials sector.

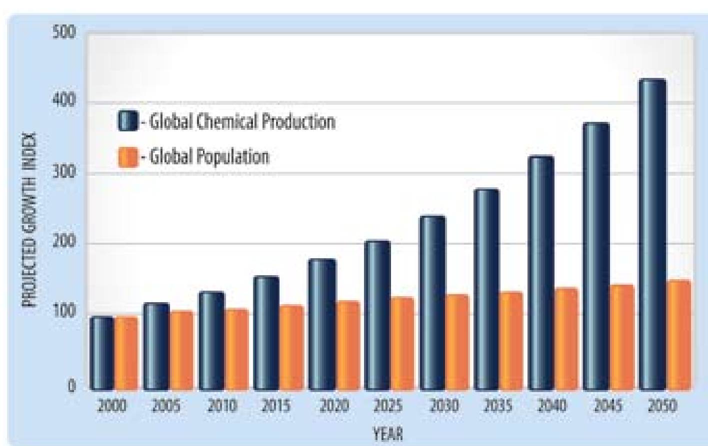


Figure 6. Global Chemical Production *is expected to double every 25 years, even as global population increases at a much slower rate. Source: American Chemistry Council (ACC)*

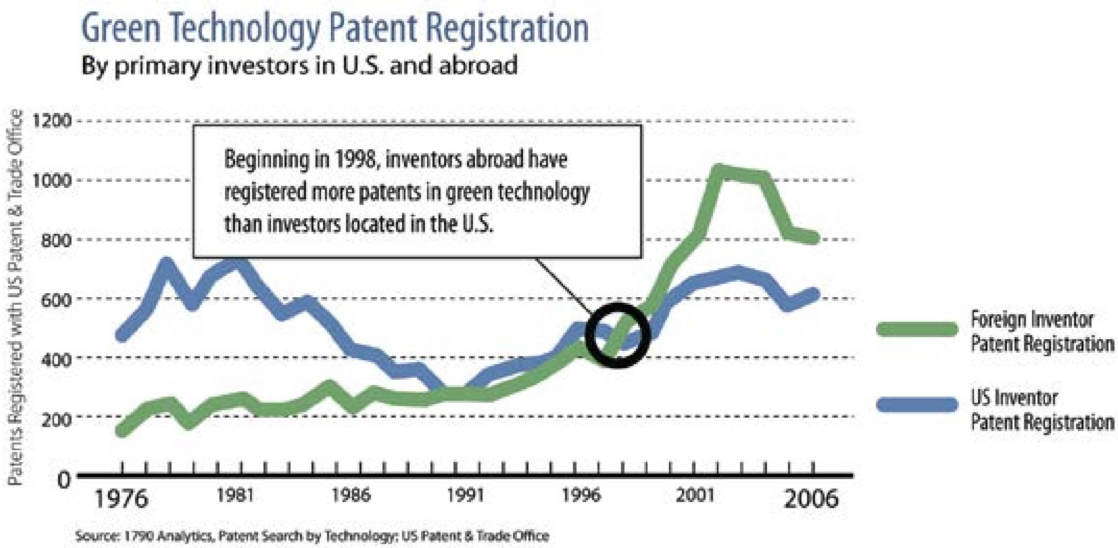
[1] The Milken Institute is an independent economic think tank whose mission is to improve the lives and economic conditions of people in the U.S. and worldwide by focusing on human, financial and social capital. http://www.milkeninstitute.org/

[2] Cleantech Venture Network: Price Waterhouse Coopers

Funding: Additional investment is needed to expand education, increase research and development, and accelerate technology transfer for green chemistry principles, processes and new products. Traditionally, the public university systems in California derive funding from state government revenues (fees and bonds). Increasingly, the public pension funds and private capital (venture capital and equity capital (see Figure 5, page 22)) have provided additional resources for public/private partnerships aimed at developing and marketing environmentally sustainable practices and goods. Both funding models could be adjusted to make existing financing available for green chemistry research and development.

The establishment of a network of research and development centers (or incubators) for green chemistry purposes could also receive other governmental funding. The research and development portions of the appropriations to the U.S. Departments of Energy, Defense, Health and Human Services and Agriculture would be relevant linkages for funding to increase green chemistry capacity in California and the nation.

Figure 7. Green Technology Patent Registration. *Since 1998 registration of green technology patents from inventors abroad have outpaced registration of patents from inventors located in the U.S.*



Re-aligning and increasing the existing governmental funds that support education, research, and technical transfer would require adjusting fees, tax incentives, credits, and financial aspects of jointly-funded intellectual property. Various bond mechanisms could also be applied for building green chemistry infrastructure. More information about various funding mechanisms is also presented in the Phase One Report; see Appendix A.

Other States and Governments: California has much to learn from other nations and states in this area. India has invested considerably in public-private green chemistry education programs in several universities and research institutions. Other developing nations are following with initial steps that are intended to position graduates and emerging businesses in the huge global chemicals market. Figure 7 (above) illustrates gains abroad in patents for new green technologies.

Several U.S. universities and institutions, including the Warner Babcock Institute for Green Chemistry in Woburn, Massachusetts, Yale University, Carnegie Mellon University, University of Oregon and Arkansas State University have created centers and academic programs emphasizing green chemistry. To date, the University of California and California State University systems have only a fragmented collection of programs and projects that include green chemistry concepts.

California's EEI program—for K-12 school children—is unique. While no other state has a similar statutory program directly integrated with its academic content and testing standards, several states teach environmental concepts as part of their overall curriculum.

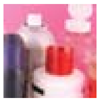
Metrics: To measure progress for increased green chemistry capacity, several metrics are possible:

1. For Education and Training:
   - New curriculum and new academic disciplines offered
   - Number of graduates who have studied green chemistry and engineering concepts as part of their academic training
   - Number of K-12 school children whose curriculum included green chemistry and engineering concepts as part of their core subjects

2. For Research and Development:
   - New and increased investments in green materials and products companies
   - Other possible indicators now used in research and development that could be adapted for green chemistry and engineering elements
   - Number of new patents issued (Figure 7, page 23)

3. For Technology Transfer and Commercialization:
   - Establishment of Technology Transfer Centers for research and development
   - Number of new companies created
   - New and expanded export markets for California companies
   - Relative economic growth created by technological innovation (see Milken Institute metric discussion on page 22)

Compliance: This strategy would not be regulatory in nature. Increased investment—in the public and private sectors—is crucial to increase California's green chemistry workforce and technological capacity. A fee on products with toxic ingredients and/or those that impose a long-term waste management cost to California taxpayers might be considered to fund fundamental research grants, graduate fellowships and technology transfer incubator centers. For the public sector, appropriate programs, goals and incentives could be considered as part of the state's annual budget process.



Policy Recommendation Three

Create an Online Product Ingredient Network

Vision: California businesses, retailers and consumers can access non-confidential information about chemicals (including nanomaterials) found in the products and goods they purchase in California. Manufacturers, importers and retailers of consumer products will disclose chemical ingredients for products sold in California. California can ensure that laws restricting or banning toxic ingredients in consumer products are consistently enforced and can ensure a level-playing field for businesses. California consumers can make better decisions for the health and safety of their families when selecting product.

Figure 8. Create an Online Product Ingredient Network

Description: Product manufacturers and suppliers should disclose all chemical ingredients, including nanomaterials, in products sold in California. A web-based data network should be established which allows users to access a list of the chemical ingredients for an individual product. Confidential business information should be protected but accessible by a designated state agency to determine whether protected information includes a hazardous chemical. All other chemical ingredient information would be available to any interested person via the web-based network.

How: California should require disclosure of chemical ingredients of products sold in California, while protecting confidential business information. A phase-in schedule may be considered so product ingredient disclosure is orderly, efficient and effective.

To optimize and standardize implementation of the online product ingredient network, manufacturers or suppliers would disclose product ingredients using an international standard identification system for each chemical ingredient and each product. For example, each chemical could be identified by its Chemical Abstract Service (CAS) number, International Union of Pure and Applied Chemistry (IUPAC) number, or International Nomenclature of Cosmetic Ingredients (INCI) number. Each product could be identified by its Uniform Product Code or barcode "tag." Using a state-of-the-art search algorithm via a portal to the online network, the product and chemical ingredient information (stored on the manufacturer or supplier's information systems) can be queried and viewed. This online network portal would be modeled on advanced data systems now in widespread use—including common search tools—and would be developed in collaboration with the information technology sector. The web-based search portal algorithm would be updated periodically to ensure consistent and easy access to this information.

For those products or ingredients for which the owner claims confidential business information, the information would be accessible to a designated state agency that would establish security criteria to protect the confidential information.

Why: Disclosing chemical ingredients in products provides essential information throughout the supply chain. With this information, raw material and feedstock suppliers, chemical intermediaries, suppliers, wholesalers, producers, manufacturers, distributors, retailers, consumers and end-users can make better informed choices. Each step in the supply chain must know which chemicals are found in which materials and products to make informed decisions about whether to use or substitute a particular chemical, intermediary, or feedstock.

Using the online product ingredient network, businesses can avoid selecting toxic ingredients which could otherwise injure their reputation, create toxic tort liability, endanger worker safety, or result in costly waste management or clean-up liabilities.

Toxics in Products Laws: Ad Hoc Enforcement Provisions Hinder the Goal of Improved Public Safety

In the last five years, California has enacted statutes to ban lead in jewelry, mercury in switches, toxics in packaging, lead in faucets, phthalates in toys, flame retardants in furniture, heavy metals in electronics and mercury in light bulbs, as well as to require ingredient disclosure in cosmetics. Some of the laws establish unique enforcement regimes under multiple state agencies – and some have no enforcement authority. The result is a haphazard set of laws that result in an uneven playing field and no assurance of achieving the intended health and safety protections for the public.

This information would allow manufacturers, retailers and ultimately consumers to make informed choices about the products they buy and use. It will also create a level playing field for California products and foreign competitors. Disclosure of the presence or absence of specific chemicals (including nanomaterials) in specific products would enable government to act quickly in response to emerging data about environmental and public health issues associated with those chemicals. The security infrastructure, or "virtual vault," would protect competitiveness and confidential information.

Funding: The development and operation of the web-based portal could be supported by its direct users—product manufacturers, suppliers and retailers who sell products and goods in California. The administrator of this data network could charge appropriate costs to those users. Those assessments could be a fixed amount or based on a sliding scale, as the administrator and users agree, and as necessary, to support the long-term operation and security of the network. Any state costs to determine and audit claims of confidential business information could be assessed to the claimant manufacturer and/or supplier.

Other States and Governments: No other state or national government has developed a product ingredient disclosure system for consumer products.

Metrics: Progress toward more complete, accessible information about which chemicals are found in products could be measured by the following metrics:

- Number of sectors (SIC code groups) for which chemical ingredient and nanomaterial information has been made accessible
- Number of products sold in California for which chemical ingredient and nanomaterial information has been made accessible

Compliance: Product manufacturers and or retailers who sell products in California would be required to disclose chemical ingredients for products they sell in California.

Policy Recommendation Four

Create an Online Toxics Clearinghouse

Vision: Building on efforts by other governments and authoritative bodies worldwide, California fills chemical information gaps by ensuring that hazard trait and toxicity data is developed and made publicly accessible via an online toxics clearinghouse. This clearinghouse (portal) will improve the ability of businesses, government and consumers to make better decisions that lead to safer choices.

Figure 9. Create an Online Toxics Clearinghouse

Description: California should establish a web-based clearinghouse portal to information containing specific chemical hazard trait and toxicological end-point data for all chemicals, including chemical compounds and nanomaterials. This chemical data should include information from a variety of authoritative sources, including California's environmental regulatory programs, U.S. EPA, other nations and other states.

How: Similar to the product ingredient disclosure system recommended in Policy Recommendation Three, an online toxics clearinghouse portal should be established (using modern information technology algorithms). To do this, California would follow a multi-step process that: (1) determines the hazard traits and toxicological end-points to be used in the online clearinghouse; (2) identifies existing sources for these data; and (3) prioritizes those chemicals of concern that will be the starting point for "populating" the online clearinghouse.

An online toxics clearinghouse should be established. As a preliminary step, the types of data (hazard traits or toxicological end-points) that will be part of the clearinghouse should be identified. A state agency, using a transparent and public process, should solicit input and select the chemical hazard trait and toxicological end-point data elements that will be used in the clearinghouse portal.

After the specific data elements are determined, a web-based search engine should be created and used to electronically access that data for all chemicals, including chemical compounds and nanomaterials.

To avoid duplication of effort or expense to California, this clearinghouse should be populated with data from existing sources first. California should establish agreements with other governments (such as the European Union, Japan and Canada) and authoritative bodies (such as the International Agency for Research on Cancer) to access their data on chemicals. Data sharing agreements and memoranda of understanding should be reached with other states such as Maine, Massachusetts, Washington and Oregon and the federal government that are also making new toxicity data available. As appropriate, chemical hazard and toxicity data from chemical producers and industry could be accessed and included in the online clearinghouse.

Similarly, this clearinghouse should not duplicate California's existing environmental regulatory programs that generate chemical toxicity information. These programs include the Water Quality Standards Program, the Pesticide Registration Program, the Toxic Air Contaminant and Air Toxics Hot Spots Program, public health goals for drinking water contaminants and Proposition 65. These data could be considered as part of the initial "input" for the clearinghouse. A graphic showing many of the potential types of data (range of hazard traits and sources of toxicity data) from existing regulatory programs and other authorities is included in Appendix E.

Next, for those chemicals for which data is currently incomplete or unavailable, a prioritization scheme must be established so information about those chemicals of highest concern to California can be developed and added to the online clearinghouse. This prioritization process could be conducted in several ways. For instance, California could convene a panel of scientific experts who would advise the state regarding which chemicals should be included in the first priority rank. The Cal/EPA Secretary or a designated state agency would consider the panel's advice and also invite public comment. The Secretary, a designated state agency, or a plural decision-making body such as the Environmental Policy Council (comprised of the heads of all the state agencies with jurisdiction over public health, safety and the environment) would consider all input and other appropriate matters when determining the prioritization ranking.

Why: For many chemicals, information about the toxicity and hazards traits is inadequate or unknown. Businesses, consumer and regulators often lack information on chemicals and their properties. Businesses find it difficult to identify hazardous chemicals in their supply chains. Consumers do not know which chemicals are in the products they buy and whether those may be toxic. Government agencies lack information to support regulatory actions. These critical information gaps prevent the free market from working properly to stimulate innovation of safer substitutes.

Establishing the online toxics clearinghouse will increase information so chemical toxicity research focuses on priority chemicals, markets accelerate the transition to less toxic alternatives and everyone throughout the supply chain can make better decisions and safer choices.

Funding: Development and operation of the online toxics clearinghouse should be built on existing authoritative bodies, such as the European Union, Japan, Canada, and other states. The administrator of the clearinghouse could charge appropriate costs to the direct users or apply other business models appropriate for online information. Any state costs associated with the development of the hazard traits and end-points data elements and prioritization and ranking of chemicals could be assessed to chemical producers and suppliers.

Other States and Governments: Recent legislation in Washington and Maine requires the respective environmental agencies to identify a specified number of chemicals of high concern, based on specified hazard endpoints. Massachusetts has long maintained a list of higher-hazard chemicals for priority-setting under its Toxic Use Reduction Act Program. The federal U.S. EPA has several voluntary programs, including the High Production Volume Challenge Program, to compile chemical toxicity and hazard information for selected chemicals.

CEPA, the Canadian Environmental Protection Act, enacted in 1999, used available existing information to categorize chemicals in its national inventory, identifying more than 4,000 chemicals that possessed hazard or exposure characteristics of potential concern.
Canada has conducted further assessments of these chemicals, focused on about 200 high-priority chemicals. Canada is currently collecting data from manufacturers and importers for the high priority chemicals.

Canada has conducted a robust priority-setting process as part of its Chemical Management Plan using existing toxicity data and mathematical modeling. The Canadian lists may serve as a starting point for California's prioritization ranking efforts.

EU REACH is the European Union Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), a law that went into effect in June 2007. It requires toxicity data to be registered with a new **European Chemicals Agency** in Helsinki for substances sold in the EU in quantities greater than 1 metric ton per year per company and evaluated for further testing. Ultimately, the EU may develop an authorization system to control substances of very high concern and progressively replace them with suitable alternatives where economically and technically viable, unless there is an overall benefit for society of using the substance.

The European Union (EU) has enacted the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) Act, which requires the chemical industry to assess and manage the risks posed by chemicals and provide appropriate safety information to their users.

Metrics: Toxicity end-point data is sparse or currently non-existent for a large number of chemicals (with the exception of pesticides and pharmaceuticals). A significant opportunity exists to fill this large data gap, improve the baseline of information and improve our ability to invent and move to safer chemistries. Specific metrics that could be used to assess progress in filling chemical information gaps and the online clearinghouse include:

- Percentage of chemicals in the clearinghouse with no hazard trait data
- Percentage of chemicals in clearinghouse with data on hazard traits of highest concern
- Percentage of chemicals in clearinghouse with complete hazardous trait data
- Number of emerging chemicals identified as being of high hazard concern
- Number of safer alternatives identified using the data housed in the clearinghouse

Compliance: Initially, the availability of the specified data should be audited to determine if data required in the first priority rank has been generated and made accessible. A designated state agency should monitor the clearinghouse. In the future, penalties for failure to make data accessible could be considered.

Policy Recommendation Five

Accelerate the Quest for Safer Products

Vision: California establishes a scientifically-based decision-making framework to evaluate chemicals of concern in products sold in the state and to prompt manufacturers of those products to use less toxic alternatives. By applying lifecycle thinking at the design stage, manufacturers find and use "greener" alternatives through design changes, product reformulation, product and input substitutions and other options. While toxicity information continues to be developed, consumers are protected more promptly as safer products replace those containing chemicals of concern.

Figure 10. Accelerate the Quest for Safer Products

Description: Chemicals of concern in products should be identified, promptly evaluated and then replaced, redesigned, restricted, or banned using lifecycle thinking principles. While toxicological and hazard trait data (or its absence) informs this process, alternatives analysis does not depend solely on complete toxicological data—rather it combines and synthesizes thinking on cleaner production, risk assessment and risk management, green chemistry, sustainable materials and product design. An alternatives analysis, which is a comparative tool and considers many factors, can begin when a specific concern arises.

Manufacturers, importers and retailers of products that are sold in California and that contain a chemical of concern would conduct this analysis to determine whether a safer alternative exists or is feasible. From that analysis, a range of regulatory actions are possible: additional research and development, technology development, phase-outs and bans, restrictions on use, engineering controls, best management practices, monitoring and extended producer responsibility.

How: Develop a science-based alternatives analysis decision-making framework, based on lifecycle thinking. The framework should include criteria to determine when a chemical of concern should be evaluated and whether an alternatives analysis will be required. These criteria should be developed through a transparent, public regulatory process and revised over time as more knowledge and better tools become available. The state should expand the role and membership of the Environmental Policy Council, to include heads of all state agencies with public health, safety and environmental jurisdiction, to review and identify the alternatives analysis framework to ensure multimedia considerations are adequately incorporated and balanced.

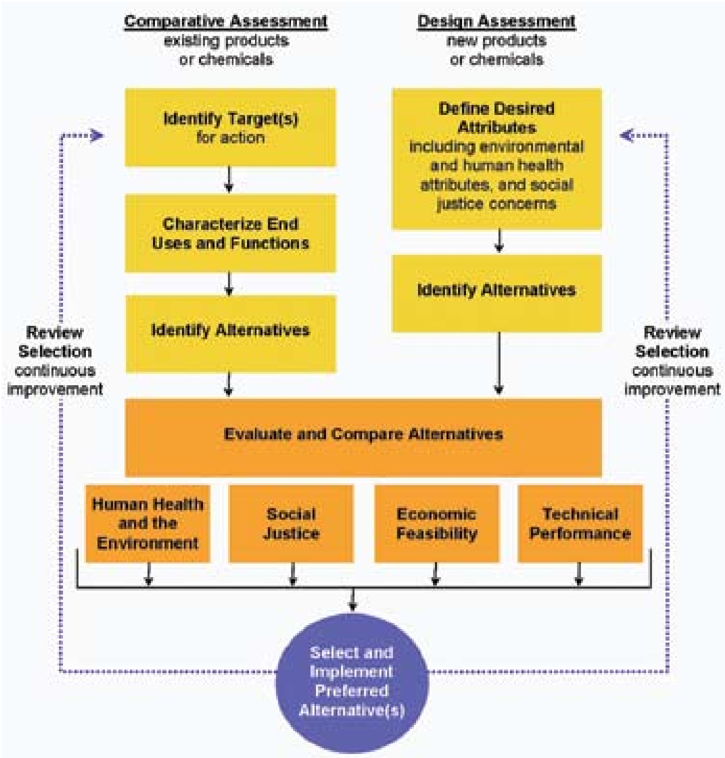


Figure 11. Conceptual Model for Alternatives Analysis. The selection of an alternatives analysis depends upon the use and function of the product or chemical and the methods used to consider factors such as health and environmental impacts, social considerations, economic feasibility and technical features. Source: Rossi, Tickner and Geiser, Alternatives Assessment Framework of the Lowell Center for Sustainable Production, July 2006.

In alternatives analysis, different outcomes are possible for the same chemical in different products. A product manufacturer, for example, may determine that a substitute for a chemical is readily available, cost-competitive and less hazardous. The same chemical used in a different product may require further research to identify a feasible alternative or to determine if restrictions, including extended producer responsibility, may be required.

The most important aspect of **alternatives analysis** is that it reorients environmental protection discussions from problems to solutions. For example, chlorinated solvents are used for degreasing and cleaning. Once we understand this function, it is possible to think of a range of alternatives, such as ultrasonic cleaning or **less toxic** aqueous cleaners or even redesigning a metal part so that the need for cleaning is eliminated altogether.

The state should establish a California Green Products Registry (CGPR), a non-governmental organization modeled after various consensus standards organizations, such as the American National Standards Institute (ANSI), International Standards Organization (ISO), Society of Automobile Engineers (SAE) and the U.S. Green Buildings Council (USGBC). This non-governmental consensus standards organization should be responsible for developing and improving the methodologies and protocols for lifecycle thinking, supporting industry and retailers in applying those methodologies, and providing multi-sector information about trends across broad economic sectors to industry and government.

Why: In most cases, California lacks a comprehensive framework for expediting the replacement or adoption of safer alternatives when a toxic substance is found in products. As such, California has been addressing toxic chemicals in products with ad hoc statutory bans of specific chemicals. While appropriate in some instances, bans often overlook the health and environmental implications of the chemicals that replace the banned one. These replacement chemicals may have significant unforeseen effects and perhaps increased risks, over the banned chemical. This ad hoc ban approach, without a means to make comparisons, stymies innovation and slows substitution of safer chemicals.

Given the huge array of products and chemical ingredients in those products, a systematic and consistent approach is critical so California can ensure that items purchased and used in the state do not harm the health and safety of our people or our environment. The current practice concentrates government resources on determining the degree of risk or hazard of a single chemical. We do not have a means to consider and compare alternatives that can enhance health and safety, reduce risk and improve performance using the best available information

Traditional risk assessment has been the predominant tool for decision-makers over the last 20 years. While risk assessment and toxicity testing must continue, society demands additional tools to reduce uncertainty and improve product safety while those efforts continue. California needs new tools for generating toxicological information, for assessing chemicals in products and for comparing alternatives.

Lifecycle assessment (also known as lifecycle analysis) is another useful tool but can also be time-intensive. A lifecycle assessment requires comprehensive documentation and evaluation of specified factors such as resource use, health effects and ecological impact. The results of lifecycle assessment can be problematic if the prescriptive methodology is not followed.

Because our present tools are labor and resource intensive and require substantial data, appropriate action on a chemical of concern may be delayed. Moreover, the potential alternatives are not identified or explored with the current tools. Using lifecycle thinking and comparing alternatives is an opportunity to act in a timely and effective manner to reduce the risk or hazard. Alternatives analysis calls attention to current and "on-the-horizon" alternatives. Resources that might otherwise be directed solely to the expensive and time-consuming process of characterizing problems can then focus on solutions.

An alternatives analysis model offers a systematic means of comparing options, weighing different hazard traits and environmental endpoints, and considering production, performance and cost factors as well as other appropriate attributes. Both government and industry will be able to make more informed decisions about substitution, reformulation, restrictions and bans. With good design, alternatives analysis can be conducted with present scientific information, at less cost and in less time. Alternatives analysis with lifecycle thinking shifts society's resources toward safer solutions that also enhance innovation and economic growth.

Funding: Funding mechanisms must be explored. For instance, the California Green Products Registry, a non-governmental consensus standards organization, could be established and assist both government and industry in developing, adapting and using alternatives analysis protocols and lifecycle tools (models for similar organizations are discussed on page 30 of this report). This organization could assess its membership, obtain tax-exempt contributions, receive grants and use other funding mechanisms. State governmental costs could be funded by assessments on the respective industry sectors and product manufacturers.

Other States and Governments: Several other U.S. states—Maine, Michigan, Oregon and Washington are implementing new statutory programs to regulate specific chemicals in specific products. Many local jurisdictions (mostly municipalities) have enacted restrictions, prohibitions and bans on certain chemical ingredients in specified products, such as polystyrene food containers and plastic grocery bags.

The European Union and Canada are implementing new programs that regulate chemicals, under EU REACH and Canadian Environmental Protection Act (CEPA) laws.

Metrics: Possible metrics for alternatives analysis to find and select safer, greener products include:

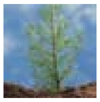
- Environmental footprint shrinking—measuring the relative change in the footprint over time
- The number of chemicals for which evaluations are required following a "trigger" event
- The number of products that are redesigned, reformulated, or otherwise assessed using alternative analysis methodologies, including lifecycle approaches
- The estimated volume of hazardous chemical(s) minimized or avoided through alternatives analysis

Compliance: In collaboration with stakeholders and the CGPR, the state would determine if alternative analysis methodologies are effective and efficient in reducing risk and hazard from chemicals of concern in products. The state could require specified response actions, where warranted and enforce those actions accordingly.

The 12 Principles of Green Chemistry are:

1. Prevent waste rather than treating it or cleaning it up.
2. Incorporate all materials used in the manufacturing process in the final product.
3. Use synthetic methods that generate substances with little or no toxicity to people or the environment.
4. Design chemical products to be effective, but reduce toxicity.
5. Phase-out solvents and auxiliary substances when possible.
6. Use energy efficient processes, at ambient temperature and pressure, to reduce costs and environmental impacts.
7. Use renewable raw materials for feedstocks.
8. Reuse chemical intermediates and blocking agents to reduce or eliminate waste.
9. Select catalysts that carry out a single reaction many times instead of less efficient reagents.
10. Use chemicals that readily break down into innocuous substances in the environment.
11. Develop better analytical techniques for real-time monitoring to reduce hazardous substances.
12. Use chemicals with low risk for accidents, explosions and fires.

Source: Anastas and Warner, Green Chemistry: Theory and Practice (1998)



Policy Recommendation Six

Move Toward a Cradle-to-Cradle Economy

Vision: California's environmental footprint is reduced through continuous innovation and design strategies that reduce production costs, improve quality, optimize resource use and generate less waste and pollution. Industries manufacture, sell and distribute "greener" products to California retailers and consumers (see Figure 12, right). Retailers—through their sourcing decisions—inspire designers and upstream industry to consider the lifecycle of the products they produce. The design of products shifts from the narrow focus on technical fabrication and function to include resource inputs, toxicity of substances used and end-of-life considerations. At the design stage, manufacturers consider which types of resources and industrial processes would be used. These decisions ultimately determine the safety and environmental characteristics of the finished product.

> **"Our Governor has a true vision and belief that the green economy can thrive here in our state and he's not waiting for the federal government to prove him right, he's taking the lead and setting the example. As with our green buildings and green fleet, the Green Chemistry Initiative is another set of policies to help lead the way for a green California."**
>
> *Rosario Marin, Secretary of the California State and Consumer Services Agency*

California is at the forefront of new green chemistry and green engineering technologies, processes and materials that are "benign by design." Leveraging this evolution of new "greener" product design, California enjoys a competitive advantage in the rapidly growing global marketplace. Californians supply the green products and technologies emerging from investments and innovation in nanotechnology, "clean tech," biotech, climate change and energy use reduction strategies and other new scientific discoveries. California expands its high-skill, high-wage jobs, greener and safer products and more efficient resource use through this vast global materials and consumer products market.

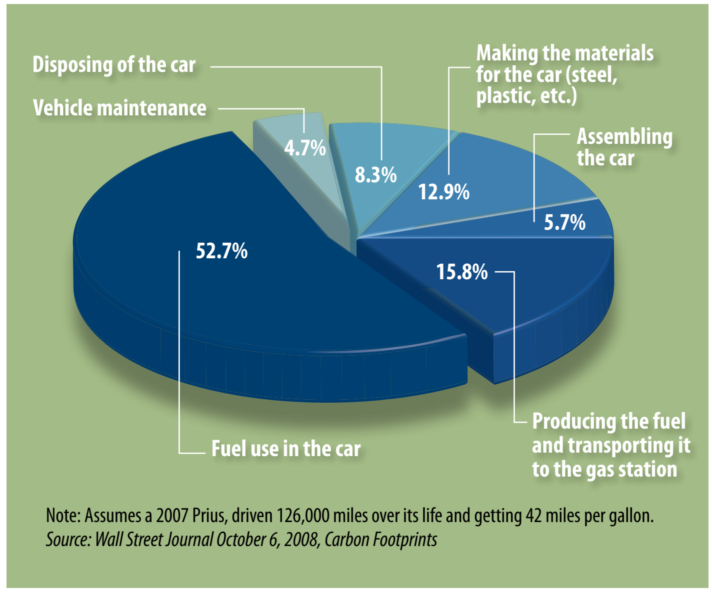
Figure 12. Move Toward a Cradle-to-Cradle Economy

Description: Product manufacturers that sell products in California should provide to retailers and consumers a sustainability metric—an environmental footprint calculator, index or "green scorecard" (not a label)—for their products or categories of products. The metric should be developed based on existing lifecycle approaches and models. Retailers should voluntarily assess their portfolio of products, set their own continuous environmental improvement targets and make the results of those efforts available to the public.

Lifecycle thinking allows consideration and balancing of different factors, including product performance, reliability, safety and toxicity, resource consumption, waste and disposal, climate change, energy efficiency, water conservation and costs. By placing added emphasis on all of the factors and attributes of a particular product, green design or lifecycle thinking can optimize materials and energy efficiency as well as change the systems or networks for production, distribution and consumption of such products.

How: A new systems-oriented green design and engineering philosophy will promote innovation. In principle, aggregate indicators such as materials or energy intensity, input-output exchanges, environmental performance, carbon footprint and other new techniques would be developed collaboratively. Retailers would be encouraged to apply these to their product portfolios to foster continuous improvement (see Figure 14, below). Retailers would work with their supply chains, who would change product design, substitute less hazardous ingredients, offer extended producer responsibility or take-back programs and other potential ways to help retailers meet their self-determined targets.

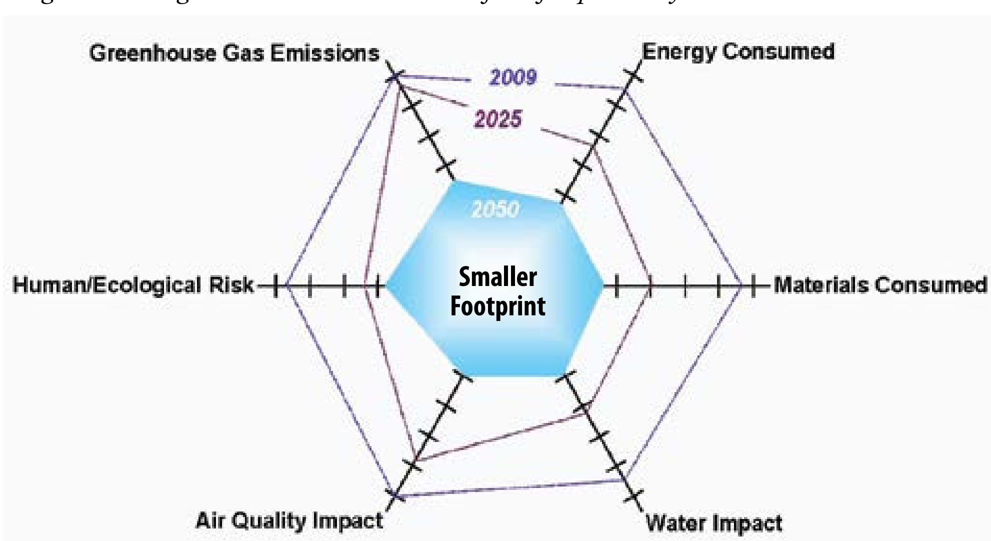
Figure 13. Carbon Footprint of Automobile



The sustainability or "environmental footprint calculator" would generate a score that would indicate a product's relative environmental impact or "greenness level." Numerous calculators are now widely available and can be tailored to meet the specific needs for calculating the footprint of a manufactured product.

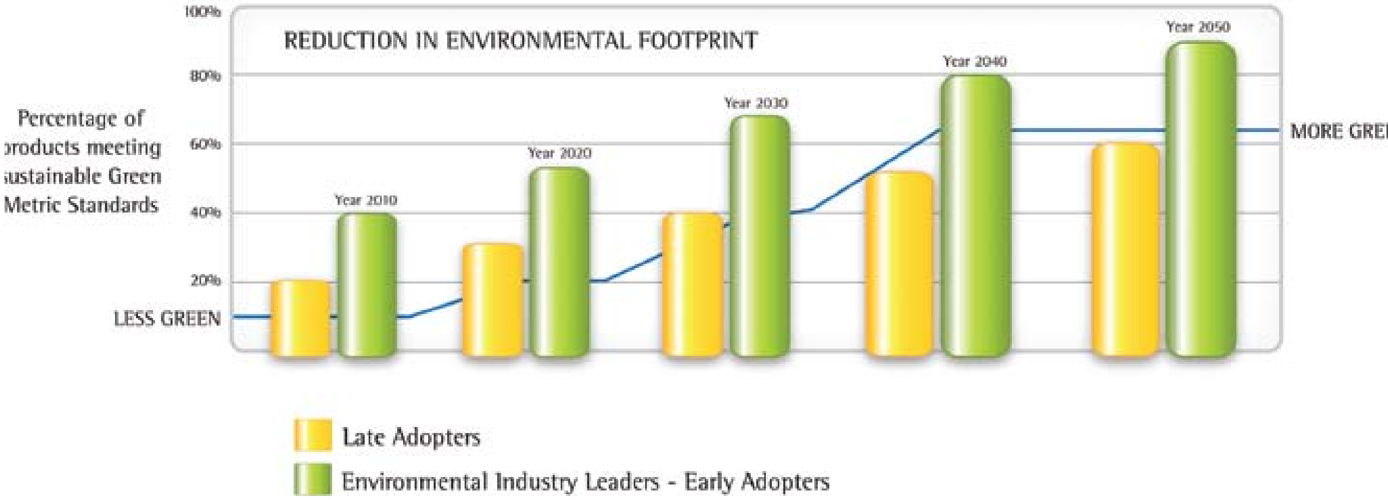
There are many examples of businesses and organizations that use such metrics. The USGBC, Patagonia, Levi-Strauss, Wal-Mart and Timberland have created and currently use environmental scorecards, rating systems or environmental footprint calculators for buildings, clothing, household cleaners and shoes, respectively. Many of these have the potential to be used as prototypes for the development of a California Green Scorecard—an approach that is more informative than a green label.

Figure 14. Reducing a Product's Environmental Footprint. *This spider diagram is one way to show how a particular product's environmental effects or "footprint" are reduced over time through incremental improvements in sustainable design. This diagram shows the dimensions of the footprint in years 2009, 2025 and 2050.*



Conceptually, with the information provided by product manufacturers, California retailers would assess their own portfolio of products and then set a "baseline." Retailers would then set their own "targets" for continuous improvement from their baseline toward safer, more sustainable products or product categories (see Figure 15, page 36). Retailers would set their own targets based on the attributes (properties of a product or service) that they select as the best means of increasing sustainability according to their own particular goals.

Figure 15. Sustainable Green Metric Growth



The California Green Products Registry, a non-governmental organization, should be established and could include a membership of lifecycle thinkers, environmental advocates, product developers and retailers who could develop consensus-based green metrics, protocols and tools. These tools will assist product manufacturers and retailers in achieving their target goals. These tools might include environmental footprint calculators, scorecards and sustainability indices. Further discussion and examples are included in Appendix F.

Voluntary goals could be established for green products targets. These goals will allow the metrics, tools and system to mature, which will benefit all retailers, but will be essential for small retailers. The state may also take into consideration that it may be more advantageous to start with products with the largest environmental footprints and those already subject to the widest range of environmental goals, restrictions and targets for specified environmental endpoints (e.g., automobiles or large appliances) or those where industry leaders have already established such tools (e.g., carpets, household cleaners and clothing). The state would then proceed to products with smaller environmental footprints or for products where development of such tools will take longer.

Consumer education and outreach would help create public demand and help the retailer achieve their targets. For further detail on how consumer education and outreach might be accomplished, see the report of the Key Element Team outlining some options in Appendix D-1.

Why: Implementation of this policy recommendation would start infusing the California marketplace with lifecycle thinking and accelerate the innovation and selection of sustainable, less toxic choices for consumers, retailers and the entire supply chain. Through the unique ability that retailers have to translate consumer demand into sourcing decisions, they would foster new designs for chemicals, processes and products based on relative hazards and environmental impacts throughout the lifecycle.

Since the majority of products consumed in California are manufactured out-of-state, our traditional regulatory approach does not foster innovation in products or the widespread development and adoption of green chemistry principles for products consumed in California. Moving to a focus on the environmental footprint of products could establish global consensus-based criteria for producing sustainable products and begin to level the playing field for California manufacturers. A common set of standards would provide a competitive advantage to those products designed and manufactured according to the most environmentally- and health-protective standards. This would be a great advantage to California businesses, while benefiting public health and the environment.

Retailers, through their sourcing decisions, will inspire designers and manufacturers to design products with reduced lifecycle impacts. Better sourcing decisions will protect people from harmful chemicals; avoid cradle-to-grave expensive cleanup costs and liabilities; allow markets to choose how to achieve the greatest environmental cost reductions; level the playing field for those manufacturers that are producing greener products; reduce risks of false "green" product claims or "greenwashing"; and contribute to solutions for energy, climate change and water pollution.

Greenwashing is a term that describes **misleading claims** about the **environmental safety** and effects of a product or service.

Multi-stakeholder, consensus-based standards take time to develop. However, once clear criteria and performance standards for "greenness" are established and garner widespread acceptance, their adoption by industry leaders leads to triple bottom line gains throughout the supply chain (see figure 3, page 17). For instance, the carpet industry collaborated with the National Science Foundation and the American National Standards Institute (ANSI) to develop lifecycle criteria and metrics for carpets. In so doing, the carpet industry provided valuable information to supply chain stakeholders. From this information, stakeholders identified sustainable attributes which enabled competition between manufacturers and their suppliers to seek out or develop environmentally preferable processes, practices, power sources and materials. Stimulating competition among market participants to reduce their product's environmental impacts and costs is the key goal of this policy recommendation. Without accounting for these costs or having a consistent way to measure them across product categories, businesses have no incentive to reduce them outside of government mandates, toxic tort and waste management liabilities. Establishing consensus-based metrics and allowing apples-to-apples comparison among product types, this policy recommendation has the potential to apply "Moore's Law" to products. With the profit motive and market competitiveness as its ally, California's environment and our public health have the potential to see great gains at increasingly lower cost.

Moore's Law refers to the prediction made in 1965 by Gordon Moore of Intel, that innovation would drive computer memory to double in capacity and speed every 18 months. Today, this principle also translates into an exponential reduction in cost.

Can this law apply to environmental protection as it did for computer memory?

As retailers and consumers select environmentally preferable products, manufacturers and those products gain a competitive advantage. As they gain marketshare and reduce cost, California also gains significant increases in environmental protection.

Funding: A California Green Products Registry should be established to assist manufacturers and retailers in developing and using sustainable or "environmental footprint" protocols, tools and metrics. The Registry could fund its on-going operations from assessments to its membership, tax-exempt contributions and grants. Retailers could work with their suppliers and supply networks to inventory products, assess lifecycle factors, establish baselines, set targets and measure performance.

Other States and Governments: No state or nation has instituted a comprehensive effort focused on consumer products and the chemicals used in those products. The International Organization for Economic Cooperation and Development (OECD) has begun efforts to develop lifecycle tools and apply those to environmental issues, eventually including consumer products. The Netherlands is embarking on the design of a cradle-to-cradle economy. For the most part, European and other international programs are voluntary. Many of these programs involve various labeling or certification schemes.

Other U.S. states—Maine and Washington—are implementing new statutory programs to regulate specific chemicals in specific products. Many states have implemented commodity-specific programs that focus on reducing or recycling certain products that contain specified hazardous chemicals such as used oil, tires and batteries. Some of these state-based programs are being implemented at the retail level.

A number of local jurisdictions have banned polystyrene take-out food packaging, including the cities of Alameda, Calabasas, Carmel, Emeryville, Long Beach, Los Angeles and Orange County. Some municipalities have also banned plastic grocery bags, typically requiring the use of compostable plastic. The cities of San Francisco, Los Angeles, San Jose and Palo Alto require that retailers meet plastics reduction and recycling goals.

Metrics: The California Green Products Registry would devise new metrics, tools and protocols based on lifecycle methodologies. Product manufacturers would apply these for their products and product categories. Retailers would use them for their product portfolios baseline and to set their targets for improvement. These quantifiable data may vary across different types or categories of products given the wide array of manufactured goods and chemical-formulated products. Once an environmental footprint calculator is established, the Registry would continue to refine and enhance it as knowledge improves over time.

IV. Next Steps

IV. Next Steps

Californians have an abiding interest in protecting their children, their health, their communities and the natural splendor of their state. Making consumer products and goods safer is a critical first step. Green chemistry and lifecycle design techniques will accelerate our transition toward a more sustainable economy, increase opportunity and enhance environmental quality. California will be at the forefront in developing clean and green technology, making more efficient use of energy and natural resources, and creating high-skill, high-wage employment.

The six policy recommendations included in this report are the initial framework. Subsequent efforts will be necessary, over several years, to make this transition. This set of six policy actions must be adopted through the normal executive, legislative and administrative processes. It will require ongoing collaboration between all stakeholders. After further analysis and public input, more specific measures will be developed for each one of the policy recommendations and key element plans over the next two years. The Secretary for Environmental Protection, along with the boards, departments and office within the California Environmental Protection Agency, will coordinate these next steps.

The proposed framework is market-driven and optimizes public and private sector efforts. The role of state government is to start the necessary transition, set rules and guidelines, and oversee and check progress. While the framework envisions limited new bureaucracy, additional resources for program implementation will be considered through the annual budgetary process. Taking these first steps now is crucial. This conceptual framework strengthens California's ability to achieve our shared public health, environmental and economic goals for the new millennium.

V. Acknowledgements

V. Acknowledgements

The California Department of Toxic Substances Control (DTSC) wishes to thank all of the individuals and organizations that helped arrange facilities, organize symposia, conduct workshops, gather ideas and comments from participants, and compile what we heard from them for this report.

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California Integrated Waste Management Board
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Department of Pesticide Regulation
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Office of Environmental Health Hazard Assessment
State Air Resources Board
State Water Resources Control Board
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Office of Emergency Services
State Water Resources Control Board
Department of Conservation
Department of General Services
Department of Pesticide Regulation
Department of Toxic Substances Control
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State Air Resources Board

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VI. Glossary of Terms and Acronyms A - C

Alternatives Assessment	A decision-making methodology which involves evaluating the pros and cons of a broad range of options. Alternatives assessment is used in public health, worker safety, and other disciplines. Alternatives assessment includes, but is not limited to, consideration of risk assessment, costs, benefits, energy inputs, waste generation, habitat effects, and other attributes of each option.
ANSI	American National Standards Institute (ANSI), a non-governmental organization comprised of government agencies, organizations, companies, academic and international bodies, and individuals. ANSI oversees the creation, promulgation, and use of thousands of standards and guidelines that directly impact businesses in nearly every sector, including globally-recognized cross-sector programs such as the ISO 9000 (quality) and ISO 14000 (environmental) management systems.
Attributes	Refers to the properties or characteristics of a product or service such as function, purpose, cost, value, usability, material inputs, resource consumption, waste outputs, and direct and indirect "effects" on human health and the environment.
Cal/ ARP	California Accidental Release Prevention Program (Cal/ARP), which includes the federal Accidental Release Prevention Program. Administered by the Office of Emergency Services, the purpose of the Cal/ARP Program is to prevent the accidental release of regulated substances. See Health and Safety Code section 25531 et. seq.
Cal/EPA	California Environmental Protection Agency (Cal/EPA), which includes the Office of the Secretary for Environmental Protection, the California Integrated Waste Management Board, the Department of Pesticide Regulation, the Department of Toxic Substances Control, the Office of Environmental Health Hazard Assessment, the State Air Resources Board, and the State Water Resources Control Board (including the nine Regional Water Quality Control Boards). See Government Code section 12812.
California Green Products Registry	Refers to a proposed California Green Products Registry (CGPR), a non-governmental consensus standards organization patterned on ANSI, ISO, SAE, USGBC, etc. As proposed, a non-profit organization would be established and would be responsible for developing protocols and metrics for sustainability. CGPR would also assist business and industry in applying those protocols and metrics.
Carl Moyer Program	Carl Moyer Memorial Air Quality Standards Attainment Program, a state grant program which provides grant assistance to participating air pollution control and air quality management districts for specific clean air projects for cleaner-than-required engines, equipment and emission reduction technologies.
CAS	Chemical Abstract Services (CAS), a division of the American Chemical Society. The society assigns a unique identifier, known as a "CAS number," to each chemical or compound. CAS produces the CAS Registry, which contains data on more than 38 million organic and inorganic substances and more than 60 million sequences.
CBI	Confidential Business information (CBI)
CEPA	*Canadian Environmental Protection Act* (CEPA 1999), is one of the Government of Canada's primary tools for achieving sustainable development and pollution prevention — the goals set out through Project Green.
Chemical	Matter which is made of atoms. For this report, all physical things (substances, compounds, objects, organisms, solids, liquids, gases, etc.) are composed of chemicals.
Chemical of Concern	Refers to a chemical, a compound, or a group or class of chemicals, effluents, or wastes that are perceived as potentially higher risk to human health or to the environment. The term is used commonly in various prioritization and risk assessment schemes.

VI. Glossary of Terms and Acronyms C - H

Cradle-to-Cradle	Phrase coined by Walter R. Stahel in the 1970s and popularized by William McDonough and Michael Braungart in their 2002 book, *Cradle-to-Cradle: Remaking the Way We Make Things*. This framework seeks to create production techniques that are not just efficient but are essentially waste free. It is described as the transformation of human industry through ecologically intelligent design.
Cradle-to-Grave	Phrase which refers to the life of a product or good from its manufacture (cradle) to disposal (grave). In U.S. law, the hazardous waste program, under the *Resource Conservation and Recovery Act*, establishes a system for controlling hazardous waste from the time it is generated to its ultimate disposal – in effect, from "cradle to grave".
CSU	California State University (CSU) system, which includes 23 campuses throughout the state and is the largest university system in the U.S.
DTSC	Department of Toxic Substances Control (DTSC). See Government Code section 12812.
EEI	Education and the Environment Initiative (EEI), a program which develops curriculum and supplemental materials, based on environmental principles and concepts, to teach math, science and language in California's primary and secondary schools. See Education Code section 33541 et. seq.
End-of-Life	Refers to the time when a product's value to the user, generally the first user, has been expended and the product is available for reuse, recycling, or disposal.
End-of-Pipe	Refers to the terminus of waste treatment and control technologies; the point of discharge, release, or disposal. Under U.S. law, the point at which regulatory permit limits apply.
Endpoints	Refers to toxicological testing results which may be used to classify a chemical or compound. Currently, most toxicology studies rely on observation outcomes of exposure, such as developmental anomalies, breeding behaviors, impaired reproduction, physical changes and alterations in the size and histopathology of organs, and, death.
Environmental Footprint	Refers to a quantifiable measure of the cumulative impacts of a process, activity, or population on the state's environment.
EU REACH	European Union *Registration, Evaluation, Authorization and Restriction of Chemical Substances* (EU REACH), a European Community law that took effect on June 1, 2007. Manufacturers and importers will be required to gather information on the properties of their chemical substances, which will allow their safe handling, and to register the information in a central database run by the European Chemicals Agency (ECHA) in Helsinki.
Extended Producer Responsibility	Extended Producer Responsibility (EPR), which is one of several possible regulatory outcomes after an alternatives analysis is conducted. EPR is also a key provision in the California Integrated Waste Management Board's directives.
GDP	Gross Domestic Product (GDP) is one of the measures of income and output for a given economy, usually a national government.
Green Chemistry	Refers to the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances and toxic chemicals.
Green Engineering	Refers to the design, commercialization and use of processes and technologies, which are feasible and economical while minimizing generation of pollution and risks to human health and the environment. [Shonnard, NAS]
Hazard Trait	Refers to characteristics of a chemical that can be used to assess potential adverse effects, including death, fire, explosion, irritation, burn, injury, illness, disease, cancer, birth defects, reproductive harm, plant and animal damages, etc.

VI. Glossary of Terms and Acronyms I - O

Hazardous Substance	Refers to a chemical which may cause injury or illness or harm the environment; synonymous with hazardous chemical, toxic chemical, toxic substance, and related terms for this report.
ISO	International Organization for Standardization (ISO), a network of the national standards institutes of 157 countries, one member per country, with a Central Secretariat in Geneva, Switzerland, that coordinates the system. ISO is a non-governmental organization that forms a bridge between the public and private sectors. Many of its member institutes are part of the governmental structure of their countries, or are mandated by their government. Other members have their roots uniquely in the private sector, having been set up by national partnerships of industry associations. See also ANSI above.
K-12	Refers to public school primary and secondary grade levels, kindergarten through twelfth grade.
LCA	Lifecycle analysis; see "lifecycle assessment".
LEED™	Leadership in Energy and Environmental Design (LEED), the U.S. Green Building Council's green building rating system.
Lifecycle	Refers to the major activities in the course of the product's life span from its design, raw materials, resource inputs, manufacture, use, operation, resource consumption, wastes generation, maintenance, and final disposal.
Lifecycle Assessment	A technique for assessing the environmental aspects and potential impacts associated with a product or process. Often used interchangeably with lifecycle analysis.
Lifecycle Thinking	Refers to the application of lifecycle principles to business practices. Lifecycle thinking involves examining the environmental sustainability over the product's entire life – from raw materials selection, manufacturing, transportation, use and end of life disposal or reuse and waste management. Tools, metrics and approaches using lifecycle thinking are often used to determine a product's "environmental footprint." Also called lifecycle approaches or lifecycle management.
Manufacturer	Refers to any person, firm, association, partnership, or corporation producing a substance, mixture of substances, a chemical, or a product or good which contains chemicals.
Metrics	Refers to methods for measuring or assessing performance.
Moore's Law	Refers to Gordon Moore's observation, in a 1965 journal article, that the number of transistors on an integrated circuit was increasing exponentially every 18 months. Carver Mead, Caltech, coined the phrase "Moore's Law," which now refers to exponential increases in capacity (function, speed, density, storage, etc.)—along with similar decreases in cost and size—for many technology sectors and industries.
Multimedia	Refers to the whole environment, specifically simultaneous impacts to air, water, and soil and to the plants, animals, habitats, people, and communities that depend on clean air, water, and land.
Nanotechnology	Refers to the design and engineering of chemicals, materials, and even machines that are extremely small (one nanometer in size, or about 1 billionth of a meter). Also nanoscale.
OECD	Organization for Economic Co-operation and Development (OECD), an international organization based in Paris. OECD provides governments with the analytical basis to develop environmental policies that are effective and economically efficient, including through performance reviews, data collection, policy analysis, and projections.

VI. Glossary of Terms and Acronyms Q - V

QSAR	Quantitative Structure Activity Relationship (QSAR), a model for assessing chemical toxicity and health risk. QSAR correlates biological activity (such as carcinogenicity) with structural or physical characteristics of chemicals and compounds.
REACH	See EU REACH.
Read-Across (Method)	Refers to a non-testing alternative approach for chemical risk assessment; closely related to QSAR.
Retailer	Refers to any person or business engaged in the selling to the consumer, not for the purpose of resale, of any product, good, or item.
SAE	Society of Automobile Engineers (SAE), an international organization comprised of engineers, business executives, educators and students who share information and exchange ideas for advancing the engineering of mobility systems. SAE Technical Reports and Standards are developed by the organization's more than 700 Technical Committees. Participation is open to all interested parties.
Source Reduction	Also known as "waste prevention" or "pollution prevention," is the practice of designing, manufacturing, purchasing, or using materials (such as products and packaging) in ways that reduce the amount or toxicity of trash created.
Sustainable Design	Refers to the design of products to comply with economic, social and ecological needs while reducing negative impacts on human health and the environment.
Through-Put (Method)	Refers to a rapid screening method to assess chemical toxicity. Through-put methods are an evolving health risk assessment tool.
Toxicity	Refers to the degree to which a substance affects an exposed organism (such as a human, animal, or plant) as well as cells and organs (such as the brain or liver). Toxicity assessment is one of four components of health risk assessments: (1) hazard identification, (2) toxicity or dose-response assessment, (3) exposure assessment, and (4) risk characterization.
Toxic Endpoints	See hazard trait, end-point.
Triple Bottom Line	Refers to a company's financial, environmental, and social performance. Also refers to a company's profits, derived from sales as well as cost savings from reductions in raw material inputs, resource consumption, waste management and disposal, liability and insurance, torts, etc.
UC	University of California (UC), which includes ten campuses, national laboratories, medical centers, and system-wide centers.
UPC	Universal Product Code (UPC), a specific type of bar code widely used in North America to track goods and products. Also stock keeping unit (SKU), a unique identifier for each distinct product.
Virtual Vault	Refers to an electronically secure system; information which only accessible via the Internet to an authorized user.

VII. Bibliography

Anastas, Paul T. and John C. Warner. *Green Chemistry: Theory and Practice.* Oxford University Press, 1998.

Ashford, Nicholas A. *An Innovation-Based Strategy for a Sustainable Environment. Innovation-Oriented Environmental Regulation: Theoretical Approach and Empirical Analysis. Proceedings of the International Conference of the European Commission Joint Research Centre,* May 27-29, 1999; pages 67-107.

Ashford, Nicholas A., Lars Koch. *Rethinking the role of information in chemicals policy: Implications for TSCA and REACH. Journal of Cleaner Production* (2006) 14: 31-36.

Ashford, Nicholas and Charles Caldart. *Technology, Law, and the Working Environment.* Van Nostrand Reinhold, 1991.

Bell, Ruth G. and James Wilson. *How Much is Too Much? Thoughts About the Use of Risk Assessment for Countries In Transition and the Developing World. Resources* (2000) Summer:10-13.

Braungart, Michael and William McDonough. *Cradle-to-Cradle: Remaking the Way We Make Things.* North Point Press, 2002.

Burtis, Patrick, Bob Epstein and Nicholas Parker. *Creating Cleantech Clusters: 2006 Update. E2, Environmental Entrepreneurs and Cleantech Venture Network, LLC.* May 2006.

California, Department of General Services. *Best Practices Manual.* Available at http://www.green.ca.gov/EPP/Introduction/default.htm.

California Environmental Protection Agency, California Resources Agency. *Environmental Protection Indicators for California.* April 2002.

California Environmental Protection Agency. *Toward the 21st Century: Planning for the Protection of California's Environment.* California Comparative Risk Project, May 1994.

California Integrated Waste Management Board. *Improving Used Oil Recycling in California.* May 2008.

California Legislative Analyst's Office. [Internet] *Cal/EPA: How well is it meeting its goals? 1998-1999 Budget Analysis.* Available at http://www.lao.ca.gov/laoapp/PubDetails.aspx?id=67.

California Legislative Analyst's Office. *Cal Facts: California's Economy and Budget in Perspective.* December 2006.

California Little Hoover Commission. *Organizing State Government to Meet California's Environmental Protection Priorities.* June 1991.

California Risk Assessment Advisory Committee. *Review of Cal/EPA Risk Assessment Practices, Policies, and Guidelines.* October 1996.

California Senate Office of Research. *Environmental Protections and Growth.* March 1996.

California Senate Office of Research. *California's Experience with Proposition 65: Implementing the Safe Drinking Water and Toxic Enforcement Act.* March 1990.

California Unified Environmental Statute Commission. *Unifying Environmental Protection in California.* January 1997.

Centers for Occupational and Environmental Health, University of California. *Green Chemistry: Cornerstone to a Sustainable California.* University of California, 2008.

Consumer Product Safety Commission. *Regulated Products.* Available at www.cpsc.gov/businessinfo/reg.html

Consumer Product Safety Commission. *Child Safety Protection Act Fact Sheet.* Available at www.cpsc.gov/cpscpub/pubs/282.html.

Environmental Products Declarations: The Green Yardstick. [Internet] Available at http://www.environdec.com/pageId.asp?id=301&menu=2,2,26.

Fava, J., R. Denison, B. Jones, M.A. Curran, B. Vigon, S. Selke, J. Barnum, eds. *A Technical Framework for Life Cycle Assessment.* Society of Environmental Toxicology and Chemistry, 1991.

Fava, J., F. Consoli, R. Denison, K. Dickson, T. Mohin, B. Vignon, eds. *A Conceptual Framework for Life-Cycle Impact Assessment.* Society of Environmental Toxicology and Chemistry, 1993.

Federal Focus and the Institute for Regulatory Policy. *Toward Common Measures, Recommendations for a Presidential Executive Order on Environmental Risk Assessment and Risk Management Policy.* June 1991.

Fiske, Alan P. and Philip E. Tetlock. *Taboo Trade-offs: Reactions to Transactions That Transgress the Spheres of Justice.* Political Psychology (1997) 18:255-297.

Geiser, Ken, Ph.D. *Making Safer Chemicals.* Lowell Center for Sustainable Production, University of Massachusetts, Lowell, April 2005.

Geiser, Kenneth and Barry Commoner. *Materials Matter: Toward a Sustainable Materials Policy (Urban and Industrial Environments).* The MIT Press, 2001.

Government Accountability Office, Chemical Regulation: *Actions Are Needed to Improve the Effectiveness of EPA's Chemical Review Program,* 2006. Available at www.gao.gov.

Governor's Reorganization Plan No. 1. May 17, 1991.

Guth, Joseph, J.D., Ph.D. [Internet] *The Chemicals Market Cannot Generate Green Chemicals Unless the Data Gap is Closed.* Science & Environmental Health Network. 2007. Available at www.sehn.org.

Guth, Joseph, J.D., Ph.D. [Internet] *The Core Legal Test in a Chemicals Law.* Science & Environmental Health Network. 2007. Available at www.sehn.org.

Guth, Joseph, J.D., Ph.D. [Internet] *Two Rules for Decisions: Trust in Economic Growth vs. Precautions.* Science & Environmental Health Network. 2007. Available at www.sehn.org.

Hadley, O.L. et. al. *Trans-Pacific transport of black carbon and fine aerosols (< 2.5) into North America.* Journal of Geophysical Research (2007) 112:D05309.

Hawken, Paul, Amory Lovins and L. Hunter Lovins. *Natural Capitalism: Creating the Next Industrial Revolution.* Little, Brown and Company, 1999.

Herrchen, Monika and Werner Klein. *Use of the life-cycle assessment (LCA) toolbox for an environmental evaluation of production processes*. Pure Appl. Chem (2000) 72(7):1247–1252. Available at http://old.iupac.org/publications/pac/2000/pdf/7207x1247.pdf.

International Organization for Standardization. *Environmental Management - Life Cycle Assessment, Principles and Framework.* ISO 14040:1997, 14040:2006 and ISO 14044:2006.

Johnson, Branden B. and Paul Slovic. *Lay Views on Uncertainty in Environmental Health Risk Assessment.* Journal of Risk Research (1998) 1:261-279.

Kahneman, Daniel and Amos Tversky. *Choices, Values and Frames. American Psychologist* (1984) 39:341-350.

Kraus, Nancy, Torbjörn Malmfors and Paul Slovic. *Intuitive Toxicology: Expert and Lay Judgments of Chemical Risks.* Risk Analysis (1992) 12:215-232.

Lindblom, Charles. *The Science of Muddling Through.* Public Administration Review (1959) Spring:79-88.

Lovins, L. Hunter. *"Chapter 3: Rethinking Production." State of the World: Innovations for a Sustainable Economy.* The Worldwatch Institute, January 2008.

Lowell Center for Sustainable Production, University of Massachusetts, Lowell. *Framing A Safe Chemicals Future, Towards Safer Chemicals, Products, and Services.* April 2005.

Lowell Center for Sustainable Production, University of Massachusetts, Lowell. *Options for State Chemicals Policy Reform, A Resource Guide.* January 2008.

Lowell Center for Sustainable Production, University of Massachusetts, Lowell. *Presumption of Safety: Limits of Federal Policies on Toxic Substances In Consumer Products.* February 2008.

Lowell Center for Sustainable Production, University of Massachusetts, Clean Water Fund. *Safer jobs and A Sustainable Economy Through Green Chemistry and Safer Alternatives to Toxic Chemicals in California, A Constituency Analysis.* March 2007.

Matus, Kira J., Paul T. Anastas and William C. Clark. *Overcoming the Challenges to the Implementation of Green Chemistry, Working Papers, Center for International Development at Harvard University, CID Working Paper No. 155.* December 2007.

Michaels, David. *Doubt is Their Product, How Industry's Assault on Science Threatens Your Health.* Oxford University Press, April 2008.

National Academy of Public Administration, environment.gov, *Transforming Environmental Protection for the 21st Century.* November 2000.

National Pollution Prevention and Toxics Advisory Committee (NPPTAC), Broader Issues Work Group. *How can EPA more efficiently identify potential risks and facilitate risk reduction decision for non-HPV existing chemicals?* 2005.

National Research Council. *Risk Assessment in the Federal Government: Managing the Process.* Washington, D.C.: National Academy Press, 1983.

National Research Council. *Science and Judgment in Risk Assessment.* Washington, D.C.: National Academy Press, 1994.

National Research Council. *Sustainability in the Chemical Industry.* The National Academies Press, 2006.

Nelson, Richard R. *The Moon and the Ghetto: An Essay on Public Policy Analysis.* New York: W.W. Norton, 1977.

Nisbett, Richard and Lee Ross. *Human Inference: Strategies of Shortcomings of Social Judgment.* Englewood Cliffs, New Jersey: Prentice-Hall, 1980.

O'Brien, Mary. *Making Better Environmental Decisions: An Alternative to Risk Assessment.* The MIT Press, 2000.

O'Brien, Mary. *What Does the Average Joe Know About Science? An Exchange.* The Networker (2000) 5:4-B.

Office of Technology Assessment. *Green Products by Design: Choices for a Cleaner Environment.* September 1992. [OTA-E-541, NTIS #PB93-101715]

Organization for Economic Cooperation and Development (OECD). *Environmental Outlook for the Chemicals Industry.* 2001. Available at http://www.oecd.org/dataoecd/7/45/2375538.pdf.

Presidential/Congressional Commission on Risk Assessment and Risk Management (CRARM). *Risk Assessment and Risk Management in Regulatory Decision-Making. Final Report, Volume 2.* Washington, D.C.: Government Printing Office, 1997.

Rossi, Mark, Ph.D., Joel Tickner, Sc.D. and Ken Geiser, Ph.D. *Alternatives Assessment Framework of the Lowell Center for Sustainable Production. Version 1.0.* Lowell Center for Sustainable Production, University of Massachusetts, Lowell, 2006.

Schapiro, Mark. *Exposed: The Toxic Chemistry of Everyday Products and What's at Stake for American Power.* Chelsea Green Publishing Company, 2007.

Sekutowski, Janine C. Greening the Telephone: *A Case Study. The Greening of Industrial Ecosystems.* 1994. National Academy Press. p. 171-177.

Silicon Valley Leadership Group. *2007 Silicon Valley Projections: Tough Challenges – Hopeful Signs,* 2007.

Simon, Julian L. *The Ultimate Resource.* Princeton, New Jersey: Princeton University Press, 1981.

TerraChoice Environmental Marketing, Inc. *The "Six Sins of Greenwashing" – A Study of Environmental Claims in North American Consumer Markets.* November 2007.

Walsh, Bryan. *"What is a Green-Collar Job, Exactly?".* Time, May 16, 2008.

United Nations, *Department of Economic and Social Affairs. World Population to 2300.* New York: United Nations, 2004. Available at http://www.un.org/esa/population/publications/longrange2/WorldPop2300final.pdf.

U.S. Department of Energy, Office of Industrial Technologies, Renewables Vision 2020, Executive Steering Group. The Technology Roadmap for Plant/Crop-based Renewable Resources 2020. 1999. [DOE/GO-10098-385] Available at http://oit.doe.gov/agriculture/

U.S. Environmental Protection Agency (U.S. EPA), Office of Research and Development. *Lifecycle Assessment: Principles and Practice.* U.S. EPA, Cincinnati, OH, 2006. [EPA/600/R-06/060]

U.S. EPA, Office of Solid Waste. *Beyond RCRA: Waste and Materials Management in the Year 2020.* U.S. EPA, 2003. [EPA 530-R-02-009]

U.S. EPA, Office of Solid Waste and Emergency Response. *WasteWise Update: Environmentally Preferable Purchasing.* U.S. EPA, 2001. [EPA 530-N-01-002]

White House Council on Environmental Quality, *The Twenty-fifth Anniversary Report of the Council on Environmental Quality.* 1997.

Wilson, Michael P., Ph.D., Daniel A. Chia and Bryan C. Ehlers. Special Report. *Green Chemistry in California: A Framework for Leadership in Chemicals Policy and Innovation. California Policy Research Center,* University of California, 2006.

Wilson, Pete, Governor. *Annual Environmental Report and Message of the Governor,* 1997-1998. California Environmental Protection Agency, January 1998.

EXHIBIT 5

Comments on the Draft Amendments to the Statewide Water Quality Control Plans to Control Trash

The Role of Polystyrene Bans

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I. Introduction

At the request of Dart Container Corporation, The Brattle Group has reviewed the draft amendments to the Statewide Water Quality Control Plans to Control Trash with respect to the proposed regulatory source controls.[1] The amendments are intended to reduce the overall volume of litter in California's surface waters. They encourage local jurisdictions to adopt "regulatory source controls," which are defined to include bans of single-use consumer products. The trash amendments appear to assume that any such ban would reduce trash in the receiving waters, and that local jurisdictions would be able to claim such bans as trash-reduction measures under Track 2 of the proposed amendments. This paper focuses on the effects of such a policy on polystyrene (PS) foam materials. Based on our review, we have concluded that including the portion of the trash amendments that encourage local PS bans is ill-advised. As we have noted in prior studies, polystyrene bans are unlikely to pass a benefit cost test[2]. In addition, such bans are not cost-effective.[3] This is the case for several reasons:

- Polystyrene represents a small share of litter volume so that a ban will contribute little to litter reduction
- Polystyrene bans have not been shown to be effective at reducing overall litter. In fact, the substitutes offset the reduction in polystyrene. In general, bans of single service items in the waste stream are unlikely to be effective for this very reason.
- Polystyrene bans are expensive. The substitutes for polystyrene food and drink containers are more expensive and will burden households, schools, and hospitals.
- Polystyrene cannot be distinguished as a particularly serious threat to the ocean ecosystem. Polystyrene represents a small share of plastic waste in the ocean and does not pose any known environmental risks.
- Polystyrene can be recycled. Promoting this activity is likely to be far more effective than a ban and is consistent with state policy regarding the management of plastic waste.

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1 "Draft Staff Report on the Draft Amendments to Statewide Water Quality Control Plans to Control Trash." Division of Water Quality, State Water Resources Control Board, California Environmental Protection Agency. June 2014.

2 Berkman and Sunding, "Economic Analysis of SB568's Proposed Polystyrene Ban," August, 2011 and "Economic Analysis of San Jose's Proposed Polystyrene Ban," February 25, 2012.

3 Cost-effectiveness determines which policy achieves an objective such as a 10% litter reduction for the least cost, in contrast to a benefit cost measure, which establishes whether indeed the benefits of an objective or policy exceed its cost.

In addition, the staff report fails to provide sufficient information regarding the cost-effectiveness of any of the institutional controls (IC) it recommends. Thus, local governments do not have sufficient guidance to make prudent decisions. Finally, the staff report fails to identify what appears to be a very cost-effective control – more waste receptacles where littering is most prevalent.[4]

It should be noted that the trash amendments encourage bans of many single-use consumer products. We have limited our analysis to bans of polystyrene foam. But bans of other products could have environmental and economic impacts similar to bans of polystyrene foam. To help it make informed decisions, the State Board should do an analysis of products that local governments are likely to ban under the trash amendments, and the likely environmental and economic consequences of such bans.

II. Polystyrene Represents a Small Share of Litter Volume

A polystyrene ban will be ineffective at reducing overall litter entering the water stream because PS is such a small share of the litter items found at storm drains nationwide. The following sections review litter studies conducted both nationwide and in the State of California. These studies show that polystyrene is a small share of litter by volume. Nationally, the share is about 2.5% and 1.5% on average in California. A recent study in Los Angeles shows higher shares – between 7% and 16%, but the study indicates these numbers may be inflated because the location of the surveys may not be representative of the city as a whole.

A. Keep America Beautiful Study

A study for Keep America Beautiful (KAB) found that that all expanded polystyrene materials accounted for 5.6% of litter collected in storm drains.[5] EPS Fast Food Service items in particular accounted for only 2.5% of the litter collected in storm drains and did not make the top ten litter types reported by KAB. Figure 1 shows this.

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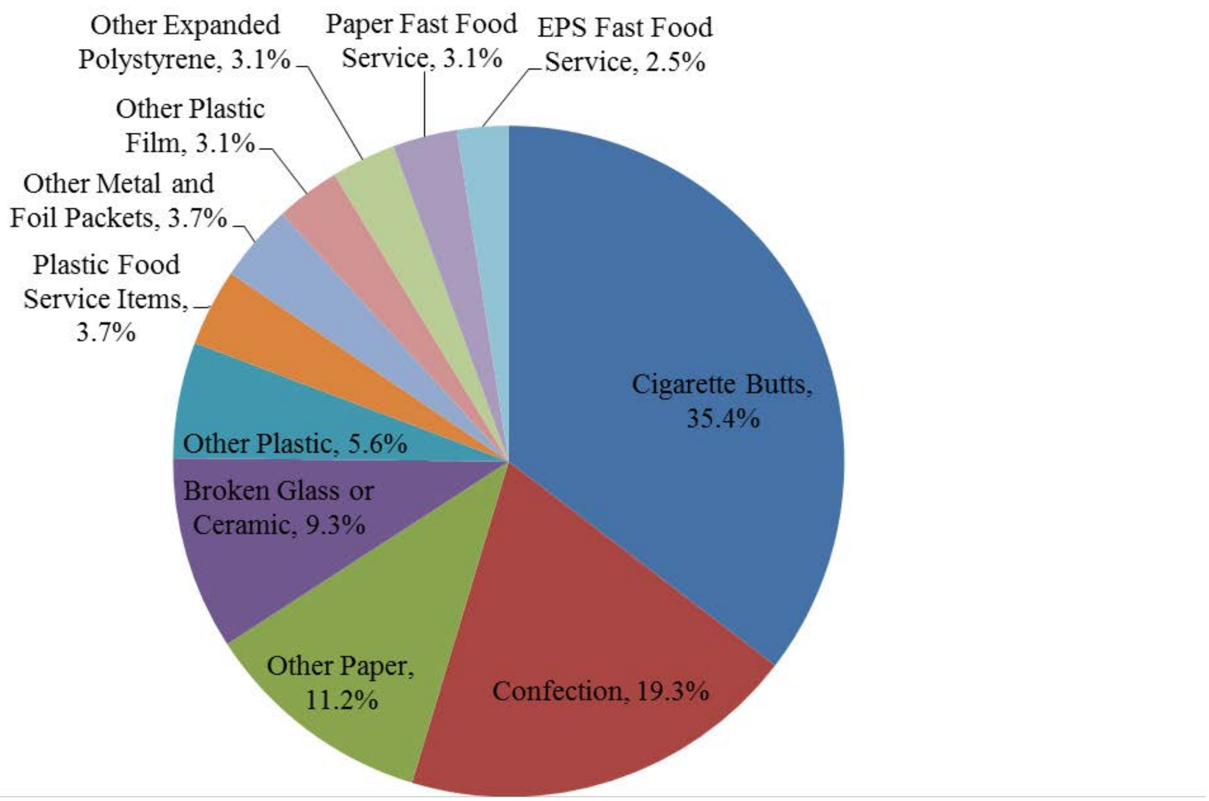
4 The 2009 KAB Study called this "the convenient truth" – citing several studies which showed that "littering rates decrease as the convenience of using a proper receptacle increases."[4]

5 Mid Atlantic Solid Waste Consultants, "2009 National Visible Litter Survey" Prepared for Keep America Beautiful, Final Report, September 18, 2009, Figure 3-6, pp. 3-30.

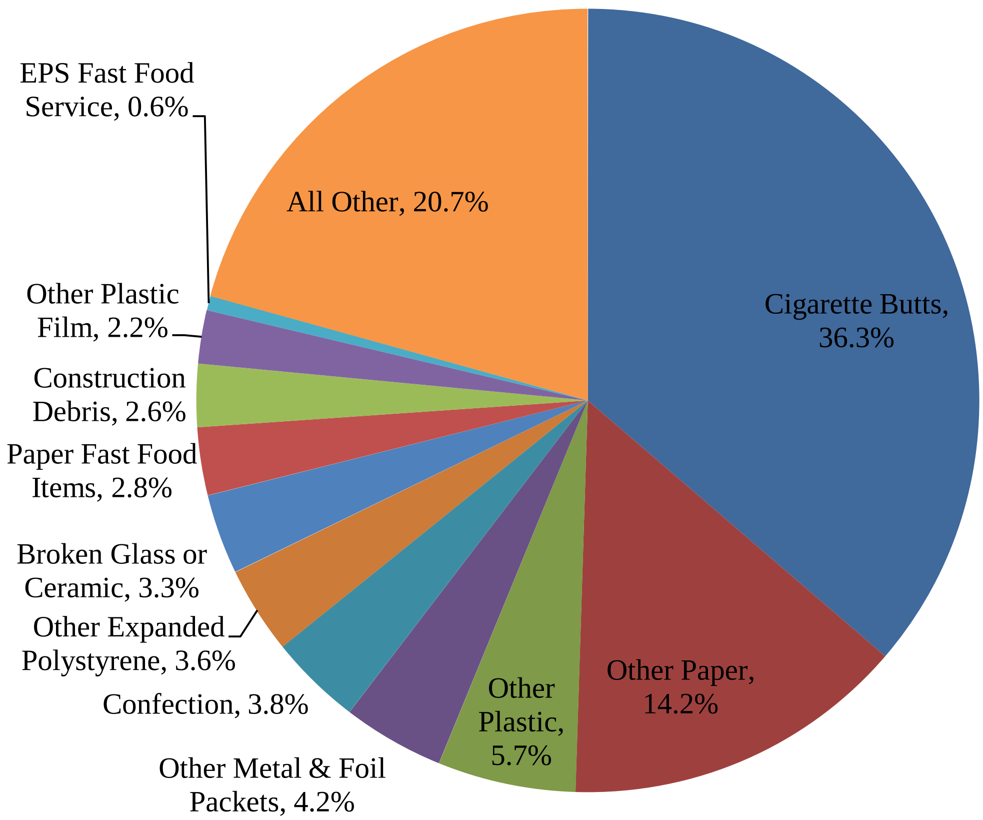
Figure 1: Share of Top 11 Most Common Litter Items at US Storm Drains



In the same study, KAB also analyzed litter found on US roadways, and found similar results. Again, non-food service EPS items accounted for 3.6% of litter items, and EPS food service items accounted for only 0.6% of litter items.[6] This can be seen in Figure 2.

[6] Mid Atlantic Solid Waste Consultants, "2009 National Visible Litter Survey" Prepared for Keep America Beautiful, Final Report, September 18, 2009, Figure 3-3, pg. 3-2. The study defines other expanded polystyrene as non-food packaging and finished products with an SPI 6 designation.

Figure 2: Relative Share of Litter Items on US Roadways



B. Environmental Resources Planning Review of Studies

In 2012, Environmental Resources Planning, LLC prepared a review of litter studies conducted during the past two decades, to determine polystyrene's share of the overall litter stream. Table 1 shows the findings of each litter study. Across all studies, the median share of PS food service products of the total litter stream was 1.5%, and the mean share was 1.7%. Just looking at the studies conducted in California, the median share is 1.4%, while the mean share is 1.5%.

Table 1: Summary of Litter Studies – Polystyrene's Share of Overall Litter

Survey	Year	Percent
San Jose	2009	2.3%
Alberta	2009	0.7%
San Jose	2008	0.8%
National	2008	1.7%
San Francisco	2008	1.1%
San Francisco	2007	1.7%
Alberta	2007	1.1%
Toronto	2006	1.1%
Toronto	2004	1.0%
Region of Peel	2003	0.5%
Region of Durham	2003	0.6%
Region of New York	2003	0.3%
Toronto	2002	1.5%
Florida	2002	2.3%
Florida	2001	2.2%
Florida	1997	3.1%
Florida	1996	3.6%
Florida	1995	3.3%
Florida	1994	3.9%
Median Value		1.5%
Mean Value		1.7%

Source: "The Contribution of Polystyrene Foam Food Service Products to Litter." Environmental Resources Planning, LLC. May 2012.

C. LOS ANGELES STUDY

In December 2013, Black and Veatch published the final report of its Quantification Study of Institutional Measures for Trash TMDL Compliance for the City of Los Angeles.[7] The study was conducted in order to objectively assess the performance of the institutional measures used by the City of Los Angeles to reduce litter volume. As part of the study, trash was collected during survey periods over two years, 2012 and 2013, and sorted by type. The study found concentrations of polystyrene between 7% and 16%, depending on the land type (low density residential, industrial, etc.). The study noted that in some areas with higher concentrations of polystyrene, a likely reason was the prevalence of food trucks, which often serve customers using polystyrene materials.

[7] "Quantification Study of Institutional Measures for Trash TMDL Compliance." Prepared for the City of Los Angeles by Black & Veatch. December 3, 2013.

III. Evidence Shows that PS Bans are Not Effective at Reducing Trash

No study has been conducted showing that bans of polystyrene materials are successful in reducing overall litter. In fact, a recent report shows that due to a substitution of alternative products for banned PS products, litter volume remains the same or even increases after the implementation of a PS ban.[8]

In San Francisco, for example, PS was banned in 2007. The City of San Francisco conducted litter audits in 2007, 2008, and 2009. Between 2007 and 2009, some polystyrene items actually increased their share of the overall litter stream, while others saw their shares decrease. Non-polystyrene food service items replacing the banned products, however, saw an increase in their share of the overall litter stream. This suggests that after the ban, alternative products were substituted for polystyrene, and that these items still entered the litter stream. It is important to recognize that substitution is likely to occur for other single service items that might be banned. In general, bans are not an effective means of protecting the environment for this reason.

Although at least 65 jurisdictions throughout California have banned expanded polystyrene,[9] there are no studies that show a direct impact of a ban leading to lower volumes of overall litter. Before other jurisdictions proceed with the recommended institutional controls, they should be informed regarding their effectiveness.

IV. The Costs of Polystyrene Bans are Likely to be Large

Based on our analysis, the costs of the proposed polystyrene ban are likely to be substantial. The draft trash amendments do not ban single-use consumer products themselves, but they encourage bans. They allow cities to enroll in Track 2 of the trash amendments, which allows the cities to adopt bans of single-use consumer products, claim those bans reduce trash, and avoid costly (but effective) structural controls. It is difficult to predict how many cities will adopt such bans, but we have seen many cities adopt bans in California even without these incentives, and it is reasonable to assume that many, perhaps even a significant majority, of cities in California will adopt bans as a result of the trash amendments. The economic analysis below presents a bounding condition, and assumes that all cities would adopt polystyrene foam bans. The cost to California consumers including households, public school districts, and other institutions that provide food services could easily reach $238 million annually.[10] Below we present cost estimates for these consumer groups based on the best currently available information. Further analysis would be necessary to provide more precise and detailed costs.

[8] Grey, Mark. "Proposed Polystyrene Foam Food Ware Ban in San Jose Will Not Reduce Trash Loads in Storm Drains and Receiving Waters." Presentation of Findings, August 2013.

[9] Draft Staff Report, p. 7.

[10] Calculated as the sum of the costs to households ($192m), schools ($42.5m), colleges ($2.5m), and hospitals ($1m), which are shown in detail in the following sections.

Some cities will probably not adopt foam bans, and to that extent, the state and its consumers would bear only a portion of the costs in this analysis. However, in one important respect, this analysis is potentially very conservative: it measures the cost only of polystyrene foam bans, while the trash amendments encourage bans of apparently all single-use consumer products. Costly substitutes for other single-use items would make bans of these components of the waste stream expensive as well.

A. Costs to Households

Household expenditures on food and meals away from home will clearly increase. Based on a recent comparison of posted prices, the price differential between polystyrene food service items (cups, plates, and trays) and alternative items is large. According to distributor price lists, the price for substitute cups, for example, is on average one and a half times the cost of equivalent expanded polystyrene (EPS) cups. As shown in Table 2, based on EPS alternative price differentials and state market volume, California consumer spending could increase by as much as $192 million per year. This cost is only for cups, bowls, plates, and clamshells (also referred to as hingeware). Similar increases are likely for the other EPS food service items replaced by higher cost substitutes. Consequently, the total cost to households could be higher.

Table 2: Total Costs of Expanded Polystyrene Substitution in California

California Market Share

US Population	316,128,839	[1]
CA Population	38,332,521	[2]
CA Share of Population	12.13%	[3]

California EPS Market Volume

Item	National Volume	California Volume
	[4]	[5]
Cups	25,503,000,000	3,092,391,970
Bowls	2,637,000,000	319,752,093
Hingeware	10,817,000,000	1,311,626,237
Plates	2,637,000,000	319,752,093

Price Comparison	**Cost (per 1000)**	**Cost of Substitution**	**Cost of California Substitution**
	[6]	[7]	[8]
Dart Flush Fill White Foam Cup - 16 oz.	$27.99		
Choice White Paper Hot Cup - 16 oz.	$42.86	$14.87	$45,983,869
Dart White Foam Bowl - 12 oz.	$13.82		
Dart Solo 12BWWF White Heavy Weight Plastic Bowl - 1	$26.65	$12.83	$4,102,419
Dart Perforated Hinged Lid Take Out Container - 9x9x3	$66.00		
Duralock Clear Hinged Lid Plastic Container - 9x9x3	$162.45	$96.45	$126,506,351
Dart 3 Compartment White Foam Plate - 9"	$24.04		
Solo Medium Weight Paper Plate - 9"	$73.98	$49.94	$15,968,420
Total Estimated Annual Cost of EPS Substitution in CA			$192,561,058

Notes:
[1]: U.S. Census Bureau population estimate for July 1, 2013.
[2]: U.S. Census Bureau population estimate for July 1, 2013.
[3] = [2] / [1].
[4]: 2010 Market Research Study on Foodservice Packaging Products, Foodservice Packaging Institute. Assumes evenly split allocation of market volume for bowls, plates, and platters.
[5] = [4] x [3].
[6]: Price of lowest cost polystyrene and alternative products obtained from www.webstaurantstore.com, assuming bulk purchases.
[7]: Difference between alternative and polystyrene products from [6].
[8] = [7] x ([5] / 1000).

B. COSTS TO CALIFORNIA'S PUBLIC SCHOOL DISTRICTS

School districts and other public institutions that provide food services using polystyrene products would experience substantial cost increases. While it is difficult to calculate these costs precisely, we do have information on the number of polystyrene trays sold to California public schools and data for some public school districts. We do not, however, have data on the number of other food service items including cups. There are also differences in the reported costs for polystyrene product replacements. Below we present a lower and an upper bound cost estimate reflecting these uncertainties.

1. Conservative Lower Bound Cost

Based on a Plastic Food Packaging Group estimate and data from a large California-based distributor, 170 million polystyrene trays are sold to California public schools annually. Since some alternatives to polystyrene trays may cost as little as $0.04 more than polystyrene trays, total annual costs of the ban would be a minimum of $6.8 million. This is conservative because it assumes every polystyrene cup would be replaced by the least-cost alternative and does not include other polystyrene food service items that schools sometimes use including cups.

Table 3 summarizes the costs of the ban to selected California school districts that currently rely on polystyrene trays.

2. Upper Bound Cost

Accounting for higher cost per tray by using an incremental cost of $0.20 per tray, the ban will cost $34.0 million annually. This cost was reported by the Long Beach School District and was confirmed in a recent phone call with the District buyer. In addition, adding other food service items (cups) with observed cost differences for alternatives of $0.05 per unit would add $8.5 million annually. Consequently, total costs of the ban could easily be six times the lower bound ($42.5 million v. $6.8 million).

Table 3: Cost of Substitution in Select Districts Currently Using Polystyrene Trays

School District	Annual Cases Ordered	Total Cost for Polystyrene Trays ($16 per case)	Total Cost for Alternative Trays ($35 per case)	Annual Cost of Substitution of Polystyrene Trays
	[1]	[2]	[3]	[4]
El Segundo	160	$2,560	$5,600	$3,040
Torrance	1,500	$24,000	$52,500	$28,500
Manhattan Beach	700	$11,200	$24,500	$13,300
Chula Vista	6,000	$96,000	$210,000	$114,000
Culver City	600	$9,600	$21,000	$11,400
Los Alamitos	600	$9,600	$21,000	$11,400
Monrovia	700	$11,200	$24,500	$13,300
Ontario	2,000	$32,000	$70,000	$38,000
Pasadena	600	$9,600	$21,000	$11,400
Santee	1,000	$16,000	$35,000	$19,000
South Bay	2,600	$41,600	$91,000	$49,400
Valley Center	300	$4,800	$10,500	$5,700

Notes

[1]: Data provided by P&R Paper Supply.

[2]: Ibid.

[3]: Ibid. Average cost of bagasse and molded fiber alternatives.

[4] = [3] - [2].

C. Costs to California's Public College System

California's college system (University of California, California State University, and community colleges) would also face rising costs in the face of a polystyrene ban. Using a procurement request distributed by UC Riverside, the total demand for disposable food service items in the California college system can be approximated. While some campuses have already excluded polystyrene products, they do so at a cost. Using the price differential between EPS products and their lowest priced alternatives, the total cost savings of maintaining or switching to EPS products is estimated at over $2.5 million annually, as depicted in Table 4.

Table 4: Expanded Polystyrene Cost Savings to California's Public College System

CALIFORNIA COLLEGE ENROLLMENT

College	Enrollment	
UC Riverside	20,746	[1]
CA Community Colleges	1,195,251	[2]
California State Colleges	446,530	[3]
University System	238,686	[4]
All California Colleges	**1,880,467**	[5]

CALIFORNIA COLLEGE ORDER VOLUME

Item	UC Riverside Total Order	Number per Student	California Colleges Total
	[6]	[7]	[8]
Cups	315,000	15.18	28,552,353
Bowls	80,000	3.86	7,251,391
Hingeware	50,000	2.41	4,532,119
Plates	360,000	17.35	32,631,260

PRICE COMPARISON

Product	Cost (per 1000)	Cost of Substitution	Cost to State Colleges
	[9]	[10]	[11]
Dart Flush Fill White Foam Cup - 16 oz.	$27.99		
Choice White Paper Hot Cup - 16 oz.	$42.86	$14.87	$424,573
Dart White Foam Bowl - 12 oz.	$13.82		
Dart Solo 12BWWF White Heavy Weight Plastic Bowl - 12 oz.	$26.65	$12.83	$93,035
Dart Perforated Hinged Lid Take Out Container - 9x9x3	$66.00		
Duralock Clear Hinged Lid Plastic Container - 9x9x3	$162.45	$96.45	$437,123
Dart 3 Compartment White Foam Plate - 9"	$24.04		
Solo Medium Weight Paper Plate - 9"	$73.98	$49.94	$1,629,605
Total Annual EPS Cost Savings to California Colleges			**$2,584,337**

Notes:

[1]: UC Riverside Facts, http://www.ucr.edu/about/facts.html, enrollment at time of proposal
[2]: Chancellor's Office, California Community College Datamart, Total Enrollment in Spring 2014 (most recent available data)
[3]: California State University Chancellor's Office, Total Enrollment in Fall 2013 (most recent available data)
[4]: University of California Office of the President, Statistical Summary and Data on UC Students, Faculty, and Staff, Fall 2012
[5]: [2] + [3] + [4]
[6]: UCR Request for Proposal #RFP 330-16 For Disposable Paper, Plastic, and Foam products
[7]: [6] / [1]
[8]: [7] x [5]
[9]: Price of lowest cost polystyrene and alternative products obtained from www.webstaurantstore.com
[10]: Difference between alternative and polystyrene products from [9]
[11]: [10] x ([8] / 1000)

D. Costs to California's Health Care Industry

Using information on the number of polystyrene cups disposed by the Gould Medical Foundation, a health care organization administering to 631,000 patient visits per year, we are able to estimate the average number of polystyrene cups in use relative to patient visits. By extrapolating this calculation to account for all patient visits within California each year, we can generate an estimate of the number of polystyrene cups used annually by California's health care industry. Comparing this total to the average cost of substitution calculated in Table 2, we find an estimated statewide cost to health care of around $1 million assuming substitution of all polystyrene cups. This calculation is depicted in Table 5 below. This is once again the cost of substitution for a single food service item, and total costs would likely be significantly higher.

Table 5: Costs to California Health Care Industry from Polystyrene Cup Substitution

Gould Medical Foundation Polystyrene Cups Used per Year	300,000	[1]
Gould Medical Foundation Patient Visits	631,000	[2]
Polystyrene Cups Used per Patient Visit	0.475	[3]
Total Patient Visits in US	1,239,387,000	[4]
California Share of US Population	12.13%	[5]
Estimated California Patient Visits	150,337,643	[6]
Total Polystyrene Cups used in CA Health Care Industry	71,410,380	[7]
Average Cost of Polystyrene Cup Substitution	$0.0149	[8]
Statewide Cost of Polystyrene Cup Substitution in Health Care	**$1,061,872**	[9]

Notes:

[1]: CalRecycle, "Waste Reduction Awards Program Winners" <http://www.calrecycle.ca.gov/WRAP/search.asp?VW=APP&BIZID=5848&YEAR=2010&CNTY=>

[2]: Sutter Gould Medical Foundation, "Facts at a Glance", 2006 <http://www.sutterhealth.org/about/snapshots/gould2.pdf>

[3]: [1] / [2]

[4]: US Department of Health and Human Services, *Health, United States, 2010* . Table 91. <http://www.cdc.gov/nchs/data/hus/hus13.pdf>

[5]: U.S. Census Bureau

[6]: [4] x [5]

[7]: [3] x [6]

[8]: See Table 1

[9]: [7] x [8]

E. Costs to California State and Local Governments

The KAB study referenced earlier also investigated the cost of litter control via a survey of local, county and state agencies. KAB's consultants used the survey to estimate per capita litter control costs for each level of government. Using this data, we can estimate the cost of litter control in California and allocate the cost shares attributable to polystyrene. As shown in Table 6, annual costs across all three government levels in California total about $151 million according to the survey. In the Draft Staff Report[11], total litter cleanup costs for California are estimated at $428 million. Thus, if effective, a complete ban of polystyrene food service items would save state and local governments between $2.5 and $7.3 million, assuming none of the substitute items would be littered.[12] This savings is very modest when it is spread across all state and local agencies responsible for litter control. More importantly, since many polystyrene substitutes will also produce litter, the savings would be much lower and probably nonexistent. As noted above there is no evidence that bans have reduced litter volume.

Table 6: Total California Litter Cleanup Costs

	KAB Data [1]	Draft Amendments [2]
State Costs	$44,332,208	
County Costs	$20,381,116	
City Costs	$86,674,005	
Total Litter Costs	$151,387,329	$428,000,000
PS Food Service Share	**$2,573,585**	**$7,276,000**

[1]: Data from KAB 2009 Study.
[2]: Data from Draft Amendments to Control Plans, Page 9

V. Polystyrene Cannot Be Distinguished as a Particularly Serious Threat to the Environment Among Litter Components

Polystyrene cannot be distinguished as a particularly serious threat to the environment for two reasons. First, when polystyrene is compared to its most likely substitutes for food service on a life cycle cost basis it imposes less of a burden on the environment. Second, there is no scientific evidence that polystyrene is a major contributor to plastic pollution of the oceans or a health threat to ocean life. In addition, it represents a small share of plastic waste found in the ocean.

11 "Draft Staff Report on the Draft Amendments to Statewide Water Quality Control Plans to Control Trash." Division of Water Quality, State Water Resources Control Board, California Environmental Protection Agency. June 2014. Page 9.

12 This figure is calculated as .017 x $151 million or $428 million, which is the share of polystyrene food containers of all litter (1.7%) multiplied by the total cost of litter abatement.

A. Based on Life Cycle Analysis, Polystyrene is Not More Harmful to the Environment Than Its Substitutes

In the case of a polystyrene ban, substitute products must be used to replace those that used to be polystyrene. Based on several life-cycle assessments, it is clear that polystyrene food service products consume less energy and water and generate less greenhouse gases in production and transport than their substitutes.[13] Consequently a PS ban is likely to substantially increase energy and water consumption and possibly generate more greenhouse gases.

For example, if 16oz polystyrene cups were replaced by any one of several substitutes identified in a recent lifecycle cost analysis, the resulting additional energy consumption would be equivalent to the additional energy consumption of between 3,130 and 12,500 homes for 16oz hot cups, and 2,700 to 39,000 homes for 32oz cold cups.[14] This is shown in Figure 3.[15]

Substitutions could also lead to increased water consumption by the equivalent of 3,700 to 9,300 average US households for 16oz hot cups and 2,200 to 41,000 households for 32oz cold cups.[16] This is displayed in Figure 4.

Greenhouse gas emissions from the same substitutions could decrease by the equivalent of 27,000 autos or increase by the equivalent of 21,000 autos for 16oz hot cups, and decrease by 50,000 autos or increase by 64,000 autos for 32oz cold cups. [17] This is portrayed in Figure 5. The result depends on which polystyrene substitutes consumers prefer and what assumptions are made about whether substitute products are fully compostable. For example, if consumers use two alternative cups as a substitute for one polystyrene cup for hot beverages, which is common because polystyrene cups are excellent insulators and many alternative cups are not, the alternatives will emit more greenhouse gases.

If one assumes that substitute products are fully compostable, then polystyrene products have lower greenhouse gas emissions than the substitute products. If one assumes that the substitute products are not compostable, then the substitute products may have lower greenhouse gas emissions; however, this negates one of the asserted advantages of these products (i.e., that they are

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13 We reviewed Franklin Associates (2011) and Herrera Environmental Consultants (2008).

14 These calculations rely on Franklin Associates (2011). Assumes Average household energy consumption is 77 million BTU.

15 The lifecycle cost analysis did not consider that unlike polystyrene cups, which contain heat effectively, other cups do a poor job resulting in many consumers using double cups. The study did account for the addition of sleeves to contain heat in some non-polystyrene cups.

16 These calculations rely on Franklin Associates (2011). Assumes average household water consumption is 114,464 gallons.

17 These calculations rely on Franklin Associates (2011). Assumes average auto fuel emissions used are 7064 lbs CO_2 equivalent.

compostable). The measurement of greenhouse gas emissions highlights how uncertain the measurement of the benefits of a polystyrene ban can be.

In addition, the greenhouse gas analysis assumes that neither polystyrene food containers nor their substitutes are recycled. This is a conservative assumption, because polystyrene food containers are readily recyclable and their substitutes may not be. For example, many cups that combine alternative products are not generally recyclable.

Figure 3: Added Energy Consumption in Average Household Equivalents from Substitution of EPS 16-oz Hot Cups and 32-oz Cold Cups

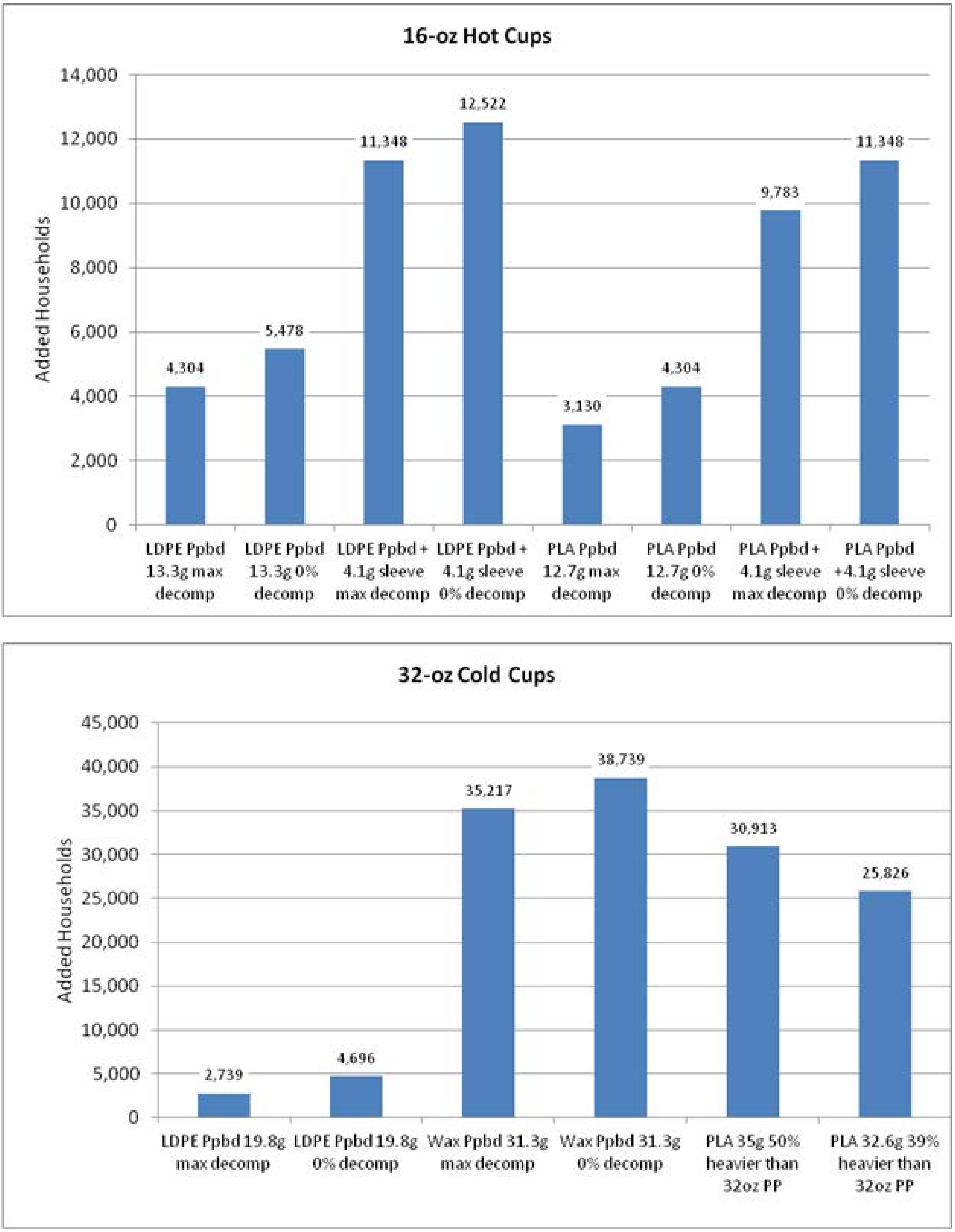


Figure 4: Added Water Consumption in Average Annual Household Use Equivalents from Substitution of EPS 16-0z Hot Cups and 32-oz Cold Cups

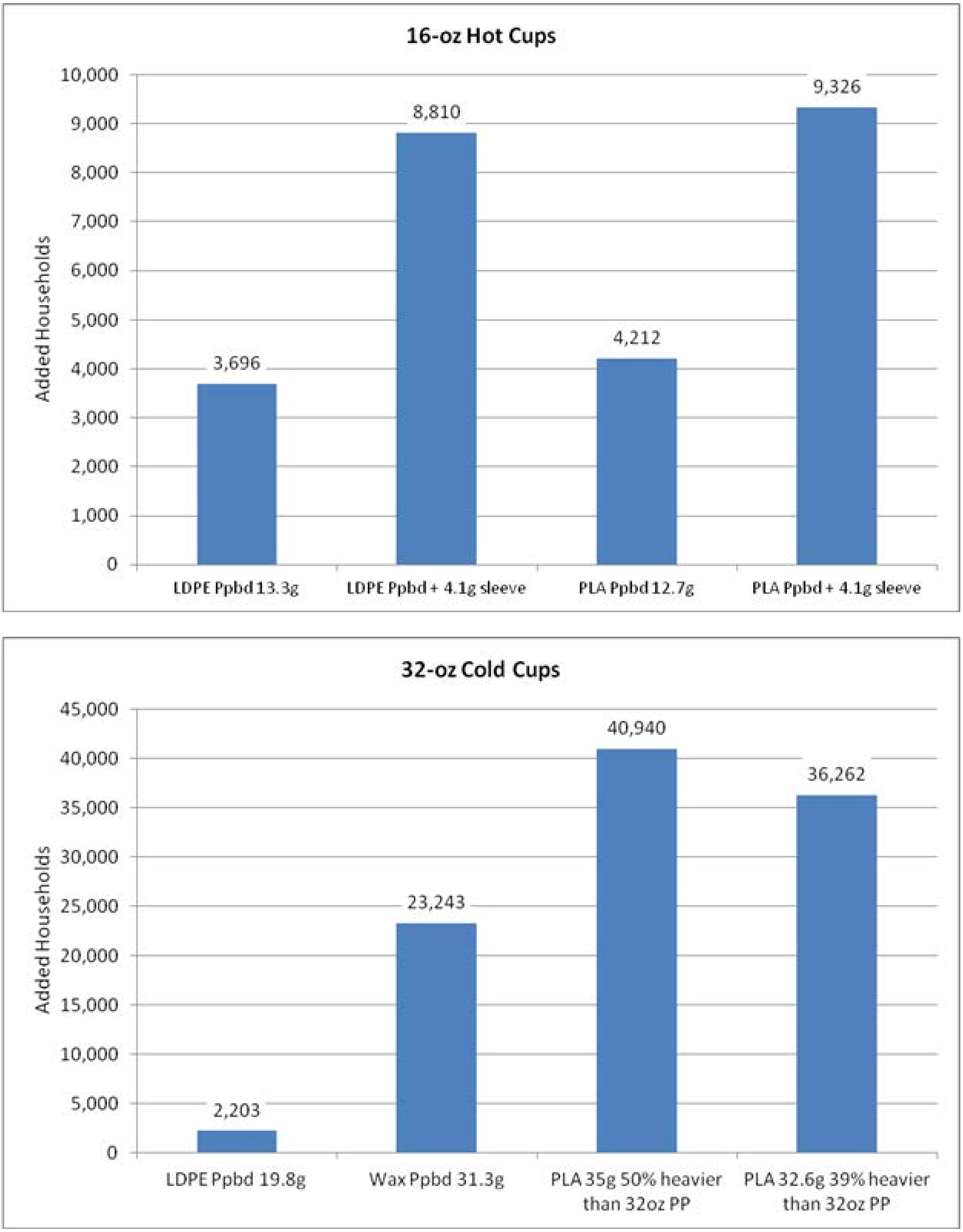
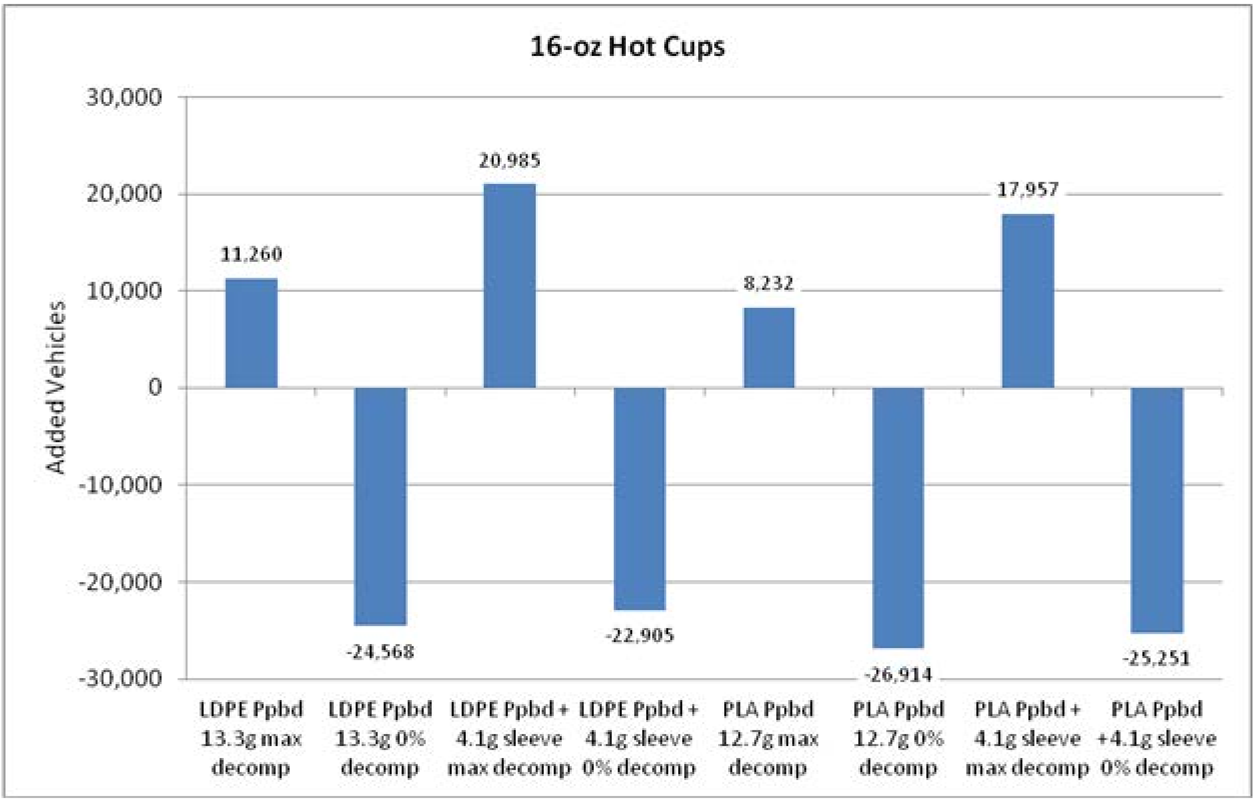
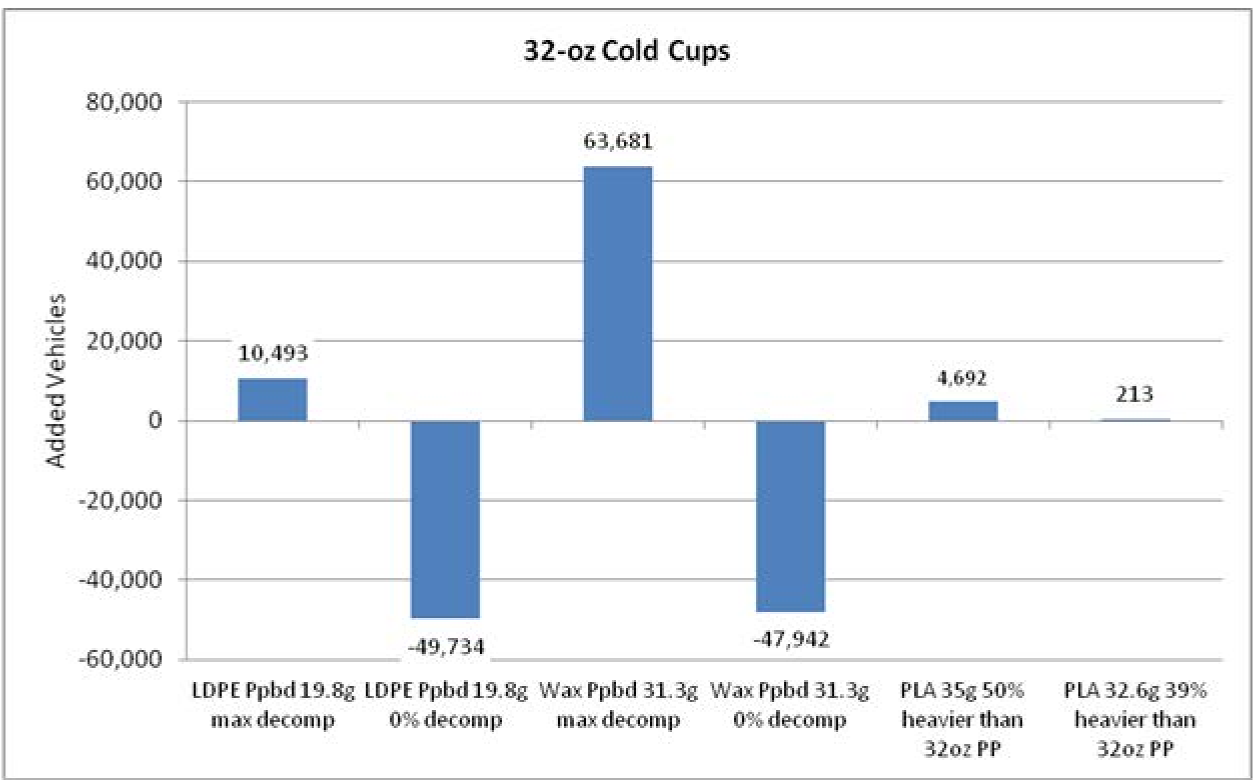


Figure 5: Added GHG Emission in Average Vehicle Equivalents from Substitution of EPS 16-oz Hot Cups and 32-oz Cold Cups





B. Polystyrene Has No Greater Impact on Marine Life than Other Components of the Litter Stream

Research has not shown any clear link between polystyrene and damage to marine life (birds, fish, and plants).[18] The National Oceanic and Atmospheric Administration (NOAA) observes that the source of the small plastics (microplastics) that are of greatest concern is unknown. Some comes from primary sources (plastics in a small state at the time of discharge) while other small plastic comes from the breakdown of larger plastic sources including litter and other marine debris.[19] NOAA further notes the "paucity of data" on the impacts of small plastic debris on the marine environment.[20] NOAA observes that "…overall the impact on entire seabird populations is either unknown or not considered large enough to warrant further investigation at this time."[21] NOAA concludes that:

> "Altogether, the science suggests that microplastics deserve further scrutiny in the laboratory and the field…. Only then will it be possible for the best science to inform management decisions for the remediation and prevention of microplastic pollution in the marine environment."[22]

A recent study found that less than 10 percent of mesopelagic fish samples in the North Pacific Gyre had ingested plastics from all sources.[23] While the study authors estimated the potential tons of plastics ingested, they recognized the uncertainties regarding the impacts on fish populations. Their finding also indicates that 90 percent of the mesopelagic fish populations were not found to ingest plastics despite being in a region with higher than normal plastics concentrations.

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18 Arthur, Courtney, Joel Baker, and Holly Bamford, editors, "Proceedings of the International Research Workshop on the Occurance, Effects, and Fate of Mircroplastic Marine Debris," Department of Commerce, National Oceanic and Atmospheric Administration, Technical Memorandum NOS-OR&R-30, January, 2009.

19 Arthur, et. al. p. 5 of the Executive Summary.

20 Arthur, et. al. p. 2 of the Executive Summary.

21 Arthur, et. al. p. 2 of the Executive Summary.

22 Arthur, et.al. p. 5 of the Executive Summary.

23 Davison, Peter and Rebecca Asch, "Plastic ingestion by mesopelagic fishes in the North Pacific Subtropical Gyre," Marine Ecology Progress Series, Vol. 432: 172-180, 2011. Mesopelagic fish primarily occupy lower ocean depths but rise to surface waters at night to feed.

VI. Polystyrene, Unlike Some Trash Components, Can Be Recycled

One common misconception regarding polystyrene is that it is destined to end up in a landfill. In fact, PS is recyclable, and recycled PS is used to make many products consumers purchase regularly. This distinguishes it from some of the other components of the litter stream.

A. Economics of Recycling

Recycling of polystyrene is already feasible throughout the state of California. More than 65 cities throughout the state accept post-consumer foam polystyrene for residential curbside recycling.[24] In addition, there are three drop-off locations spread across the state, which receive foam from schools, community recyclers, supermarkets, manufacturers, and individuals.[25]

Recycling polystyrene is not only a smart environmental decision, but can also be a wise economic decision for companies as well. A 2011 California Ocean Science Trust report recounts how some companies in California "have voluntarily embraced this concept of waste reduction in packaging without the need for legislation."[26]

One key sign that recycling of polystyrene is economically feasible is the existence of a market for recycled PS, with both buyers and sellers. Buyers exist because recycled polystyrene can be used as an input in manufacturing processes. Companies are currently using recycled PS to produce products such as picture frames, crown molding, baseboards, and flower pots.[27] Regarding sellers, the California Ocean Science Trust report cites several examples. One of the companies mentioned in the report, FP International, is able to recycle about 4 million pounds of polystyrene per year, while another saves $80,000 per year by recycling EPS.

B. Plastic Waste Recycling

Plastics, in large part because of their durability and share of the waste stream, are of particular concern to some environmentalists and policy makers. In fact, plastic waste management studies have promoted recycling as the most effective means of controlling this waste stream. The California Ocean Trust study noted above suggested that plastic recycling be expanded.[28] The recycling of polystyrene appears economic and increased efforts to promote it are consistent with

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24 Dart California Recycling Information. <https://www.dart.biz/web/environ.nsf/pages/californiaRecycling.html>

25 Dart Drop-Off Locations for Foam Recycling. <https://www.dart.biz/web/environ.nsf/pages/drop-off.html>

26 Stevenson, C. "Plastic Debris in the California Marine Ecosystem: A Summary of Current Research, Solution Strategies and Data Gaps." California Ocean Science Trust, Oakland, CA. 2011.

27 Dart Container Corporation YouTube series on Recycling. <https://www.youtube.com/user/DartContainerCorp>

28 Stevenson , et. al,2011

the Trust's suggestion. Recycling is far more attractive than bans on reducing the amount of polystyrene waste in landfills and the ocean in part because it avoids the substitution problem. This may be true for other plastics in the litter stream that are not currently accepted for recycling or not promoted. As shown in Table 7, plastics recycling is occurring in California, but there is room to increase the rates of recycling, something policymakers should encourage provided that benefits of recycling targets exceed the costs.

Table 7: California Recycling Rates by Type of Resin

Resin Identification Number	Resin	Recycling Rate in CA
1	Polyethylene terephthalate (PET)	74%
2	High-density polyethylene (HDPE)	108%
3	Polyvinyl chloride (PVC)	14%
4	Low-density polyethylene (LDPE)	1%
5	Polypropylene (PP)	10%
6	Polystyrene (PS)	19%
7	Other (O)	5%

Sources:
"SPI Resin Identification Code - Guide to Correct Use." SPI - The Plastics Industry Trade Association. <http://www.plasticsindustry.org/AboutPlastics/content.cfm?Item
"Biannual Report of Beverage Container Sales, Returns, Redemption, and Recycling Rates." CalRecycle Department of Resources Recycling and Recovery. May 9, 2014.

VII. Conclusion

In sum, the proposed trash amendments' encourage bans of polystyrene foam and other single-use consumer products. The evidence suggests that polystyrene foam bans are likely to impose significant economic costs, not materially reduce trash in the receiving waters, and create other environmental impacts from product substitution. We have not analyzed the effects of bans of other products that the draft trash amendments encourage, but bans of those other products could have their own environmental and economic costs and fail to reduce litter because of substitution like polystyrene. Local governments need more information than has been provided to make sound decisions regarding which, if any, of the measures provided in the staff report are appropriate. Finally, staff failed to acknowledge an institutional control that has been documented to work – placing trash receptacles near where litter is most commonly found.

VIII. Sources

"2010 Market Research Study on Foodservice Packing Products." Foodservice Packing Institute.

Arthur, Courtney; Joel Baker; and Holly Bamford, editors, "Proceedings of the International Research Workshop on the Occurance, Effects, and Fate of Mircroplastic Marine Debris," Department of Commerce, National Oceanic and Atmospheric Administration, Technical Memorandum NOS-OR&R-30, January, 2009.

Berkman, Mark and David Sunding. "Economic Analysis of SB568's Proposed Polystyrene Ban." Prepared for Dart Container Corporation. August 15, 2011.

Berkman, Mark and David Sunding. "Economic Analysis of San Jose's Proposed Polystyrene Ban." Prepared for Dart Container Corporation. February 25, 2012.

Dart California Recycling Information. <https://www.dart.biz/web/environ.nsf/pages/californiaRecycling.html>

Dart Container Corporation YouTube series on Recycling. <https://www.youtube.com/user/DartContainerCorp>

Dart Drop-Off Locations for Foam Recycling. <https://www.dart.biz/web/environ.nsf/pages/drop-off.html>

Davison, Peter and Rebecca Asch, "Plastic ingestion by mesopelagic fishes in the North Pacific Subtropical Gyre," Marine Ecology Progress Series, Vol. 432: 172-180, 2011. Mesopelagic fish primarily occupy lower ocean depths but rise to surface waters at night to feed.

"Draft Staff Report on the Draft Amendments to Statewide Water Quality Control Plans to Control Trash." Division of Water Quality, State Water Resources Control Board, California Environmental Protection Agency. June 2014.

Grey, Mark. "Proposed Polystyrene Foam Food Ware Ban in San Jose Will Not Reduce Trash Loads in Storm Drains and Receiving Waters." Presentation of Findings, August 2013.

"Life Cycle Inventory of Foam Polystyrene, Paper-Based, and PLA Foodservice Products." Franklin Associates, prepared for The Plastic Foodservice Packaging Group. February 4, 2011.

"Littering Behavior in America: Results of a National Study." Action Research, prepared for Keep America Beautiful. January 2009.

Mid Atlantic Solid Waste Consultants, "2009 National Visible Litter Survey" Prepared for Keep America Beautiful, Final Report, September 18, 2009.

"Request for Proposal #RFP 330-16 for Disposable Paper, Plastic and Foam products." University of California – Riverside Purchasing Department. May 10, 2011.

"Quantification Study of Institutional Measures for Trash TMDL Compliance." Prepared for the City of Los Angeles by Black & Veatch. December 3, 2013.

Stein, Steven R. "The Contribution of Polystyrene Foam Food Service Products to Litter." Environmental Resources Planning, LLC. May 2012.

Stevenson, C. "Plastic Debris in the California Marine Ecosystem: A Summary of Current Research, Solution Strategies and Data Gaps." California Ocean Science Trust, Oakland, CA. 2011.

IX. Author Bios

MARK P. BERKMAN

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EDUCATION

University of Pennsylvania, Wharton School, Ph.D. in Public Policy Analysis; Harvard University, M.A. in Planning, Policy Analysis and Administration; George Washington University, B.A. in Economics and Urban Affairs

BIOGRAPHY

Dr. Mark Berkman is an expert in applied microeconomics. His experience spans the areas of the environment, energy, and natural resources; environmental health and safety; labor and employment; intellectual property; antitrust; commercial litigation and damages; and public finance. He has assisted both public and private clients and provided testimony before state and federal courts, arbitration panels, regulatory bodies, and legislatures.

His environmental work has involved the review of proposed air, water, solid waste, and worker and product safety regulations. Dr. Berkman has quantified the costs and benefits of these regulations, as well as toxic tort and product liability claims. In addition, he has valued natural and water resources as well as property damages associated with pollution from Superfund sites, landfills, and power plants.
His work on energy matters includes the valuation of coal resources, power plants, and transmission rights-of-way.

He has also prepared energy demand and price forecasts. He has extensive experience working with Native American tribes on energy valuation matters.
Clients in a variety of industries ranging from computer chip to shoe manufacturers have sought Dr. Berkman's assistance to value patents, trade secrets, and trademarks. He has also been called on to address questions of market power in a variety of industries including solid waste, computer manufacturing, and medical devices. He has testified regarding market definition and market power and participated in Hart-Scott-Rodino proceedings.

Dr. Berkman also has substantial experience in labor and discrimination litigation. He has conducted statistical analyses of alleged discrimination in hiring, promotion, pay, and contracting, and completed damage analyses regarding these allegations. He has also conducted statistical analyses regarding mortgage lending discrimination.

Prior to joining Brattle he was a co-founder and director at Berkeley Economic Consulting and a vice president at both Charles River Associates and NERA Economic Consulting.

David Sunding

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EDUCATION

University of California, Berkeley, Ph.D. in Agricultural and Resource Economics; University of California, Los Angeles, M.A. in African Area Studies; Claremont McKenna College, B.A. in Economics

BIOGRAPHY

Dr. David Sunding has extensive experience as a researcher, consultant, and expert witness in matters related to natural resources, environmental quality, energy, and the economics of regulation. His expertise includes experience in complex litigation, regulation, and transactions. He has testified in state and federal courts and in regulatory proceedings around the country.

He has assisted corporations, utilities, and government agencies in developing economic testimony in a variety of matters concerning environmental damages, product liability, risk assessment, resource planning, cost allocation, and project financing. Dr. Sunding has played a central role in several prominent water resource matters, including the landmark Quantification Settlement Agreement for the Colorado River, interstate water disputes before the U.S. Supreme Court, and the Federal Energy Regulatory Commission's relicensing of hydropower facilities. He has authored several widely cited studies on the economics of water quality regulation and has served as an expert in cases involving regulation and litigation under the Clean Water Act, the Endangered Species Act, and other statutes.

Dr. Sunding is the Thomas J. Graff Professor in the College of Natural Resources at UC Berkeley, where he is also the co-director of the Berkeley Water Center. He has received numerous awards for his research, including grants from the National Science Foundation, the U.S. Environmental Protection Agency, and private foundations. He is currently a Visiting Professor in the Woods Institute of the Environment at Stanford University.

Prior to joining The Brattle Group, Dr. Sunding was a founding director of Berkeley Economic Consulting. Previously, he was a senior consultant at Charles River Associates and NERA. He served as a senior economist for President Clinton's Council of Economic Advisers, and is a member of the American Economic Association, the Association of Environmental and Resource Economists, the Econometric Society, and the American Law and Economics Association.

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THE Brattle GROUP

EXHIBIT 6

The Brattle Group

Economic Analysis of SB568's Proposed Polystyrene Ban

June 24, 2011

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Economic Analysis of SB 568's Proposed Polystyrene Ban

Introduction and Summary

A product ban must be considered in terms of its cost and what it achieves from an environmental and social point of view.[1] Based on our analysis, the costs of banning polystyrene food and beverage containers in California could easily be over $500 million per year and lead to the loss of hundreds of jobs in the state. Costs to already financially strapped public schools, in particular, could exceed $112 million annually. At the same time, the social benefits of the ban are highly uncertain and quite possibly very modest. According to recent life cycle cost comparisons, substitute products will result in higher energy and water consumption and, depending on the mix of substitutes preferred by consumers, higher greenhouse gas emissions. The impact on litter—a main objective of the ban—also appears to be small. The impact of polystyrene on marine ecosystems is yet unknown and available evidence does not provide justification for significant environmental and economic costs the ban will entail.

The Costs of a Polystyrene Ban Are Likely to be Large

Based on our analysis, the costs of the proposed polystyrene ban are likely to be substantial. The cost to California consumers including households, public school districts, and other government institutions that provide food services could easily reach $500 million annually. Below we present cost estimates for these consumer groups based on the best currently available information. Further analysis would be necessary to provide more precise and detailed costs.

Costs to Households

Household expenditures on food and meals away from home will clearly increase. Based on a recent comparison of posted prices, the price differential between polystyrene food service items (cups, lids, plates, and trays) and compostable items is large. According to distributor price lists, the price for substitute cups, for example, is on average 3 times the cost of equivalent polystyrene cups. As shown in Table 1, based on this price differential and the average per capita consumption of 16oz polystyrene cups, California consumer spending could increase by as much as $355 million per year. This cost is only for cups. Similar increases are likely for the other food service items replaced by higher cost substitutes

[1] SB 568 allows school districts and cities and counties to opt out of the ban if they establish recycling programs that they show "based on empirical data" will result in the recycling of at least 60 percent of polystyrene food containers in their jurisdiction. The deadline for school districts to make such a finding is 2017 and the deadline for cities and counties is 2016. The proponents of SB 568 have not shown that it is feasible for cities, counties, and school districts to meet the limited exceptions to the ban. It is reasonable to assume that few jurisdictions will be able to meet SB 568's limited exceptions.

Consequently, the total cost to households accounting for plates, clamshells, and trays as well as cups could be several times higher reaching perhaps $500 million or more.

Table 1: Average Total Costs of Polystyrene Cup and Lid Substitution in California

ASSUMPTIONS

Polystyrene Cups Disposed of in US per Year	25,000,000,000	[1]
US Population	307,000,000	[2]
CA Population	37,000,000	[3]
CA Share of Population	12%	[4]
CA Share of Disposed Polystyrene Cups	3,000,000,000	[5]

PRICE COMPARISON

	Cost (per 1000)	Vs. Average Substitute Price	Cost for CA Substitution of Polystrene Cups & Lids
	[6]	[7]	[8]
Polystyrene Cups			
Dart 16 oz. Impulse Stock Printed Cups	$45.78	-76.44	
Dart Big Drink Foam Cup - 16 oz. RPI	$37.55	-84.67	
Dart Foam Cup Flush Fill 16 oz.	$31.95	-90.27	
Dart Cafe G Printed Foam Cups - 16 oz.	$51.75	-70.47	
Average Polystyrene Cup Price	**$41.76**	-80.47	
Lids for Polystyrene Cups			
Dart Translucent Lids with Straw Slot RPI	$16.23	-39.68	
Dart Lift n Lock Wide Lid w Straw Slot RPI	$19.73	-36.18	
Average Lid Price for Polystyrene Cups	**$17.98**	-37.93	
Alternative Cups			
Dixie 16 oz. PLA Paper Hot Cups	$129.18	87.42	$262,267,500
PerfectTouch Paper Coffee Cup - 16 oz.	$118.60	76.84	$230,527,500
World Centric 16oz. PLA Paper Hot Cup	$112.29	70.53	$211,597,500
World Centric 16oz. PLA Clear Cold Cup	$128.82	87.06	$261,187,500
Average Alternative Cup Price	**$122.22**	80.47	$241,395,000
Alternative Lids			
White Dixie Drink Thru Lid	$40.00	22.02	$66,060,000
World Centric Compostable Lids	$71.82	53.84	$161,520,000
Average Alternative Lid Price	**$55.91**	37.93	$113,790,000
Average Cost of Polystyrene Cup & Lid Substitution in CA			**$355,185,000**

Notes:

[1]: U.S. Environmental Protection Agency, "Fact Flash" <http://www.epa.gov/superfund/students/clas_act/haz-ed/ff06.pdf>
[2]: U.S. Census Bureau
[3]: U.S. Census Bureau
[4]: [3] / [2]
[5] [1] x [4]
[6] Costs obtained from www.reliablepaper.com and www.worldcentric.org
[7] Item cost from [6] less average substitute item cost from [6].
[8] [5] x [7] / 1000

Costs to Public Institutions

School districts and other public institutions that provide food services would experience substantial cost increases. While it is difficult to calculate these costs precisely, the Long Beach Unified School District has estimated that it will cost between $0.84 and $1.5 million annually to replace polystyrene trays with compostable products. Taking the midpoint of this range and the number of students enrolled in the District results in a cost of about $18 per pupil per year. As shown in Table 2, extrapolating this cost to all public school children in California results in annual cost of $61 to $112 million. While not all public schools necessarily use polystyrene trays, this may still under estimate state level costs since this estimate is only for one food service item. Total costs could be considerably higher if polystyrene plates, cups, or clamshells are used in schools. For, example, if one assumes that one plate and one cup are used with each tray, the savings from using polystyrene could be as high as $148 million per year.[2]

Table 2: Costs to Public School Districts from Polystyrene Tray Substitution

Long Beach Unified School District Cost to Substitute Polystyrene Trays	$0.12 to $0.22 per tray	[1]
Number of Trays Used per Year	7,000,000	[2]
Annual Cost	$840,000 to $1,540,000	[3]
Number of Students Enrolled in District	85,257	[4]
Cost Per Student	$9.85 to $18.06	[5]
Statewide Public School Enrollment	6,191,566	[6]
Statewide Cost of Polystyrene Tray Substitution in Public Schools	**$61,002,797 to $111,838,461**	[7]

Notes:

[1]: "Recyclable foam trays a cure for Long Beach schools' headache", Long Beach Press-Telegram, May 19, 2011. <http://www.presstelegram.com/ci_18100171?source=rv>

[2]: Ibid.

[3]: [1] x [2]

[4]: 2010-2011 Enrollment. Long Beach Unified School District, "Adopted Budget: Fiscal Year 2011-2012", Overview, p. 1 <http://www.lbschools.net/Main_Offices/Business_Services/pdf/FY12%20Adopted%20Budget%20Book.pdf>

[5]: [3] / [4]

[6]: California Department of Education, CALPADS, 2011

[7]: [5] x [6]

Although similar cost data is not readily available for other institutions including public colleges, universities, and hospitals, the additional costs imposed by the ban will be considerable. For example, California Community Colleges enroll about 2,700,000 students annually, the California State College system enrolls over 400,000 students per year and the

[2] Assuming 6,191,566 students, a 184 day school year and a $0.13 premium per cup and plate combined.

University system enrolls another 219,000. [3] Even if only a quarter of these students rely on university food services, and the cost per student are similar to the public schools then the ban could easily cost these institutions over $17 million annually. Again this is for a single food service item—trays. Accounting for additional items including cups and plates would undoubtedly increase total costs to public colleges and universities.

Using information on the number of polystyrene cups disposed by the Gould Medical Foundation, a health care organization administering to 631,000 patient visits per year, we are able to estimate the average number of polystyrene cups in use relative to patient visits. By extrapolating this calculation to account for all patient visits within California each year, we can generate an estimate of the number of polystyrene cups used annually by California's health care industry. Comparing this total to the average cost of substitution calculated in Table 1, we find an estimated statewide cost to health care of around $8 million assuming substitution of all polystyrene cups. This calculation is depicted in Table 3 below. This is once again the cost of substitution for a single food service item, and total costs would likely be higher.

Table 3: Costs to California Health Care Industry from Polystyrene Cup and Lid Substitution

Gould Medical Foundation Polystyrene Cups Used per Year	300,000	[1]
Gould Medical Foundation Patient Visits	631,000	[2]
Polystyrene Cups Used per Patient Visit	0.475	[3]
Total Patient Visits in US	1,189,619,000	[4]
California Share of US Population	12%	[5]
Estimated California Patient Visits	142,754,280	[6]
Total Polystyrene Cups used in CA Health Care Industry	67,870,498	[7]
Average Cost of Polystyrene Cup & Lid Substitution	$0.1184	[8]
Statewide Cost of Polystyrene Cup & Lid Substitution in Health Care Industry	**$8,035,867**	[9]

Notes:
[1]: Sutter Gould Medical Foundation, "Facts at a Glance", 2006 <http://www.sutterhealth.org/about/snapshots/gould2.pdf>
[2]: CalRecycle, "Waste Reduction Awards Program Winners" <http://www.calrecycle.ca.gov/WRAP/search.asp?VW=APP&BIZID=5848&YEAR=2010&CNTY=>
[3]: [1] / [2]
[4]: US Department of Health and Human Services, *Health, United States, 2010*. Table 91. <http://www.cdc.gov/nchs/data/hus/hus10.pdf>
[5]: U.S. Census Bureau
[6]: [4] x [5]
[7]: [3] x [6]
[8]: See Table 1
[9]: [7] x [8]

[3] Chancellor's Office, California Community College Datamart; California State University Chancellor's Office; and University of California Office of the President, Statistical Summary and Data on UC Students, Faculty, and Staff, Fall 2010.

The Benefits of a Polystyrene Ban Are Uncertain

Measuring the benefits of a ban requires special attention to the available substitutes. The substitutes can be worse than the banned product with respect to the intended objective of the ban. In fact, based on several life-cycle assessments, polystyrene food service products consume less energy and water and generate less greenhouse gases in production and transport than substitutes such as wax coated paper and polyethylene.[4] Consequently a ban is likely to substantially increase energy and water consumption and possibly generate more greenhouse gases.

Impacts on Energy and Water Consumption

For example, if 16 oz polystyrene cups were replaced by any one of several substitutes identified in a recent lifecycle cost analysis, the resulting additional energy consumption would be equivalent to the additional energy consumption of between 3,130 and 12,500 homes for 16oz hot cups, and 2,700 to 39,000 homes for 32oz cold cups.[5] This is shown in Figure 1.[6]

Substitutions could also lead to increased water consumption by the equivalent of 3,700 to 9,300 average US households for 16oz hot cups and 2,200 to 41,000 households for 32oz cold cups.[7] This is shown in Figure 2.

Impacts on Greenhouse Gas Emissions

Greenhouse gas emissions from the same substitutions could decrease by the equivalent of 27,000 autos or increase by the equivalent of 21,000 autos for 16oz hot cups, and decrease by 50,000 autos or increase by 64,000 autos for 32oz cold cups. [8] This is shown in Figure 3 The result depends on which polystyrene substitutes consumers prefer and what assumptions are made about whether substitute products are fully compostable. For example, if consumers use two paper cups as a substitute for one polystyrene cup for hot beverages, which is common because polystyrene cups are excellent insulators and paper cups are not, the paper cup substitutes will emit more greenhouse gases.

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[4] We reviewed Franklin Associates (2011) and Herrera Environmental Consultants (2008).

[5] These calculations rely on Franklin Associates (2011). Assumes Average household energy consumption is 77 million BTU. See appendix table A-1.

[6] The lifecycle cost analysis did not consider that unlike polystyrene cups, which contain heat effectively, other cups do a poor job resulting in many consumers using double cups. The study did account for the addition of paper sleeves to contain heat in some non-polystyrene cups.

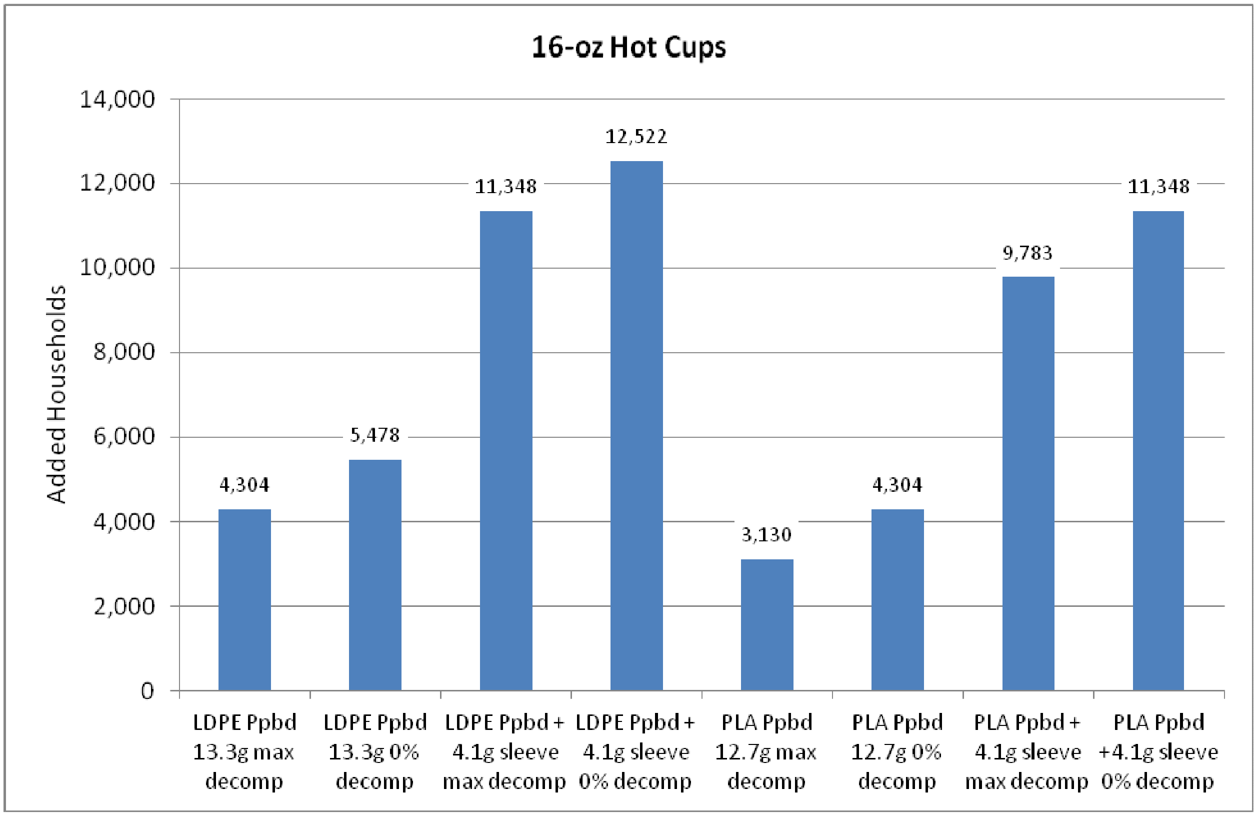
[7] These calculations rely on Franklin Associates (2011). Assumes average household water consumption is 114,464 gallons. See appendix table A-2.

[8] These calculations rely on Franklin Associates (2011). Assumes average auto fuel emissions used are 7064 lbs CO_2 equivalent. See appendix table A-3.

If one assumes that substitute products are fully compostable, then polystyrene products have lower greenhouse gas emissions than the substitute products. If one assumes that the substitute products are not compostable, then the substitute products may have lower greenhouse gas emissions; however, this negates one of the asserted advantages of these products (i.e., that they are compostable). The measurement of greenhouse gas emissions highlights how uncertain the measurement of the benefits of a polystyrene ban can be.

In addition, the greenhouse gas analysis assumes that neither polystyrene food containers nor their substitutes are recycled. This is a conservative assumption, because polystyrene food containers are readily recyclable and their substitutes may not be.

Figure 1: Added Energy Consumption in Average Household Equivalents from Substitution of EPS 16-oz Hot Cups and 32-oz Cold Cups



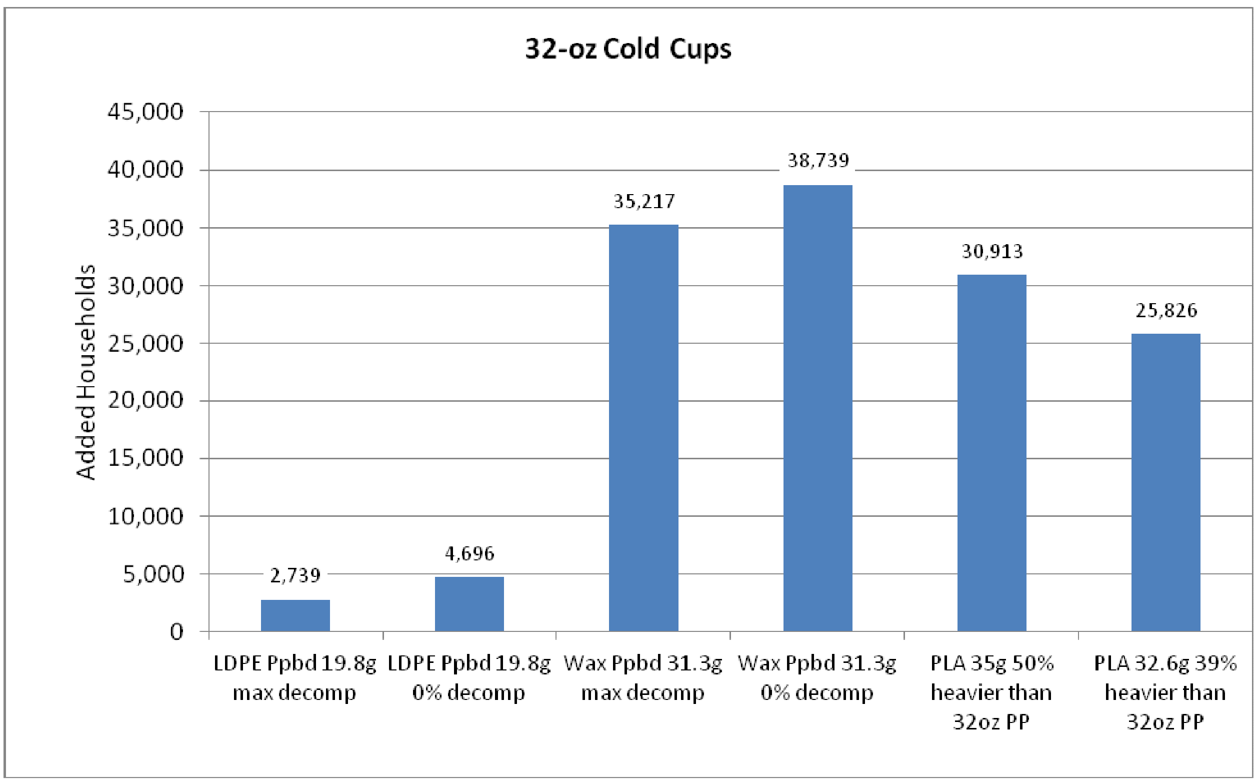
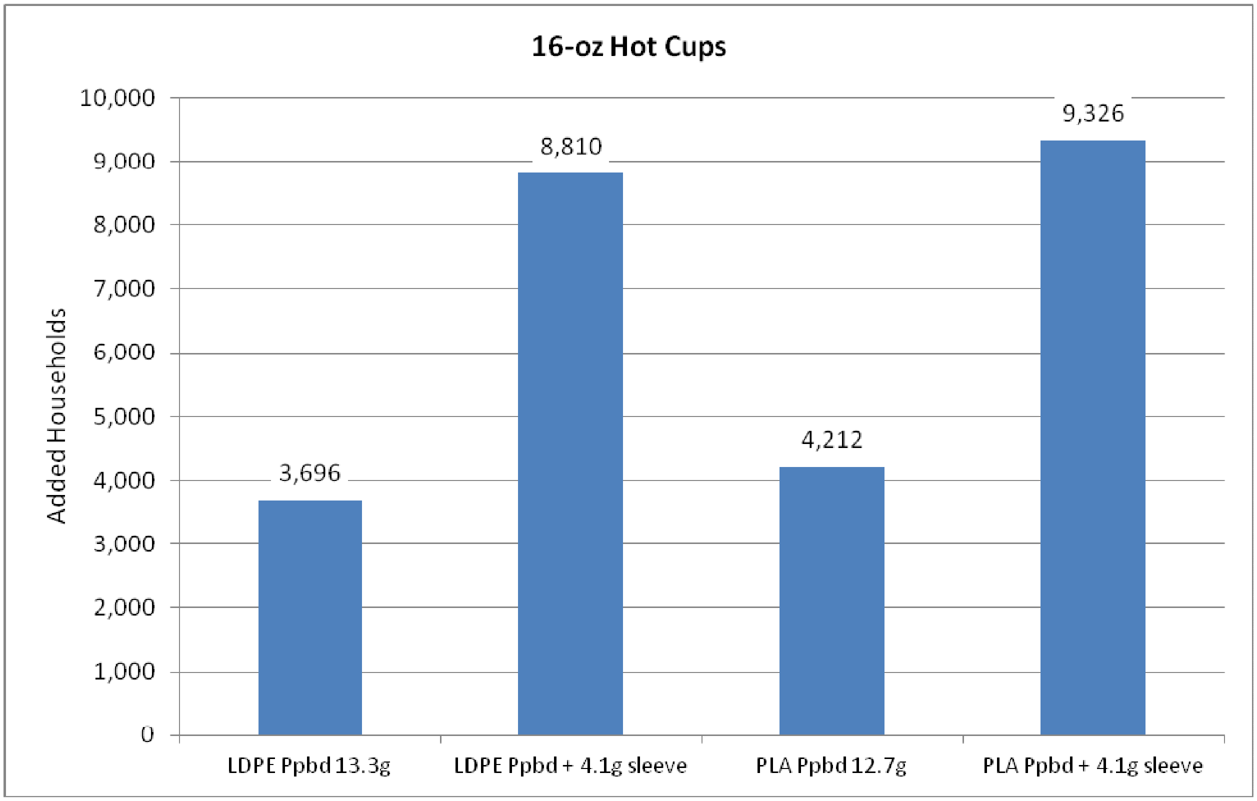


Figure 2: Added Water Consumption in Average Annual Household Use Equivalents from Substitution of EPS 16-oz Hot Cups and 32-oz Cold Cups



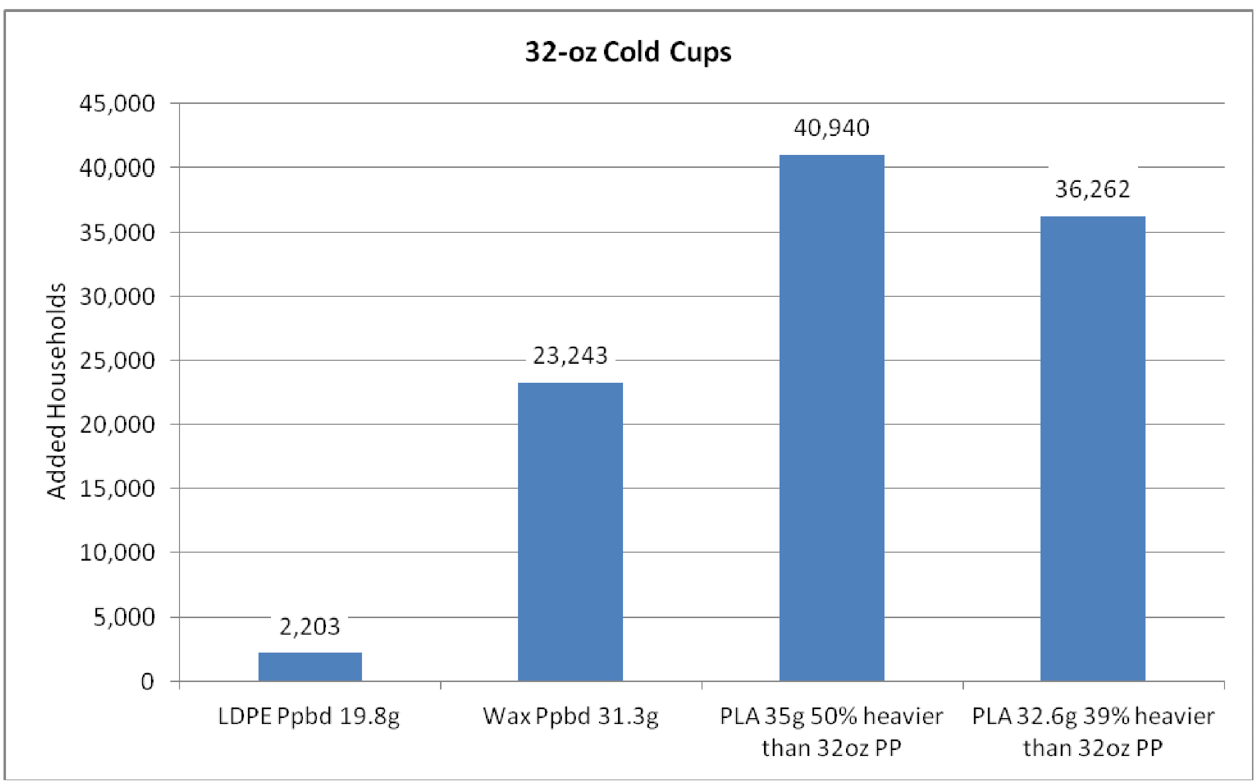
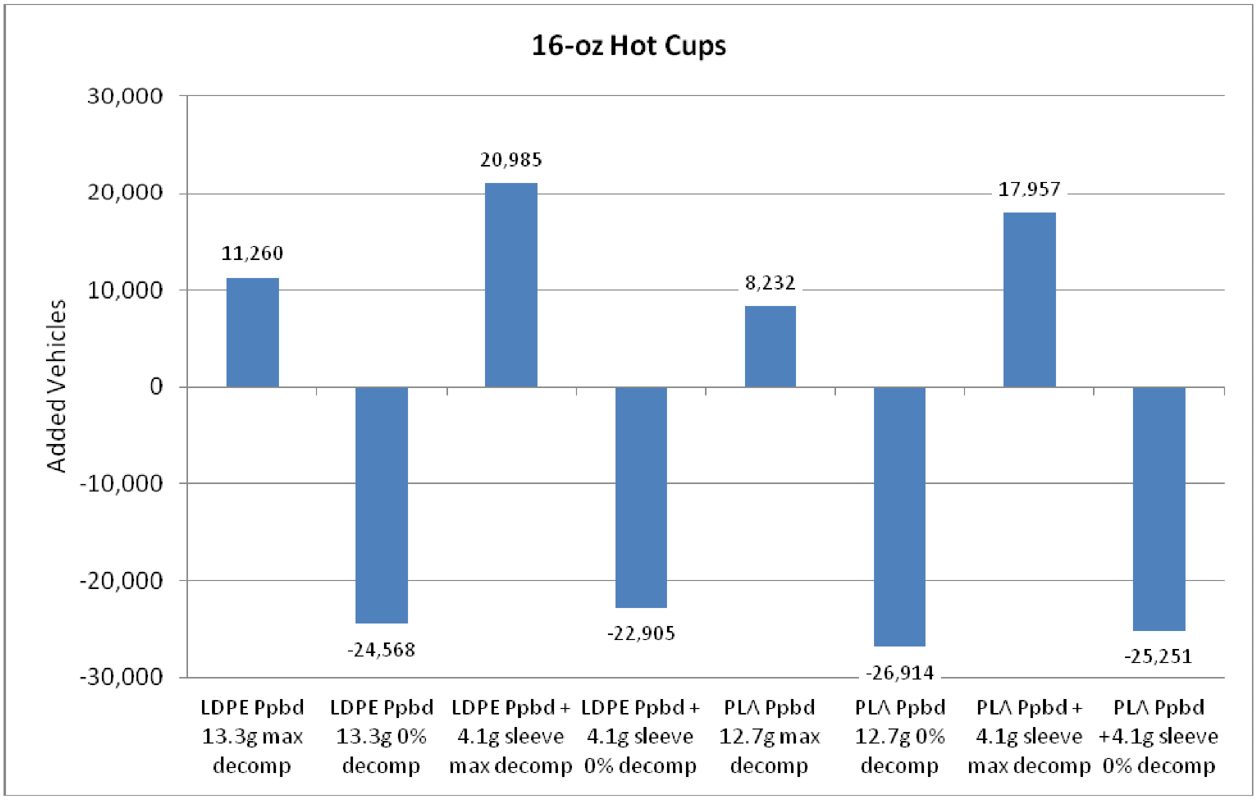
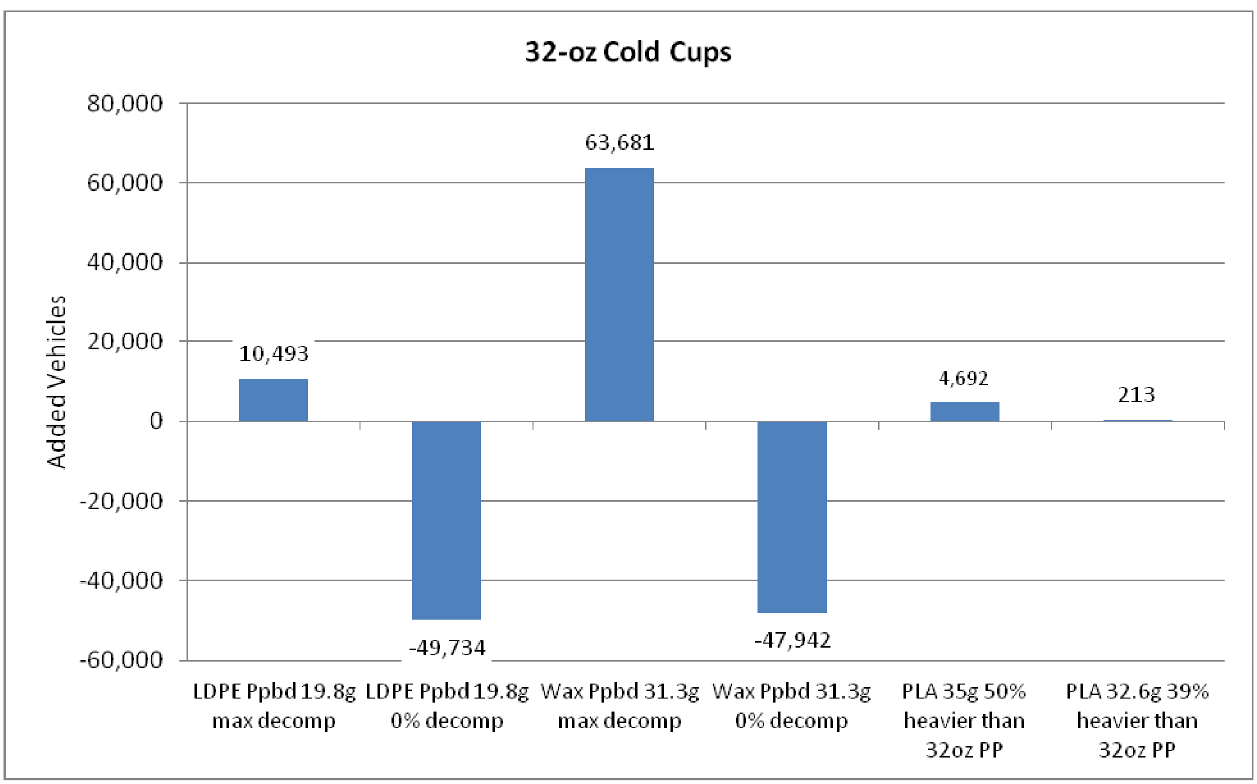


Figure 3: Added GHG Emissions in Average Vehicle Equivalents from Substitution of EPS 16-oz Hot Cups and 32-oz Cold Cups





Impact on Marine Environments

Polystyrene has been identified as a possible source of damage to marine life (birds, fish, and plants, but to date, as described by the National Oceanic and Atmospheric Administration (NOAA), research has not shown any clear link[9]. NOAA observes that the source of the small plastics (microplastics) that are of greatest concern is unknown. Some comes from primary sources (plastics in a small state at the time of discharge) while other small plastic comes from the breakdown of larger plastic sources including litter and other marine debris. [10]NOAA further notes the "paucity of data" on the impacts of small plastic debris on the marine environment.[11] NOAA observes that " … overall the impact on entire seabird populations is either unknown or not considered large enough to warrant further investigation at this time."[12] NOAA concludes that:

> Altogether, the science suggests that microplastics deserve further scrutiny in the laboratory and the field…. Only then will it be possible for the best science to inform management decisions for the remediation and prevention of microplastic pollution in the marine environment.[13]

In addition, polystyrene substitutes are not clearly less of a problem to marine life than some of the available substitutes that contain other plastics. Given the significant environmental and economic costs of a ban on polystyrene food containers, the unknown, speculative potential benefits to the marine environment cannot justify the a ban on polystyrene food containers.

Impact on Litter Reduction

It is also not clear that banning polystyrene food service items will reduce litter – a prime objective of the ban. What is more likely to happen is a change in the composition of litter. We have found no evidence that litter control costs have declined in cities where polystyrene items have been banned. It is also worth noting that polystyrene does not appear to be a major litter component. A 2007 San Francisco survey conducted before the City

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[9] Courtney Arthur, Joel Baker, and Holly Bamford, editors, "Proceedings of the International Research Workshop on the Occurance, Effects, and Fate of Mircroplastic Marine Debris," Department of Commerce, National Oceanic and Atmospheric Administration, Technical Memorandum NOS-OR&R-30, January, 2009.
[10] Arthur, et. al. p. 5 of the Executive Summary.
[11] Arthur, et. al. p. 2 of the Executive Summary.
[12]Arthur, et. al. p. 2 of the Executive Summary.
[13] Arthur, et.al. p 5 of the Executive Summary.

implemented a ban on polystyrene service items, for example, found that polystyrene cups accounted for less than 2% of observed litter.[14]

Other litter reduction strategies may prove far more effective. A recent study by Keep American Beautiful, for example, found that litter levels have fallen dramatically since the late 1960s. Much of this reduction is attributed to better education, more street cleaning, and recycling.[15]

There are alternatives to the polystyrene ban to reduce litter. Los Angeles has elected to encourage polystyrene recycling. Other California cities have also rejected polystyrene bans, and presumably are pursuing other approaches.

Since other California cities including San Francisco, Oakland, and Berkeley have introduced bans, there is a great opportunity to conduct an important social experiment. Different approaches to litter reduction (and marine protection) can be compared regarding litter volume, composition, and cost and effectiveness provided enough time has elapsed to collect the necessary data. At the same time, research regarding the impacts of polystyrene and other plastics on the marine environment is likely to progress.

Conclusion

The available evidence does not support the introduction of a polystyrene ban. The costs are likely to be large without clear corresponding benefits. At the same time, the different approaches to litter reduction taken by various California cities and counties provide the opportunity to study the costs and benefits of multiple approaches.

[14] "The City of San Francisco Streets Litter Audit." Prepared for the City and County of San Francisco Department of Environment by HDR, Brown Vence & Associates, and MGM Management, June 2007. P. 27. The survey was completed in April 2007, the ban went into effect on June 1, 2007.
[15] Midatlantic Solid Waste Consultants, 2009 National Visible Litter Survey and Litter Cost Study, prepared for Keep America Beautiful, Final Report, September 18, 2009.

APPENDICES

Table A-1: Energy Use Comparison for Polystyrene Foodservice Product Alternatives

Product	Million BTU	Net vs. Polystyrene	Net Difference as % of Annual Average Household Consumption	Converted Products Required to Consume Energy of 1 Additional Household	Added Households of Energy Consumption from Substitution of EPS
	[1]	[2]	[3]	[4]	[5]
Energy Use for 16-oz Hot Cups (10,000 average weight cups)					
EPS 4.7g	5.4				
LDPE Ppbd 13.3g max decomp	6.5	1.1	1.43%	700,000	4,304
LDPE Ppbd 13.3g 0% decomp	6.8	1.4	1.82%	550,000	5,478
LDPE Ppbd + 4.1g sleeve max decomp	8.3	2.9	3.77%	265,517	11,348
LDPE Ppbd + 4.1g sleeve 0% decomp	8.6	3.2	4.16%	240,625	12,522
PLA Ppbd 12.7g max decomp	6.2	0.8	1.04%	962,500	3,130
PLA Ppbd 12.7g 0% decomp	6.5	1.1	1.43%	700,000	4,304
PLA Ppbd + 4.1g sleeve max decomp	7.9	2.5	3.25%	308,000	9,783
PLA Ppbd +4.1g sleeve 0% decomp	8.3	2.9	3.77%	265,517	11,348
Energy Use for 32-oz Cold Cups (10,000 average weight cups)					
EPS 8.8g	9.6				
LDPE Ppbd 19.8g max decomp	10.3	0.7	0.91%	1,100,000	2,739
LDPE Ppbd 19.8g 0% decomp	10.8	1.2	1.56%	641,667	4,696
Wax Ppbd 31.3g max decomp	18.6	9	11.69%	85,556	35,217
Wax Ppbd 31.3g 0% decomp	19.5	9.9	12.86%	77,778	38,739
PLA 35g 50% heavier than 32oz PP	17.5	7.9	10.26%	97,468	30,913
PLA 32.6g 39% heavier than 32oz PP	16.2	6.6	8.57%	116,667	25,826
Energy Use for 9-inch Plates (10,000 average weight plates)					
Heavy-Duty Plates					
GPPS 10.8g	8.4				
LDPE Ppbd 18.4g max decomp	10.3	1.9	2.47%	405,263	
LDPE Ppbd 18.4g 0% decomp	9.7	1.3	1.69%	592,308	
Mold Pulp 16.6g max decomp	10.9	2.5	3.25%	308,000	
Mold Pulp 16.6g 0% decomp	11.3	2.9	3.77%	265,517	
PLA 20.7g	10.4	2	2.60%	385,000	
Lightweight Plates					
2009 GPPS 4.7g	3.6				
2009 LDPE Ppbd 12.1g max decomp	6.1	2.5	3.25%	308,000	
Energy Use for Sandwich-size Clamshells (10,000 average weight clamshells)					
GPPS 4.8g	3.8				
Fluted Ppbd 10.2g max decomp	5.8	2	2.60%	385,000	
Fluted Ppbd 10.2g 0% decomp	6	2.2	2.86%	350,000	
PLA 23.3g	14.4	10.6	13.77%	72,642	

Notes:

Net expended energy = total energy requirements - energy recovery - energy content of landfilled material

[1]: Franklin Associates, "Life Cycle Inventory of Foam Polystyrene, Paper-Based, and PLA Foodservice Products", 4 February 2011.

[2]: [1] - Equivalent Polystyrene Product Energy Use in [1]

[3]: Assumes 2005 Western census region annual household energy consumption.
<http://www.eia.gov/totalenergy/data/annual/txt/ptb0204.html>

[4]: 1 / [3] * 10,000

[5]: Assumes 3 billion cups disposed of in CA per year. See Table 1.

Table A-2: Water Use Comparison for Polystyrene Foodservice Product Alternatives

Product	Gallons	Net vs. Polystyrene	Net Difference as % of Annual Average Household Consumption	Converted Products Required to Consume Water of 1 Additional Household	Added Households of Water Consumption from Substitution of EPS
	[1]	[2]	[3]	[4]	[5]
Water Use for 16-oz Hot Cups (gallons per 10,000 average weight cups)					
EPS 4.7g	4748				
LDPE Ppbd 13.3g	6152	1404	1.23%	815,271	3,696
LDPE Ppbd + 4.1g sleeve	8095	3347	2.92%	341,990	8,810
PLA Ppbd 12.7g	6348	1600	1.40%	715,400	4,212
PLA Ppbd + 4.1g sleeve	8291	3543	3.10%	323,071	9,326
Water Use for 32-oz Cold Cups (gallons per 10,000 average weight cups)					
EPS 8.8g	8441				
LDPE Ppbd 19.8g	9278	837	0.73%	1,367,551	2,203
Wax Ppbd 31.3g	17271	8830	7.71%	129,631	23,243
PLA 35g 50% heavier than 32oz PP	23994	15553	13.59%	73,596	40,940
PLA 32.6g 39% heavier than 32oz PP	22217	13776	12.04%	83,089	36,262
Water Use for 9-inch Plates (gallons per 10,000 average weight plates)					
Heavy-Duty Plates					
GPPS 10.8g	7466				
LDPE Ppbd 18.4g	8898	1432	1.25%	799,330	
Mold Pulp 16.6g	9017	1551	1.36%	738,001	
PLA 20.7g	14208	6742	5.89%	169,778	
Water Use Emissions for Sandwich-size Clamshells (gallons per 10,000 average weight clamshells)					
GPPS 4.8g	3873				
Fluted Ppbd 10.2g	4951	1078	0.94%	1,061,818	
PLA 23.3g	15996	12123	10.59%	94,419	

Notes:

[1]: Franklin Associates, "Life Cycle Inventory of Foam Polystyrene, Paper-Based, and PLA Foodservice Products", 4 February 2011.

[2]: [1] - Equivalent Polystyrene Product Water Use in [1]

[3]: Assumes average domestic per capita water use at average household size of 3.2 individuals, equal to 114,464 gallons per year. <http://ga.water.usgs.gov/edu/wateruse/pdf/wudomestic-2005.pdf>

[4]: 1 / [3] * 10,000

[5]: Assumes 3 billion cups disposed of in CA per year. See Table 1.

Table A-3: Greenhouse Gas Emissions Comparison for Polystyrene Foodservice Product Alternatives

Product	Pounds CO2 Equivalents	Net vs. Polystyrene	Net Difference as % of Average Annual Vehicle Emissions	Converted Products Required to Generate Emissions of 1 Additional Vehicle	Added Average Vehicle Emissions Added from Substitution of EPS
	[1]	[2]	[3]	[4]	[5]
Greenhouse Gas Emissions for 16-oz Hot Cups (lb CO2 eq per 10,000 average weight cups)					
EPS 4.7g	723				
LDPE Ppbd 13.3g max decomp	987	264	3.74%	267,576	11,260
LDPE Ppbd 13.3g 0% decomp	147	-576	-8.15%	-122,639	-24,568
LDPE Ppbd + 4.1g sleeve max decomp	1215	492	6.96%	143,577	20,985
LDPE Ppbd + 4.1g sleeve 0% decomp	186	-537	-7.60%	-131,546	-22,905
PLA Ppbd 12.7g max decomp	916	193	2.73%	366,010	8,232
PLA Ppbd 12.7g 0% decomp	92	-631	-8.93%	-111,949	-26,914
PLA Ppbd + 4.1g sleeve max decomp	1144	421	5.96%	167,791	17,957
PLA Ppbd +4.1g sleeve 0% decomp	131	-592	-8.38%	-119,324	-25,251
Greenhouse Gas Emissions for 32-oz Cold Cups (lb CO2 eq per 10,000 average weight cups)					
EPS 8.8g	1309				
LDPE Ppbd 19.8g max decomp	1555	246	3.48%	287,154	10,493
LDPE Ppbd 19.8g 0% decomp	143	-1166	-16.51%	-60,583	-49,734
Wax Ppbd 31.3g max decomp	2802	1493	21.14%	47,314	63,681
Wax Ppbd 31.3g 0% decomp	185	-1124	-15.91%	-62,847	-47,942
PLA 35g 50% heavier than 32oz PP	1419	110	1.56%	642,182	4,692
PLA 32.6g 39% heavier than 32oz PP	1314	5	0.07%	14,128,000	213
Greenhouse Gas Emissions for 9-inch Plates (lb CO2 eq per 10,000 average weight plates)					
Heavy-Duty Plates					
GPPS 10.8g	1142				
LDPE Ppbd 18.4g max decomp	1406	264	3.74%	267,576	
LDPE Ppbd 18.4g 0% decomp	206	-936	-13.25%	-75,470	
Mold Pulp 16.6g max decomp	1712	570	8.07%	123,930	
Mold Pulp 16.6g 0% decomp	532	-610	-8.64%	-115,803	
PLA 20.7g	840	-302	-4.28%	-233,907	
Lightweight Plates					
2009 GPPS 4.7g	497				
2009 LDPE Ppbd 12.1g max decomp	927	430	6.09%	164,279	
Greenhouse Gas Emissions for Sandwich-size Clamshells (lb CO2 eq per 10,000 average weight clamshells)					
GPPS 4.8g	529				
Fluted Ppbd 10.2g max decomp	681	152	2.15%	464,737	
Fluted Ppbd 10.2g 0% decomp	216	-313	-4.43%	-225,687	
PLA 23.3g	1492	963	13.63%	73,354	

Notes:

[1]: Franklin Associates, "Life Cycle Inventory of Foam Polystyrene, Paper-Based, and PLA Foodservice Products", 4 February 2011.

[2]: [1] - Equivalent Polystyrene Product Emissions in [1]

[3]: Assumes annual vehicle emissions at average California CAFE Standard levels and 12,000 driving miles per year. <http://www.dieselnet.com/standards/us/ca_ghg.php>

[4]: 1 / [3] * 10,000

[5]: Assumes 3 billion cups disposed of in CA per year. See Table 1.

References

California State University Chancellor's Office. Accessed 24 June 2011. <www.calstate.edu/executive>

CalRecycle, "Waste Reduction Awards Program Winners". Accessed 24 June 2011. <http://www.calrecycle.ca.gov/WRAP/search.asp?VW=APP&BIZID=5848&YEAR=2010&CNTY=>

Chancellor's Office, *California Community College Datamart.* Accessed 24 June 2011.

Courtney Arthur, Joel Baker, and Holly Bamford, editors, "Proceedings of the International Research Workshop on the Occurance, Effects, and Fate of Mircroplastic Marine Debris," Department of Commerce, National Oceanic and Atmospheric Administration, Technical Memorandum NOS-OR&R-30, January, 2009.

DieselNet, "California Fleet Average GHG Emission Standards". Accessed 24 June 2011. <http://www.dieselnet.com/standards/us/ca_ghg.php>

Energy Information Administration, "Household Energy Consumption by Census Region, Selected Years, 1978-2005." Accessed 24 June 2011. <http://www.eia.gov/totalenergy/data/annual/txt/ptb0204.html>

Franklin Associates, "Life Cycle Inventory of Foam Polystyrene, Paper-based, and PLA Foodservice Products." Prepared for The Plastic Foodservice Packaging Group, 4 February 2011.

Herrera Environmental Consultants, "Alternatives to Disposable Shopping Bags and Food Service Items: Volume 1." Prepared for Seattle Public Utilities, 29 January 2008.

Long Beach Unified School District, "Adopted Budget: Fiscal Year 2011-2012", Overview, p. 1. Accessed 24 June 2011. <http://www.lbschools.net/Main_Offices/Business_Services/pdf/FY12%20Adopted%20Budget%20Book.pdf>

Midatlantic Solid Waste Consultants, 2009 National Visible Litter Survey and Litter Cost Study, prepared for Keep America Beautiful, Final Report, September 18, 2009.

"Recyclable foam trays a cure for Long Beach schools' headache", Long Beach Press-Telegram, May 19, 2011. Accessed 24 June 2011.
<http://www.presstelegram.com/ci_18100171?source=rv>

Sutter Gould Medical Foundation, “Facts at a Glance.” Accessed 24 June 2011.
<http://www.sutterhealth.org/about/snapshots/gould2.pdf>

“The City of San Francisco Streets Litter Audit.” Prepared for the City and County of San Francisco Department of Environment by HDR, Brown Vence & Associates, and MGM Management, June 2007. P. 27. The survey was completed in April 2007, the ban went into effect on June 1, 2007.

United States Geological Survey, “Estimated Use of Water in the United States in 2005.” Accessed 24 June 2011. <http://ga.water.usgs.gov/edu/wateruse/pdf/wudomestic-2005.pdf>

University of California Office of the President, “Statistical Summary and Data on UC Students, Faculty, and Staff.” Fall 2010.

US Department of Health and Human Services, Health, United States, 2010. Table 91. Accessed 24 June 2011.
<http://www.cdc.gov/nchs/data/hus/hus10.pdf>

US Environmental Protection Agency, "Fact Flash"
<http://www.epa.gov/superfund/students/clas_act/haz-ed/ff06.pdf>

Author Bios

Mark Berkman

Education

University of Pennsylvania, Wharton School, Ph.D. in Public Policy Analysis; Harvard University, M.A. in Planning, Policy Analysis and Administration; George Washington University, B.A. in Economics and Urban Affairs

Biography

Dr. Mark Berkman is an expert in applied microeconomics. His experience spans the areas of the environment, energy, and natural resources; environmental health and safety; labor and employment; intellectual property; antitrust; commercial litigation and damages; and public finance. He has assisted both public and private clients and provided testimony before state and federal courts, arbitration panels, regulatory bodies, and legislatures.

His environmental work has involved the review of proposed air, water, solid waste, and worker and product safety regulations. Dr. Berkman has quantified the costs and benefits of these regulations, as well as toxic tort and product liability claims. In addition, he has valued natural and water resources as well as property damages associated with pollution from Superfund sites, landfills, and power plants.

His work on energy matters includes the valuation of coal resources, power plants, and transmission rights-of-way. He has also prepared energy demand and price forecasts. He has extensive experience working with Native American tribes on energy valuation matters.

Clients in a variety of industries ranging from computer chip to shoe manufacturers have sought Dr. Berkman's assistance to value patents, trade secrets, and trademarks. He has also been called on to address questions of market power in a variety of industries including solid waste, computer manufacturing, and medical devices. He has testified regarding market definition and market power and participated in Hart-Scott-Rodino proceedings.

Dr. Berkman also has substantial experience in labor and discrimination litigation. He has conducted statistical analyses of alleged discrimination in hiring, promotion, pay, and contracting, and completed damage analyses regarding these allegations. He has also conducted statistical analyses regarding mortgage lending discrimination.

Prior to joining *Brattle* he was a co-founder and director at Berkeley Economic Consulting and a vice president at both Charles River Associates and NERA Economic Consulting.

David Sunding

Education

University of California, Berkeley, Ph.D. in Agricultural and Resource Economics; University of California, Los Angeles, M.A. in African Area Studies; Claremont McKenna College, B.A. in Economics

Biography

Dr. David Sunding has extensive experience as a researcher, consultant, and expert witness in matters related to natural resources, environmental quality, energy, and the economics of regulation. His expertise includes experience in complex litigation, regulation, and transactions. He has testified in state and federal courts and in regulatory proceedings around the country.

He has assisted corporations, utilities, and government agencies in developing economic testimony in a variety of matters concerning environmental damages, product liability, risk assessment, resource planning, cost allocation, and project financing. Dr. Sunding has played a central role in several prominent water resource matters, including the landmark Quantification Settlement Agreement for the Colorado River, interstate water disputes before the U.S. Supreme Court, and the Federal Energy Regulatory Commission's relicensing of hydropower facilities. He has authored several widely cited studies on the economics of water quality regulation and has served as an expert in cases involving regulation and litigation under the Clean Water Act, the Endangered Species Act, and other statutes.

Dr. Sunding is the Thomas J. Graff Professor in the College of Natural Resources at UC Berkeley, where he is also the co-director of the Berkeley Water Center. He has received numerous awards for his research, including grants from the National Science Foundation, the U.S. Environmental Protection Agency, and private foundations. He is currently a Visiting Professor in the Woods Institute of the Environment at Stanford University.

Prior to joining *The Brattle Group*, Dr. Sunding was a founding director of Berkeley Economic Consulting. Previously, he was a senior consultant at Charles River Associates and NERA. He served as a senior economist for President Clinton's Council of Economic Advisers, and is a member of the American Economic Association, the Association of Environmental and Resource Economists, the Econometric Society, and the American Law and Economics Association.

EXHIBIT 7

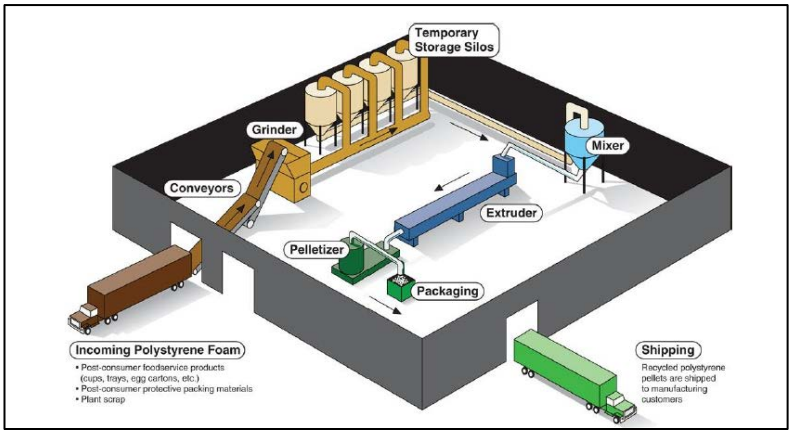
Commonly referred to as Styrofoam, a trademark of Dow Chemical, foam #6 is also known as polystyrene foam, expanded polystyrene, EPS, and foam. Due to its light weight, low cost, and unique physical properties, foam helps reduce shipping costs and is excellent at cushioning and insulation. It is widely used to as electronics packaging, egg cartons, fast food take-out containers, foam plates, and foam cups. Another benefit of this material is that it is recyclable.

Foam #6 is a thermoplastic, so it is technically recyclable over and over again. Foam has real value once it has been compacted. There are now many markets for foam and the price they pay often exceeds the price of cardboard and other popular recycling commodities. New technology has made recycling foam much more efficient than in the past. For example, there are now many options for special compactors – one such option is the densifier. The densifier breaks down the cellular structure of polystyrene foam through mechanical pressure and can compact foam at as much as an 85:1 ratio.

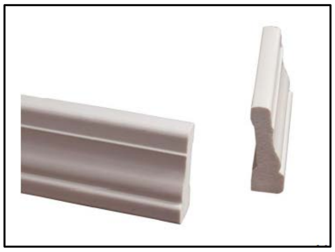
Dart's CARE densifier

32 lbs. of foam
Loose foam (left) / Densified foam (right)

The conversion of foam into new products is a simple process that reduces the need to harvest crude oil from the earth and all of the energy associated with the process required to make virgin resin. Reclaimers simply place the compacted material into a grinder, which feeds an extruder. The extruder is similar to a Play-Doh machine in that the ground material goes into the machine, melts, and comes out the other end like spaghetti. The spaghetti is then cooled and chopped into small pieces (pellets). Once it is in the form of pellets, it then can be used to make useful new products.



Foam recycling helps businesses that use it to make new products and practice good environmental stewardship. Recycled foam costs significantly less than virgin material and will perform well in a variety of applications ranging from premium interior molding and picture frames to horticultural materials like “pony packs” used for flowers at nurseries across the country.



Expanded polystyrene (EPS) foam packaging is an excellent material for recycling and reuse with a long history of environmental stewardship. EPS packaging recycling rate remains one of the highest among all the plastics family, achieved an average post-consumer recycling rate of 14% and average post industrial recycling rate of 25% for the past fifteen years. And, particularly in recent years, shows a dependable track record to deliver consistent results. In 2012, more than 93 million pounds of EPS was recycled. *See generally* EPS Industry Alliance, *2012 EPS Recycling Rate Report* (2012).

2012 DOMESTIC EPS RECYCLING

(MILLIONS OF POUNDS)

Post-Consumer	**36.7**
Post-Industrial	**56.9**
Total EPS Recycling	**93.7**

Advances in EPS recycling technology, collaborative collection programs, and new end-use markets have continued to broaden EPS recycling opportunities. Some companies are choosing to promote and support EPS recycling through shared responsibility within the supply chain. Walmart has created a closed-loop EPS recycling strategy that takes the collected material and uses it to create recycled picture frames. Several pharmaceutical companies have implemented pre-paid return shipping recycling programs for EPS biomedical coolers. This integrated approach – with everyone doing their part – an even higher recycling rate for foam is still possible.

U.S. POST-CONSUMER EPS RECYCLING COLLECTION DATA (1990–2012)

MILLION OF POUNDS

RATE COMPONENT	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	2010	2012
POUNDS RECYCLED	3.0	20.8	24.2	22.5	19.2	24.9	26.2	25.0	32.0	33.6	37.1	36.7
POUNDS SOLD	179	218	238	217	202	206	201	222	166	172	130	123
RECYCLING RATE	1.7	9.5	10.2	10.4	9.5	12.1	13.0	12.0	19.3	19.5	28	30

Note: Recycling rates only reflect the percentage of material recycled for that particular year and do not account for any significant change in production volume from one year to the next.

EXHIBIT 8

California Recycling Information

- Home
- Green Commitment

  ## Dart's Green Commitment

  Dart's Environmental Ethic

  Maximizing Efficiency

  Promoting Environmental Attributes

  Developing New Materials, Products, & Technologies

- Q & A

  ## Environmental Questions and Answers

  Why do we use disposables?

  What is the truth about foam products & our throw away society?

  Why choose foam products instead of paper?

  How are foam foodservice products made?

  What about disposal and landfill issues?

  What about litter?

  Are foam products biodegradable?

  Can foam products be recycled?

  Where can I recycle my foam cups and containers?

- PS Foam Recycling

Dart's Recycling Programs

Public Foam Recycling Drop-Off Locations
Dart Facilities and other public locations, including **Michigan county programs**, provide public foam recycling drop-off opportunities.

Dart's Care Program
Cups Are REcyclable! Offered to Dart customers with a large volume of foodservice material, the CARE program makes foam recycling practical and efficient.

Dart's Recycla-Pak Program
Smaller businesses using Dart foam products can take advantage of this program, developed to collect and ship the material to a Dart facility for recycling.

School Foodservice Foam Recycling Information
Dart offers some insight and ideas on implementing a successful school foodservice foam recycling program.

Dart's Recycling Partners

Other Recycling Options

Additional sources of foam recycling locations can be found at:
earth911.com
epspackaging.org

- Health & Safety
  - Introduction
  - CFCs and Blowing Agents
  - Inks
  - Kosher/Halal
  - Latex
  - Lemon Tea
  - Microwaving
  - Styrene
  - Bisphenol-A

- **Media Library**
  - **Informational Videos**
  - **Downloadable Literature**
  - **Scientific Studies**
  - **Dart in the Media**
  - **Additional Source Links**
  - **News Archive**

California RECYCLES!

CA Curbside Recycling

More than 65 cities have access!

- **The following cities have included post-consumer foam polystyrene in their list of accepted items for residential curbside recycling:**

  Commerce (Partial), Covina, El Segundo, Encinitas, Escondido, Long Beach ,Los Angeles (includes the following communities: Arleta, Arlington Heights, Atwater Village, Bel Air, Beverly Crest, Beverlywood, Boyle Heights, Brentwood, Cahuega Pass, Canoga Park, Century City, Chatsworth, Cheviot Hills, Chinatown, Crenshaw, Crestview, Cypress Park, Del Rey, Eagle Rock, East Hollywood, Echo Park, El Sereno, Elysian Park, Elysian Valley, Encino, Fairfax, Glassell Park, Granada Hills, Hancock Park, Harbor City, Harbor Gateway, Harvard Heights, Highland Park, Hollywood, Hyde Park, Jefferson Park, Koreatown, Lake Balboa, Lakeview Terrace, La Tuna Canyon, Leimert Park, Lincoln Heights, Los Feliz, Mar Vista, Mission Hills, Montecito Heights, Mt. Washington, North Hills, North Hollywood, Northridge, Oaks, Pacific Palisades, Pacoima, Palms, Panorama City, Pico Union, Playa Vista, Porter Ranch, Rancho Park, Reseda, San Pedro, Sawtelle, Shadow Hills, Sherman Oaks, Silver Lake, South Carthay, South Robertson, Studio City, Sunland, Sun Valley, Sylmar, Tarzana, Toluca lake, Tujunga, University Hills, Valley Glen, Valley Village, Van Nuys, Venice, Watts, West Adams, Westchester, West Hills, Westlake, West Los Angeles, Westwood, Wilmington, Wilshire Center, Winnetka, and Woodland Hills), Imperial Beach, La Mesa, Manhattan Beach ,Norwalk , Ontario(Partial), Pasadena, Poway, Rancho Cucamonga, Redondo Beach , Rialto, Riverside, Rolling Hills Estates, Sacramento, San Bernardino(Partial), Santa Fe Springs, Torrance, Tracy, and Upland.

Proud Member of

- **The following cities have not posted that they accept post-consumer foam polystyrene in their list of accepted items for residential curbside recycling, however, the companies that sort their recyclables <u>have confirmed they do sort foam</u> for recycling if residents place it in their recycling containers:**

  Alpine, Arrow Bear, Bloomington, Bonita, Bonsall, Cerritos, Coronado, Crestline, Dictionary Hill ,Downey, East vale, Fallbrook, Fontana, Fountain Valley , Grand Terrace ,Highland, Huntington Beach ,Lake Arrowhead, Lomita, Julian, Lakeside, Lemon Grove , Lincoln Acres, Montclair, Mt.Helix , National City, Paramount, Pomona(Partial), Rainbow, Ramona, Rancho Santa Fe, Rim of The World, Riverside County(Partial), Rubidoux, Running Springs, San Bernardino County (Partial), San Marcos, Spring Valley, Valley Center, Vista, and Yucaipa (Partial).

CA Drop-Off Locations

- Go to **Home for Foam** for more details.
- For more foam recycling locations go to **www.earth911.com** and search for "Styrofoam".

CA Recycling Successes

- The following California Schools are now recycling their foam lunch trays: El Segundo USD, Chula Vista USD, Lodi USD, Culver City USD, Los Alamitos USD, Ontario USD, Santee USD, South Bay USD, Valley Center USD, Rialto USD, Hemet USD, and Long Beach USD.

Watch Video

The Dart Story

The Dart story begins with a small machine shop in Mason, Michigan known as Dart Manufacturing Company. Established in 1937, this modest business prospered through the manufacture of such products as plastic key cases, steel tape measures, and identifcation tags for the armed services. Subsequent experimentation with expandable polystyrene in the late 1950s led to a line of high quality insulated foam cups, and Dart Container Corporation was born.

Today, Dart manufactures products in two California facilities strategically located near major markets in Northern and Southern California.

Dart strives to produce high-quality, cost-effective products in a manner sensitive to environmental concerns while providing tremendous value to the great state of California.

California Economic Benefits

- Dart employs 720 full-time employees
- Dart Pays $30 million per year in payroll dollars
- Dart Pays $19.9 million per year to California based vendors
- Dart Pays $2.6 million per year in state and local taxes

Environmental Stewardship

Dart's ongoing drive for efficiency has reaped an extraordinary harvest in reductions of our carbon footprint. From the lighting fixtures in our offices to the technologies on our factory floors, each element of our business is scrutinized for ways to further reduce energy consumption, air emissions, and solid wastes.

Examples of DART'S Environmental STEWARDSHIP

- Energy conservation measures include recovering heat from our cup-making process to warm our buildings.
- Electrical usage has been substantially reduced through the use of programmable controls and lower wattage lighting.
- Dart's largest factory uses landfill gas to run the boilers for its foam cup production and the ovens for its oriented polystyrene operations, resulting in a net reduction in greenhouse gas emissions.
- Dart has led its industry in emissions reduction and source reduction efforts, including the reduction of pentane emissions, the expansion agent for foam cups. Dart recaptures pentane for use in our production processes.
- By choosing inks curable by ultraviolet light, Dart avoids the solvent emissions associated with typical solvent-based printing inks.
- The amount of material used to produce many Dart products has been reduced without altering product performance.
- The amount of materials used in the packaging of our products, both corrugated cartons and plastic films, has been reduced.

Dart RECYCLES!

Dart currently operates polystyrene foam drop-off locations at our production plants for anyone who wishes to recycle foam products. In addition, we have recycling centers at our production facilities in Michigan, Pennsylvania, Florida, and Ontario, Canada, capable of reprocessing 12 million pounds of foam products annually. Dart sells its recycled polystyrene to manufacturers who reprocess it into useful products. Recycled polystyrene is used in the making of picture frames, plastic lumber, egg cartons, building insulation, toys, and office desk products.

Dart RECYCLING Programs

Dart offers the **CARE (Cups Are REcyclable) Program** to make recycling polystyrene foam foodservice products easier for our customers. The CARE Program helps large users of foam foodservice products separate the foam from other products, consolidate the collected material, and arrange to have it recycled. Recycled foam foodservice products can be reprocessed into building insulation, plastic lumber, and many other products.

The Dart densifier can compress 8,000 eight ounce foam cups into a cylinder 15" tall and 15" in diameter.

The Dart **Recycla-Pak program** is an easy way for any business to recycle their foam cups. Simply purchase a specially designed Recycla-Pak corrugated collection bin and you can start recycling foam cups. The Recycla-Pak collection bin doubles as the shipping carton used to return the collected cups for recycling at a Dart or industry recycling facility. The bin will be shipped to you flat and, after a simple assembly, you are ready to begin collecting used foam cups for recycling. During use, a cardboard divider in the bin keeps the collected cups neatly stacked. A pre-printed shipping label attached to the bin allows for easy return of the cups for recycling, freight prepaid. Most paper foodservice products are coated with wax, polyethylene plastic, or other nonbiodegradable materials and are, therefore, essentially no more degradable than foam.

Foam Facts

- Most paper foodservice products are coated with wax, polyethylene plastic, or other nonbiodegradable materials and are, therefore, essentially no more degradable than foam.
- The manufacture of average-weight polystyrene foam hot beverage cups requires less energy than the manufacture of comparable plastic coated paperboard hot cups with cardboard sleeves. The manufacturing of polystyrene foam cold beverage cups requires less energy than the manufacture of comparable wax-coated paperboard cold cups.
- Plastic-coated paperboard cups don't insulate as efficiently as foam cups. Plastic-coated paper cup users frequently use two cups together for hot beverages to protect their hands, thereby doubling the environmental impact of choosing paper.[1]
- The manufacture of Dart polystyrene foam products does not deplete the ozone layer.
- Polystyrene foam can be recycled as part of an integrated solid waste management strategy. Paper foodservice disposables, on the other hand, are rarely recycled.

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1 Franklin Associates, Ltd., Final Peer-Reviewed Report: Life Cycle Inventory of Polystyrene Foam, Bleached Paperboard, and Corrugated Paperboard Foodservice Products (Prepared for The Polystyrene Packaging Council, March 2006), Table 2-2, p. 2-7.

Media Library

- Informational Videos
- Downloadable Literature
- Additional Source Links
- Scientific Studies
- News Archive

Did you know...

Most paper foodservice products are no more degradable than foam.

Contact Us

We welcome your comments and questions on our products' relationship with the environment and will get back to you as soon as possible. If you are inquiring about a particular product, go to our **MAIN CONTACT PAGE**.

CONTACT US

EXHIBIT 9

A Home for Foam

Recycling Update

2nd Qtr, 2014

Dart's Community Action Team (D-CAT) provided 10 recycling tours, participated in 15 foam recycling/clean-up events, and gave 20 off-site educational presentations in the first quarter of 2014. Please let us know if you would like to participate in future events.

Curbside Recycling- For a detailed list of US cities that offer curbside and drop-off recycling for clean post-consumer foam foodservice containers, please go to www.HomeForFoam.com and click on the Foam 101 tab.

Drop-off Locations- More locations have been added throughout the US. For a list of drop-off locations for clean foam foodservice containers, please go to www.dart.biz/recycle

School Lunch Tray Recycling - The following schools are now recycling their foam lunch trays or other foam materials with Dart: Ann Arbor Public (Ann Arbor, MI), Arlington Heights USD #25 (Chicago, IL), Bedford Public Schools (Temperance, MI), Central Michigan U (Mt. Pleasant, MI), Chula Vista USD (Chula Vista, CA), Durand Area Schools (Durand, MI), El Segundo USD (El Segundo, CA), Hanford USD (Hanford, CA), Hemet USD (Hemet, CA), Hope D. Wall School (Aurora, IL), Lodi USD (Lodi, CA), Long Beach USD (Long Beach, CA), Los Alamitos USD (Los Alamitos, CA), Essexville Hampton (Essexville, MI), Highlands Middle School (Grand Rapids, MI), John Paul II Catholic School (Lincoln Park, MI), Kalamazoo College (Kalamazoo, MI), Marble Elementary (East Lansing, MI), Marie Elementary (Grosse Pointe, MI), Michigan State University (East Lansing, MI), Ontario USD (Ontario, CA), Paint Creek Elementary (Lake Orion, MI), Post Oak Elementary (Lansing, MI), Quitman Upper Elementary School (Quitman, MS), Rialto USD (Rialto, CA), Riverside USD (Riverside, CA), Robinson Elementary School (Grand Haven, MI), Santee USD (Santee, CA), South Bay USD (Imperial Beach, CA), U of Michigan (Ann Arbor, MI), Valley View School District (Romeoville, IL), and Western Michigan U (Kalamazoo, MI).

For more information on school recycling, please go to- www.dart.biz/schools

Recycla-Pak Placements (This is a U.S. mail-back program in which customers purchase a corrugated container from Dart that serves as a foam cup collection device as well as a shipping container). We now have sold more than 3,982 kits. Each kit holds two collection devices. For more information, please go to- www.recycla-pak.com

CARE Placements (The Cups Are REcyclable program helps large end-users of foam foodservice products collect and compact their post-consumer foam so it can be recycled). This program has spread to fifteen states and we now have thirty-nine participants. For more details, please go to www.dart.biz/care

Recycling Partners- Go to this page to learn more about the businesses Dart partners with to recycle foam. In addition, this page serves as a data base for recyclers that want to buy post-industrial and post-consumer foam. For more information, please go to www.dart.biz/partners

News Bits- See the latest information about Dart's recycling, education, and litter abatement efforts as reported by media throughout the U.S. at www.dart.biz/enewsbits

The Dart Channel on YouTube now has a section dedicated to recycling videos. Videos include residential MRF recycling for foam, picture frame manufacturing with post-consumer foam, school lunch tray recycling, and footage of Dart's Corona wash and dry facility- http://www.youtube.com/user/DartContainerCorp

Don’t forget to visit our Facebook page! http://www.facebook.com/DartEnvironment and click “Like.”

EXHIBIT 10

The Brattle Group

Economic Analysis of San Jose's Proposed Polystyrene Ban

February 25, 2012

Mark Berkman, Ph.D.
Principal
The Brattle Group

David Sunding, Ph.D.
Principal
The Brattle Group and the
Thomas Graff
Professor in the College of Natural Resources
University of California, Berkeley

Prepared for

Dart Container Corporation

Introduction and Summary

A product ban must be considered in terms of its cost and what it achieves from an environmental and social point of view. Based on our analysis, the costs of banning polystyrene food and beverage containers in San Jose could easily be over $4 million per year and lead to the loss of local jobs. This is a substantial expense, especially in view of City Government financial constraints. This amount would, for example, pay the salaries of about 35 police or firefighters, or 60 public school teachers. At the same time, the social benefits of the ban are highly uncertain and quite possibly even negative. According to recent life cycle cost comparisons, substitute products will result in higher energy and water consumption and, depending on the mix of substitutes preferred by consumers, higher greenhouse gas emissions. The impact on litter—a main objective of the ban—also appears to be small or nonexistent. Litter collection costs are unlikely to fall because polystyrene food service items represent a small share of litter and polystyrene replacements will also generate litter—perhaps more than continued use of polystyrene. Polystyrene also represents a very small share of total litter volume. Further, a ban is not an effective or cost-effective means to help the City meet trash reduction targets. Comprehensive actions aimed at multiple sources of waste and litter are likely to be far more cost effective. Finally, the impact of polystyrene on marine ecosystems is yet unknown and available evidence does not provide justification for significant environmental and economic costs the ban will entail.

The Costs of a Polystyrene Ban Are Likely to be Substantial

Based on our analysis, the costs of the proposed polystyrene ban are likely to be substantial. The cost to San Jose consumers could easily reach $4.4 million annually.

Household expenditures on food and meals away from home would clearly increase. Based on a recent comparison of posted prices, the price differential between polystyrene food service items (cups, plates, and trays) and alternative items is large. According to distributor price lists, the price for substitute cups, for example, is on average twice the cost of equivalent expanded polystyrene (EPS) cups. As shown in Table 1, based on EPS alternative price differentials and regional market volume, San Jose consumer spending could increase by over $4 million per year. This cost is only for cups, bowls, plates, and clamshells (also referred to as hingeware). Similar increases are likely for the other EPS food service items replaced by higher cost substitutes. Consequently, the total cost to households could be higher.

Table 1: Total Costs of Expanded Polystyrene Substitution in San Jose

SAN JOSE NATIONAL MARKET SHARE

US Population	307,000,000	[1]
San Jose Population	967,500	[2]
San Jose Share of Population	0.32%	[3]

SAN JOSE EPS MARKET VOLUME

Item	National Volume [4]	San Jose Volume [5]
Cups	25,503,000,000	80,371,832
Bowls	2,637,000,000	8,310,415
Hingeware	10,817,000,000	34,089,406
Plates	2,637,000,000	8,310,415

PRICE COMPARISON

Product	Cost (per 1000) [6]	Cost of Substitution [7]	Cost of San Jose Substitution [8]
Dart White Foam Cup - 16 oz.	$33.50		
Choice Paper Hot Cup - 16 oz.	$47.55	$14.05	$1,129,224
Dart White Foam Bowl - 12 oz.	$13.17		
White Heavy Weight Plastic Bowl - 12 oz.	$27.06	$13.89	$115,432
Dart Perforated Hinged Lid Take Out Container - 9" x 9" x 3"	$66.40		
Clear Hinged Lid Plastic Container - 9" x 9" x 9"	$146.00	$79.60	$2,713,517
Dart 3 Compartment White Foam Plate - 9"	$24.64		
Solo Medium Weight Paper Plate - 9"	$74.98	$50.34	$418,346
Total Estimated Annual Cost of EPS Substitution in San Jose			**$4,376,519**

Notes:
[1]: U.S. Census Bureau
[2]: U.S. Census Bureau
[3]: [3] / [2]
[4]: 2010 Market Research Study on Foodservice Packaging Products, Foodservice Packaging Institute.
Assumes evenly split allocation of market volume for bowls, plates, and platters.
[5]: [3] x [4]
[6]: Price of lowest cost polystyrene and alternative products obtained from www.webstaurantstore.com
[7]: Difference between alternative and polystyrene products from [6]
[8]: [7] x ([5] / 1000)

These costs reflect the assumption that restaurants will simply pass the cost of polystyrene replacement items through to consumers. This, however, may not be possible for some types of restaurants because of negative customer response, as acknowledged by an economic impact report prepared for the City.[1] While it is difficult to estimate this response with any

[1] Economic and Environmental System Planners, “Economic Impact Analysis of Expanded Polystyrene Costs”, Final Report, November 2012. Prepared for the City of San Jose.

degree of certainty, the ability of fast food restaurants in particular to absorb these costs is limited. As noted in the economic impact report, these restaurants operate on very small margins. In addition, as of March 2013 they must raise wages to meet San Jose's new minimum wage law. Consequently, facing additional costs and consumer price sensitivity owners will be forced to consider cost cutting measures including firing employees. If only a quarter of the $4.4 million cost increase is absorbed, this could result in as many as 40 minimum wage ($10/hour) full-time or 80 half-time equivalent job losses. These jobs are primarily held by younger and unskilled workers, many of whom are from minority communities. In San Jose, the low wage workforce most likely to be impacted by a ban is disproportionately Hispanic.[2] Furthermore, businesses in the foodservice industry in the San Jose area that are likely to be affected are predominantly minority-owned. According to the U.S. Census' 2007 Survey of Business Owners, out of 1,895 businesses in the accommodation and food services industry operating in San Jose, 74% were owned by minorities.[3]

The Environmental Benefits of a Polystyrene Ban Are Uncertain and Possibly Negative

Measuring the benefits of a ban requires special attention to the available substitutes. Substitutes for polystyrene foam food service products would not have smaller environmental impacts overall. In fact, based on several life-cycle assessments, polystyrene food service products consume less energy and water and generate less greenhouse gases in production and transport than substitutes such as wax coated paper and polyethylene.[4] Consequently, a ban is likely to substantially increase energy and water consumption and possibly generate more greenhouse gases.

Impacts on Energy and Water Consumption

For example, if 16 oz polystyrene cups were replaced by any one of several substitutes identified in a recent lifecycle cost analysis, the resulting additional energy consumption would be equal to 0.8 to 3.2 million BTU for every 10,000 16oz hot cups substituted, and 0.7 to 9.9 million BTU for 32oz cold cups.[5] This is shown in Figure 1.[6]

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[2] Reich, Michael. "Increasing the Minimum Wage in San Jose: Benefits and Costs." Center on Wage and Employment Dynamics, University of California, Berkeley. October 2012.
[3] U.S. Census Bureau, *2007 Survey of Business Owners.* "Statistics for All U.S. Firms by Geographic Area, Industry, Gender, Ethnicity, and Race: 2007." Accessed at http://factfinder2.census.gov.
[4] We reviewed Franklin Associates (2011) and Herrera Environmental Consultants (2008).
[5] These calculations rely on Franklin Associates (2011). Assumes Average household energy consumption is 77 million BTU. See appendix table A-1.
[6] The lifecycle cost analysis did not consider that unlike polystyrene cups, which contain heat effectively, other cups do a poor job resulting in many consumers using double cups. The study did account for the addition of paper sleeves to contain heat in some non-polystyrene cups.

Substitutions could also lead to increased water consumption of 1,404 to 3,543 gallons for every 10,000 16oz hot cups, and 837 to 15,553 gallons for 32oz cold cups.[7] This is displayed in Figure 2.

Impacts on Greenhouse Gas Emissions

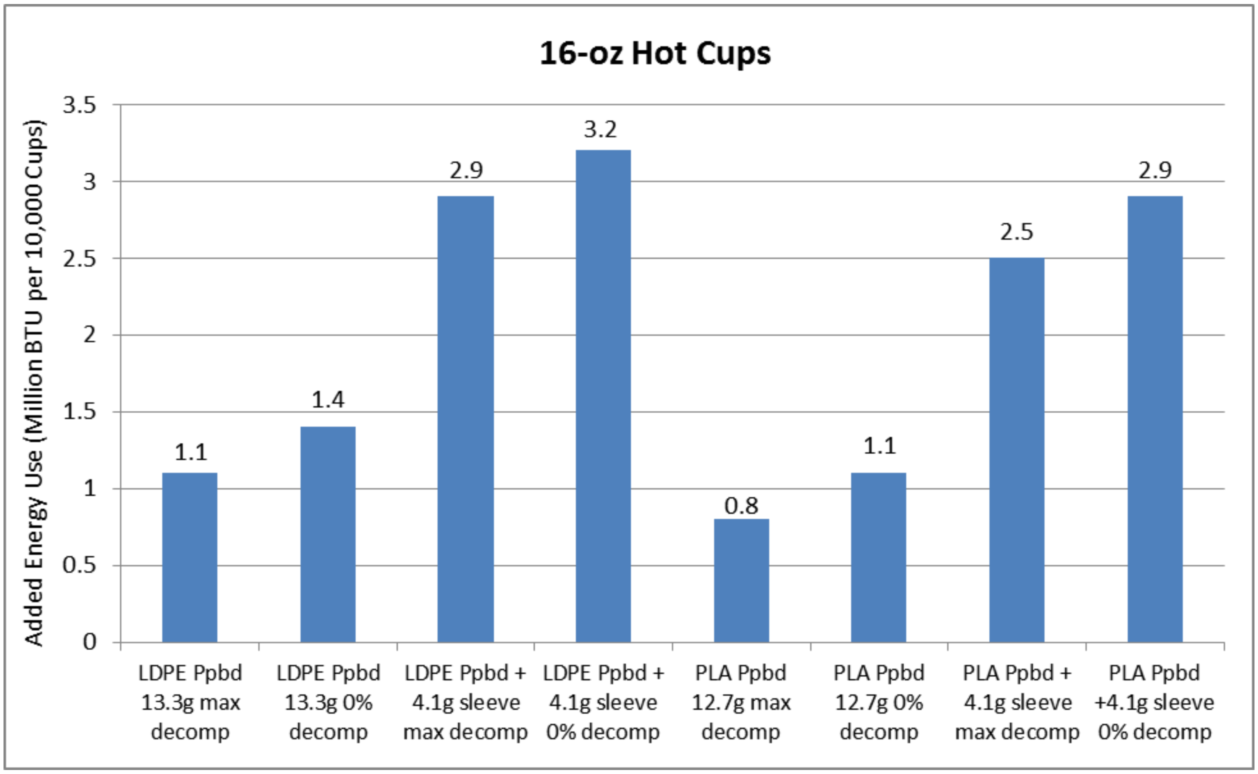
Greenhouse gas emissions from the same substitutions could decrease by 631 pounds or increase by 492 pounds for every 10,000 16oz hot cups, and decrease by 1,166 pounds or increase by 1,493 pounds for 32oz cold cups. [8] This is portrayed in Figure 3. The result depends on which polystyrene substitutes consumers prefer and what assumptions are made about whether substitute products are fully compostable. For example, if consumers use two paper cups as a substitute for one polystyrene cup for hot beverages, which is common because polystyrene cups are excellent insulators and paper cups are not, the paper cup substitutes will emit more greenhouse gases.

If one assumes that substitute products are fully compostable, then polystyrene products have lower greenhouse gas emissions than the substitute products. If one assumes that the substitute products are not compostable, then the substitute products may have lower greenhouse gas emissions; however, this negates one of the asserted advantages of these products (i.e., that they are compostable). The measurement of greenhouse gas emissions highlights how uncertain the measurement of the benefits of a polystyrene ban can be.

In addition, the greenhouse gas analysis assumes that neither polystyrene food containers nor their substitutes are recycled. This is a conservative assumption, because polystyrene food containers are readily recyclable and their substitutes may not be. For example, cups that combine paper and plastic are not generally recyclable.

[7] These calculations rely on Franklin Associates (2011). Assumes average household water consumption is 114,464 gallons. See appendix table A-2.
[8] These calculations rely on Franklin Associates (2011). Assumes average auto fuel emissions used are 7064 lbs CO2 equivalent. See appendix table A-3.

Figure 1: Added Energy Consumption from Substitution of EPS 16-oz Hot Cups and 32-oz Cold Cups



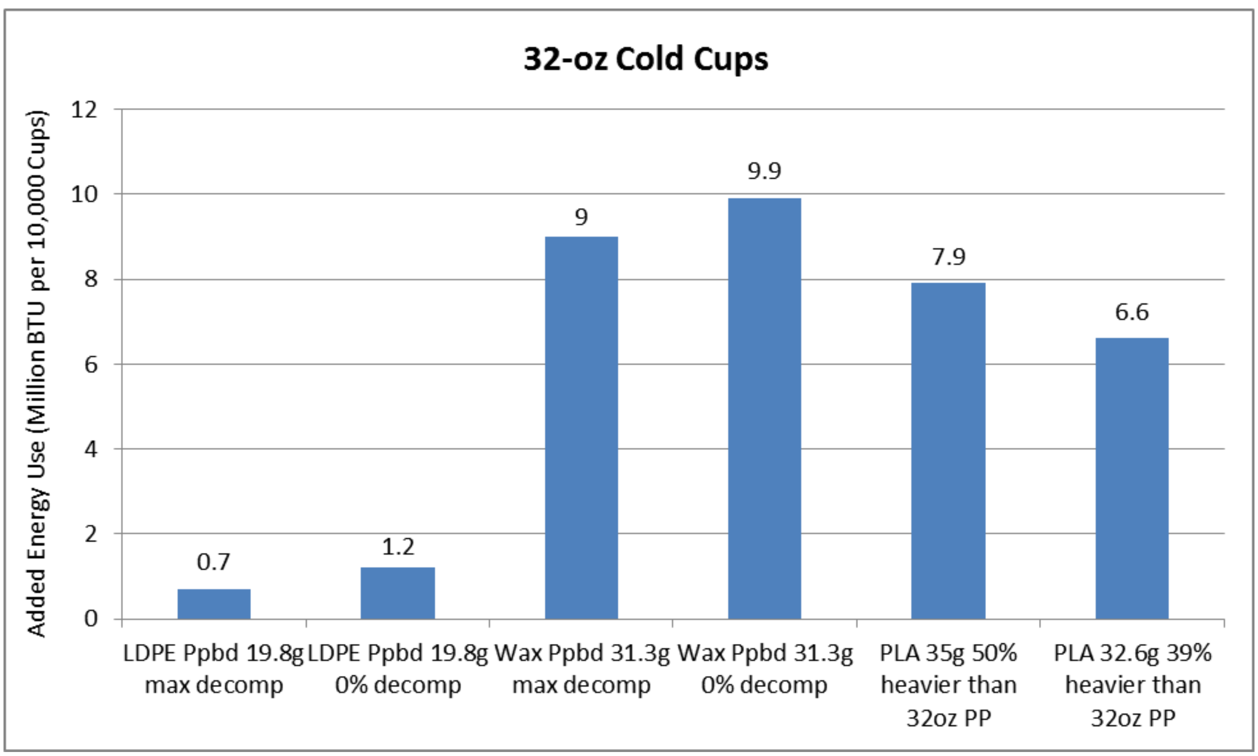
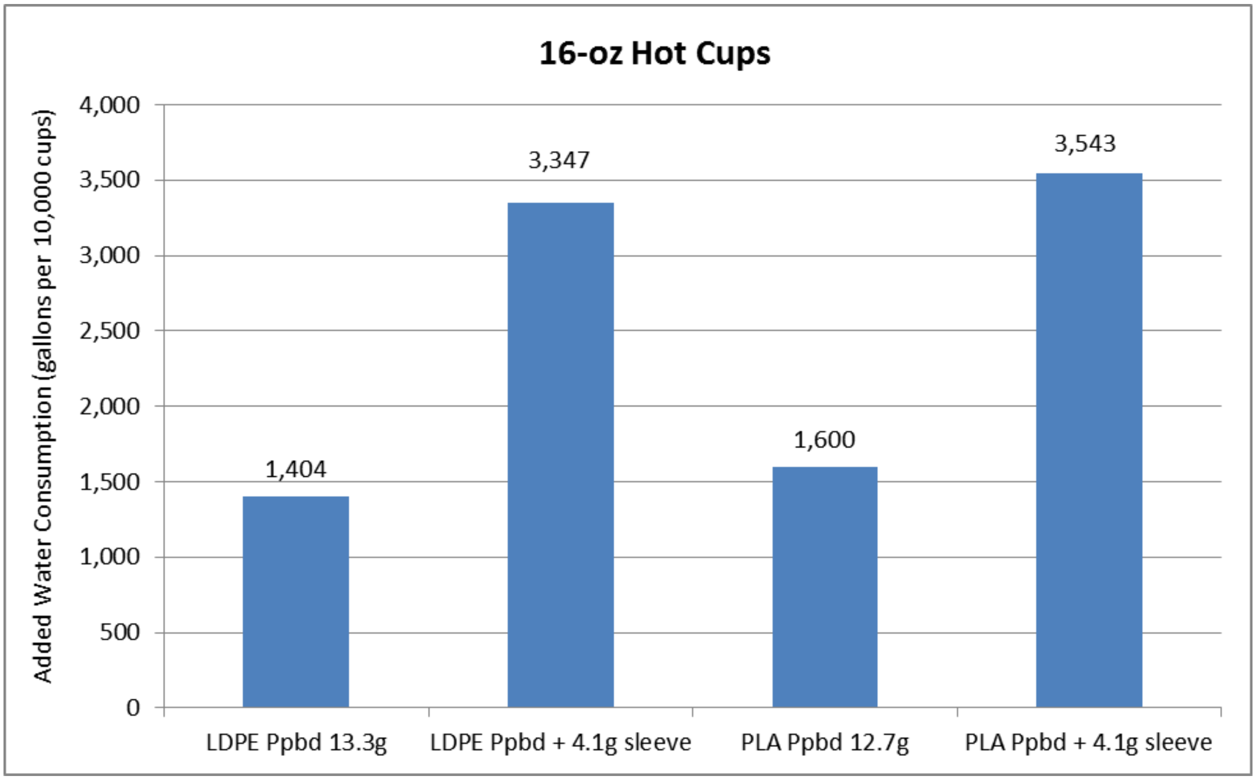


Figure 2: Added Water Consumption from Substitution of EPS 16-oz Hot Cups and 32-oz Cold Cups



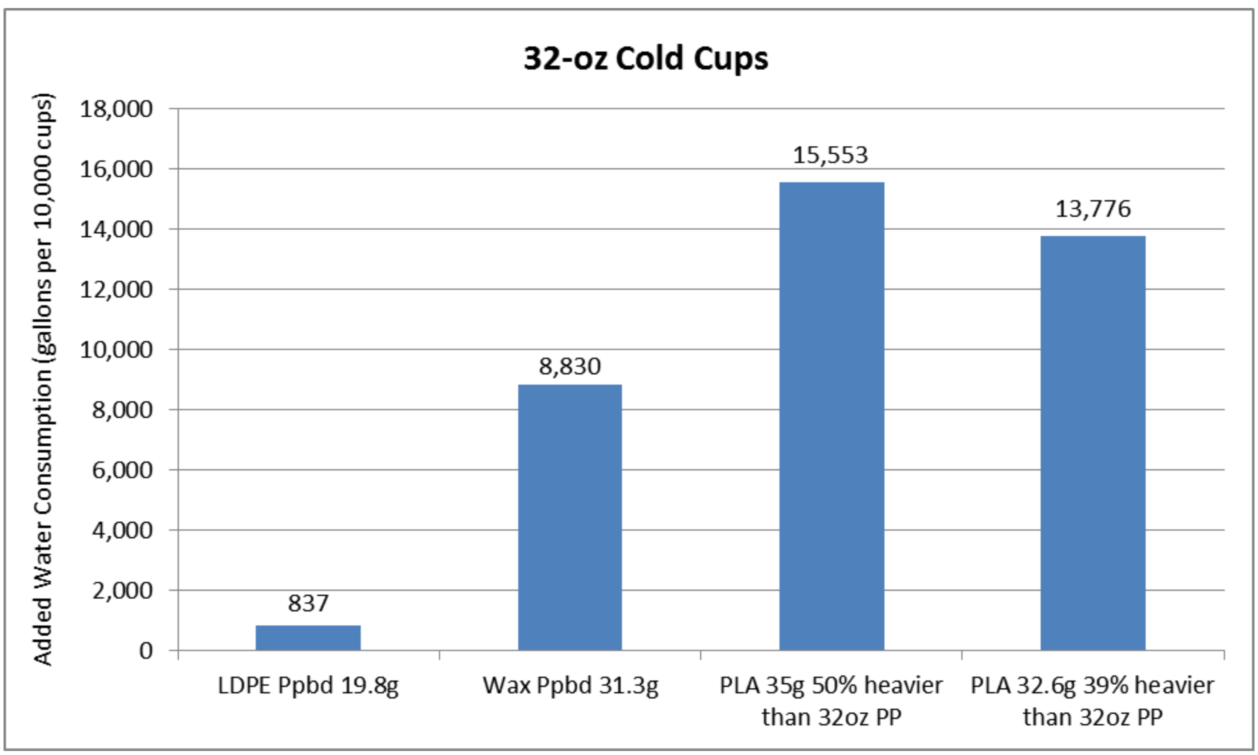
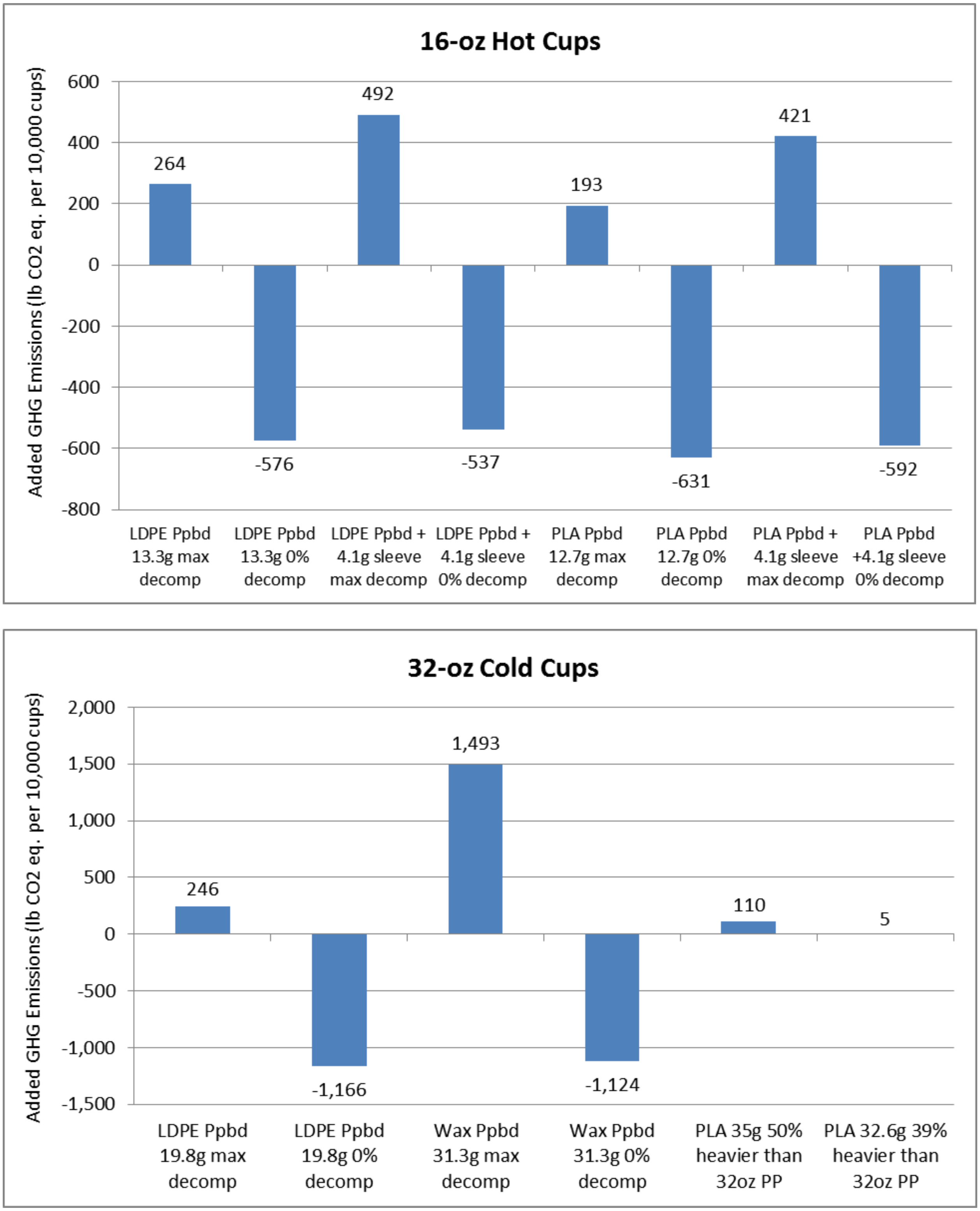


Figure 3: Added Greenhouse Gas Emissions from Substitution of EPS 16-oz Hot Cups and 32-oz Cold Cups



Impact on Marine Environments

Research has not shown any clear link between polystyrene and damage to marine life (birds, fish, and plants).[9] The National Oceanic and Atmospheric Administration (NOAA) observes that the source of the small plastics (microplastics) that are of greatest concern is unknown. Some comes from primary sources (plastics in a small state at the time of discharge) while other small plastic comes from the breakdown of larger plastic sources including litter and other marine debris.[10] NOAA further notes the "paucity of data" on the impacts of small plastic debris on the marine environment.[11] NOAA observes that "…overall the impact on entire seabird populations is either unknown or not considered large enough to warrant further investigation at this time."[12] NOAA concludes that:

> Altogether, the science suggests that microplastics deserve further scrutiny in the laboratory and the field…. Only then will it be possible for the best science to inform management decisions for the remediation and prevention of microplastic pollution in the marine environment.[13]

Not only are the sources and impacts of marine microplastics unknown, the amount of plastic debris from polystyrene is likely to be small. A recent study for Keep American Beautiful (KAB), for example, found that expanded polystyrene materials other than food service items accounted for a very modest share of the litter items found at storm drains nationwide. [14] This is shown in Figure 4. Expanded polystyrene food service items accounted for only 2.5% of litter collected in storm drains and did not make the top ten litter types reported by KAB.[15]

In addition, substitute products for polystyrene are not clearly less of a problem to marine life than some of the available substitutes that contain other plastics. Given the significant environmental and economic costs of a ban on polystyrene food containers, the unknown, speculative potential benefits to the marine environment cannot justify a ban on polystyrene food containers.

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[9] Courtney Arthur, Joel Baker, and Holly Bamford, editors, "Proceedings of the International Research Workshop on the Occurance, Effects, and Fate of Mircroplastic Marine Debris," Department of Commerce, National Oceanic and Atmospheric Administration, Technical Memorandum NOS-OR&R-30, January, 2009.

[10] Arthur, et. al. p. 5 of the Executive Summary.

[11] Arthur, et. al. p. 2 of the Executive Summary.

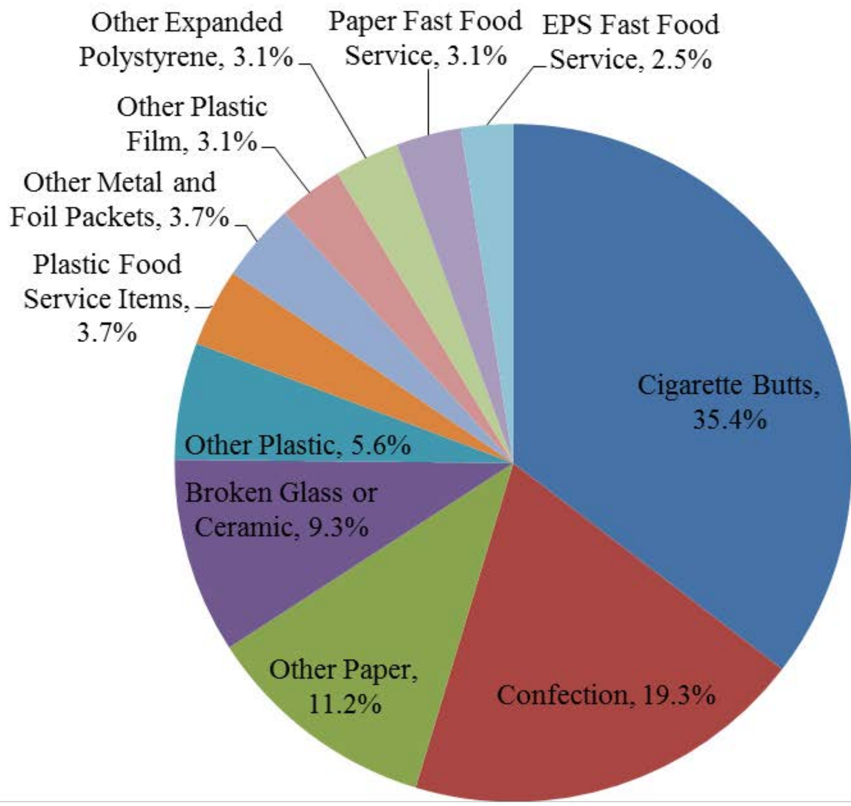
[12] Arthur, et. al. p. 2 of the Executive Summary.

[13] Arthur, et.al. p 5 of the Executive Summary.

[14] Mid Atlantic Solid Waste Consultants, "2009 National Visible Litter Survey" Prepared for Keep America Beautiful, Final Report, September 18, 2009,Figure 3-6, pg.3-30.

[15] Other studies have found polystyrene food items comprising a larger fraction of litter found at storm drains. The Surfrider Foundation, for example, recently studied litter at two storm drains and found that polystyrene food items accounted for 20 percent of litter. Since litter composition will be affected by surrounding land uses, there is likely to be substantial variation across sites. The KAB study is based on a wider sampling of storm drains.

Figure 4: Share of Top 11 Most Common Litter Items at US Storm Drains



Impact on Litter Reduction

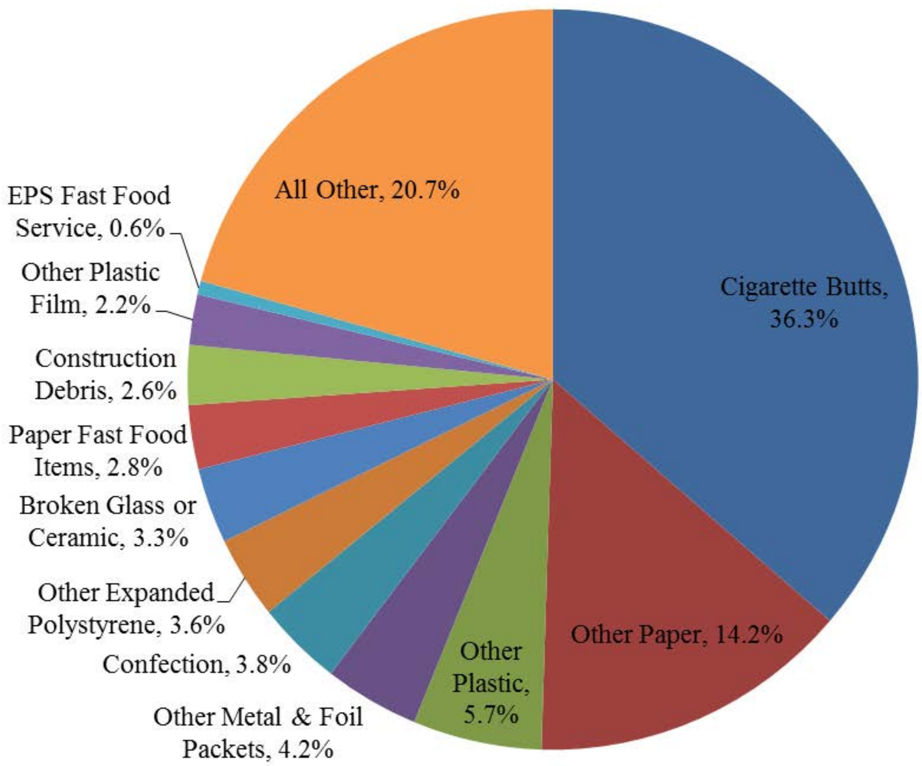
It is also unlikely that banning polystyrene food service items will reduce litter – a prime objective of the ban. What is more likely to happen is a change in the composition of litter. We have found no evidence that litter control costs have declined in cities where polystyrene items have been banned. It is also worth noting that polystyrene does not appear to be a major litter component. Consequently, banning polystyrene will not reduce the cost of litter clean-up substantially. A 2007 San Francisco survey conducted before the City implemented a ban on polystyrene service items, for example, found that polystyrene cups accounted for less than 2% of observed litter.[16] The Keep American Beautiful litter study referenced earlier determined that EPS fast food service litter accounted for only 0.6% of litter found at storm drains and that *other* expanded polystyrene accounted for only 3.6% of the litter itemsfound on at storm drains.[17] See Figure 5. Again polystyrene food service items were

[16] "The City of San Francisco Streets Litter Audit." Prepared for the City and County of San Francisco Department of Environment by HDR, Brown Vence & Associates, and MGM Management, June 2007. P. 27. The survey was completed in April 2007, the ban went into effect on June 1, 2007.

[17] Midatlantic Solid Waste Consultants, 2009 National Visible Litter Survey and Litter Cost Study, prepared for Keep America Beautiful, Final Report, September 18, 2009, pp 3-2 to 3-2, Figure 3-3. The study defines other expanded polystyrene as non-food packaging and finished products with an SPI 6 designation. (See Appendix A.)

not among the top ten sources of litter. Based on the KAB survey, polystyrene food items litter ranked 21st among shares of litter found on U.S roadways.[18]

Figure 5: Relative Share of Litter Items on U.S. Roadways



Additionally, a review of multiple litter surveys conducted in major cities over the past two decades found that polystyrene food products made up a very small proportion of all large litter, with a median value of only 1.5%.[19] San Jose was the site of two of the more recent surveys, with polystyrene food products found to make up only 0.8% of all large litter in 2008, and 2.3% in 2009.[20] Furthermore, in both surveys *none* of the observed small litter was found to come from polystyrene food products. Table 2 below includes a summary of the study's findings.[21] Given the low litter volume of polystyrene observed in San Jose and elsewhere, a ban on polystyrene will achieve little litter reduction at a high cost.

[18] Personal communications with a KAB study author.
[19] Environmental Resources Planning, LLC. "The Contribution of Polystyrene Foam Food Service Products to Litter." Final Report, May 2012.
[20] Ibid.
[21] Ibid.

Table 2: EPS Food Products Proportion of Large Litter

Survey Region	Year	Percent
San Jose	2009	2.30%
Alberta	2009	0.70%
San Jose	2008	0.80%
National	2008	1.70%
San Francisco	2008	1.10%
San Francisco	2007	1.70%
Alberta	2007	1.10%
Toronto	2006	1.10%
Toronto	2004	1.00%
Region of Peel	2003	0.50%
Region of Durham	2003	0.60%
Region of York	2003	0.30%
Toronto	2002	1.50%
Florida	2002	2.30%
Florida	2001	2.20%
Florida	1997	3.10%
Florida	1996	3.60%
Florida	1995	3.30%
Florida	1994	3.90%
Median Value		**1.50%**

Source: Environmental Resources Planning, LLC. "The Contribution of Polystyrene Food Service Products to Litter." Final Report, May 2012.

Impact on Litter Abatement Costs

San Jose does not appear to have considered the proposed ban's impact on litter abatement costs or to have considered alternative methods to reduce litter. Since polystyrene substitutes are just as likely to be littered, there is no reason to expect that litter abatement costs would fall. Even in the unlikely scenario that banning polystyrene materially reduced litter in San Jose, polystyrene makes up such a small share of observed litter that any savings would be very modest relative to the substitution costs imposed on households and food service establishments.

The previously cited KAB study investigated the cost of litter control via a survey of local, county and state agencies. KAB's consultants used the survey to estimate per capita litter control costs for each level of government. Using this data, we can estimate the cost of litter control in San Jose and allocate the cost share attributable to polystyrene. As shown in Table 3, annual litter control costs for large cities are $2.91 per capita according to the survey, equal to total annual costs of $2.8 million for a city the size of San Jose. Another study reported annual litter control costs of $4.9 million in San Jose, equal to $5.06 per resident. Thus, using the polystyrene share of large litter found in San Jose's recent litter surveys, eliminating polystyrene food items, assuming that there is no litter from the substitute items chosen, would reduce annual litter abatement and removal costs by no more than $75,950. This calculation is depicted in Table 3 below. However, even those savings are likely to be a high estimate. Since polystyrene substitutes such as paper cups will also produce litter, the ban would likely produce no savings in litter abatements costs. Even if these savings were achieved, they would be dwarfed by the $4.4 million total cost of polystyrene substitution incurred by households and food service establishments in San Jose.

The KAB study also found that litter levels have fallen dramatically since the late 1960s. Much of this reduction can be attributed to better education, more waste receptacles, more street cleaning, better landfill management, and container deposit programs.

Table 3: Total San Jose Litter Cleanup Costs

		Keep America Beautiful Study		Green Cities California Study
Surveyed Large City Per Capita Litter Cleanup Cost	[1], [2]	$2.91	-	$5.06
San Jose Population	[3]	967,487		
Estimated San Jose Litter Control Costs	[4], [5]	$2,815,387	-	$4,900,000
San Jose Polystyrene Share of Total Litter	[6]	1.55%		
Polystyrene's Share of Annual Litter Control Costs	**[7],[8]**	**$43,639**	**-**	**$75,950**

Notes:

[1] Keep America Beautiful, "2009 National Visible Litter Survey." Prepared by Mid Atlantic Solid Waste Consultants, Final Report, September 18, 2009, p. 4-7.

[2] = [5] / [3]

[3] 2010 U.S. Census

[4] = [1] x [3]

[5] Green Cities California, "White Paper on the Methodology for Analyzing the Cost of Litter Cleanup Efforts." Prepared by ICF International, October 2010, p. 12.

[6] = Average polystyrene large litter share, 2008 and 2009 San Jose Litter Assessments.

[7] = [4] x [6]

[8] = [5] x [6]

Recycling is a feasible, cost effective and environmentally preferable alternative to a ban

Given the high cost to businesses and consumers from a polystyrene ban, other cost-effective alternatives to the polystyrene ban to reduce litter should be considered. Los Angeles has elected to encourage polystyrene recycling. Collection points for polystyrene recycling currently exist in the Bay Area, as shown in Figure 6, and numerous California cities include polystyrene on their list of accepted recyclables. Many other cities have rejected polystyrene bans, and presumably are pursuing other approaches. Equipment is available to reduce the volume of polystyrene in either a hot or cold densification process, making the material inexpensive to ship.

City documents have asserted that recycling polystyrene foam food containers is not feasible because of food contamination. However, all food containers face similar challenges with recycling. Materials recovery facilities (MRFs) generally sort food containers that are heavily contaminated by food materials for land filling—regardless of what the containers are made of. For example, a recycling facility in Milpitas (approximately 10 miles from San Jose) circulated a promotional flyer stating that it accepts clean polystyrene food containers, noting that it has new technology to handle it.[22]

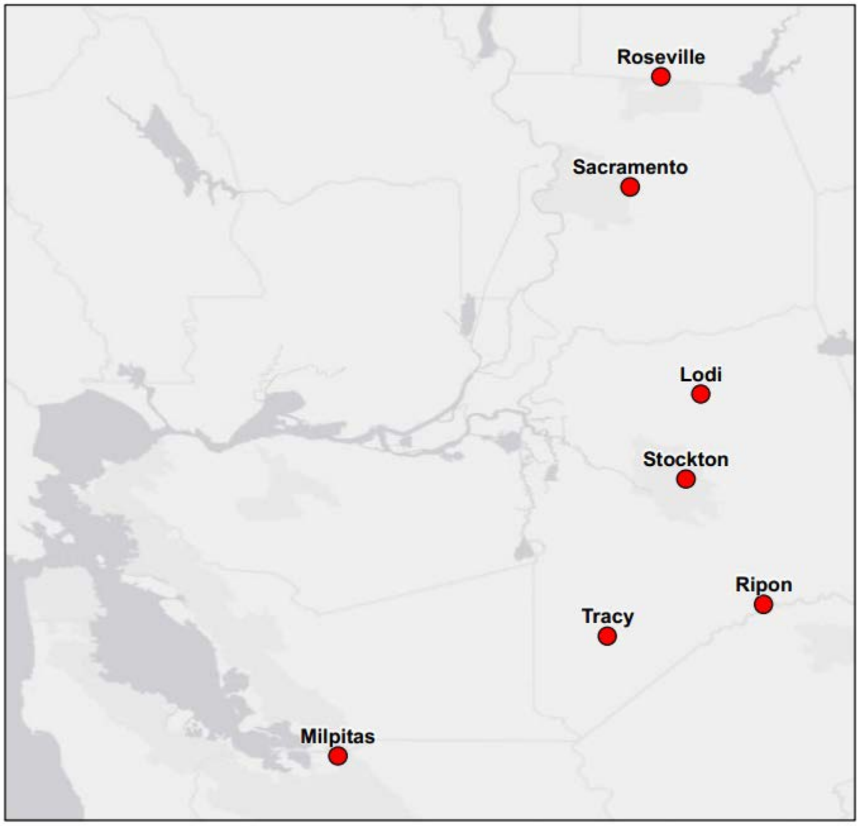
Polystyrene foam food containers that are relatively free from large food particles are readily recyclable. Numerous MRFs in California already accept used foam foodservice materials.

City documents have also asserted that there is no market for recycled foam. This too appears to be based on incomplete information. The market price for recycled foam ranges from \$100-\$500 per ton depending on quality.[23] In contrast, the market price for recycled cardboard is approximately between \$80-\$180 per ton.[24] In other words, there is significant market demand for recycled polystyrene foam. As one example, Natural Environmental Protection Company (NEPCO), a quickly growing California-based manufacturer, used recycled polystyrene foam (including food service foam) to manufacture picture frames. NEPCO reports that is unable to obtain sufficient used polystyrene locally and must import material from Mexico and other locations.

Recycling polystyrene foam food containers is feasible. Banning polystyrene foam is likely to have negative environmental effects (including increasing energy use and water consumption) and would do nothing to reduce trash or litter overall. It would also increase costs to consumers and may result in job losses, particularly by low-wage Hispanic workers. But encouraging recycling would be an effective way for the city to meet its goal of reducing waste that would have none of the negative effects of a ban.

[22] "Stumped by Styrofoam?" < http://www.ci.milpitas.ca.gov/_pdfs/res_StyrofoamRecyclingFlyer.pdf >
[23] Personal communication with California waste broker.
[24] Quote from recycler in San Jose and market observations.

Figure 6: Bay Area Polystyrene Recycling Drop-Off Locations



Devoting resources to comprehensive trash control efforts is likely to have larger, more cost-effective impacts than a policy targeting a specific product that comprises less than 2% of total litter. In a white paper addressing the recycling and disposal of plastics, the State of California Integrated Waste Management Board wrote:

> "Litter is a pervasive problem involving diffuse sources and human behavior, and there are no easy solutions. A principal tenet of this issue is that litter is not a problem caused by specific materials, such as plastics; rather, litter is caused by human behavior. Attributing the litter issue to one particular packaging material does not solve the litter problem, because another type of packaging will take its place as litter unless human behavior changes."[25]

Since other California cities including San Francisco, Oakland, and Berkeley have introduced bans, there is a great opportunity to conduct an important social experiment. Different approaches to litter reduction (and marine protection) can be compared regarding litter volume, composition, and cost and effectiveness provided enough time has elapsed to collect

[25] State of California Integrated Waste Management Board, "Plastics White Paper: Optimizing Plastics Use, Recycling, and Disposal in California," May 2003, p. 16.

the necessary data. Surprisingly, there are no carefully done studies comparing litter pre- and post-ban implementation, despite the number of cities imposing them. At the same time, research regarding the impacts of polystyrene and other plastics on the marine environment is likely to progress to a point where, as NOAA has observed, well informed policy decisions can be made.

Conclusion

The available evidence does not support the introduction of a polystyrene ban. The costs are likely to be large without clear corresponding benefits. This conclusion is consistent with a previous study conducted by the Integrated Solid Waste Management Board for the State Legislature.[26] The Board did not find a polystyrene ban attractive. Instead the Board recommended increasing educational efforts to discourage litter, issuing litter tickets, and conducting further research regarding effective litter management approaches. In fact, the different approaches to litter reduction and polystyrene taken by various California cities and counties provide the opportunity to study the costs and benefits of multiple approaches to efficiently manage polystyrene and other waste materials including bans and incentives for recycling.

[26] Integrated Solid Waste Management Board,"Use and Disposal of Polystyrene in California, A Report to the California Legislature," December 2004, pp5-6.

APPENDICES

Table A-1: Energy Use Comparison for Polystyrene Foodservice Product Alternatives

Product	Million BTU	Net vs. Polystyrene
	[1]	[2]
Energy Use for 16-oz Hot Cups (10,000 average weight cups)		
EPS 4.7g	5.4	
LDPE Ppbd 13.3g max decomp	6.5	1.1
LDPE Ppbd 13.3g 0% decomp	6.8	1.4
LDPE Ppbd + 4.1g sleeve max decomp	8.3	2.9
LDPE Ppbd + 4.1g sleeve 0% decomp	8.6	3.2
PLA Ppbd 12.7g max decomp	6.2	0.8
PLA Ppbd 12.7g 0% decomp	6.5	1.1
PLA Ppbd + 4.1g sleeve max decomp	7.9	2.5
PLA Ppbd +4.1g sleeve 0% decomp	8.3	2.9
Energy Use for 32-oz Cold Cups (10,000 average weight cups)		
EPS 8.8g	9.6	
LDPE Ppbd 19.8g max decomp	10.3	0.7
LDPE Ppbd 19.8g 0% decomp	10.8	1.2
Wax Ppbd 31.3g max decomp	18.6	9
Wax Ppbd 31.3g 0% decomp	19.5	9.9
PLA 35g 50% heavier than 32oz PP	17.5	7.9
PLA 32.6g 39% heavier than 32oz PP	16.2	6.6
Energy Use for 9-inch Plates (10,000 average weight plates)		
Heavy-Duty Plates		
GPPS 10.8g	8.4	
LDPE Ppbd 18.4g max decomp	10.3	1.9
LDPE Ppbd 18.4g 0% decomp	9.7	1.3
Mold Pulp 16.6g max decomp	10.9	2.5
Mold Pulp 16.6g 0% decomp	11.3	2.9
PLA 20.7g	10.4	2
Lightweight Plates		
2009 GPPS 4.7g	3.6	
2009 LDPE Ppbd 12.1g max decomp	6.1	2.5
Energy Use for Sandwich-size Clamshells (10,000 average weight clamshells)		
GPPS 4.8g	3.8	
Fluted Ppbd 10.2g max decomp	5.8	2
Fluted Ppbd 10.2g 0% decomp	6	2.2
PLA 23.3g	14.4	10.6

Notes:
Net expended energy = total energy requirements - energy recovery - energy content of landfilled material
[1]: Franklin Associates, "Life Cycle Inventory of Foam Polystyrene, Paper-Based, and PLA Foodservice Products", 4 February 2011.
[2]: [1] - Equivalent Polystyrene Product Energy Use in [1]

Table A-2: Water Use Comparison for Polystyrene Foodservice Product Alternatives

Product	Gallons	Net vs. Polystyrene
	[1]	[2]
Water Consumption for 16-oz Hot Cups (gallons per 10,000 average weight cups)		
EPS 4.7g	4,748	
LDPE Ppbd 13.3g	6,152	1,404
LDPE Ppbd + 4.1g sleeve	8,095	3,347
PLA Ppbd 12.7g	6,348	1,600
PLA Ppbd + 4.1g sleeve	8,291	3,543
Water Consumption for 32-oz Cold Cups (gallons per 10,000 average weight cups)		
EPS 8.8g	8,441	
LDPE Ppbd 19.8g	9,278	837
Wax Ppbd 31.3g	17,271	8,830
PLA 35g 50% heavier than 32oz PP	23,994	15,553
PLA 32.6g 39% heavier than 32oz PP	22,217	13,776
Water Consumption for 9-inch Plates (gallons per 10,000 average weight plates)		
Heavy-Duty Plates		
GPPS 10.8g	7,466	
LDPE Ppbd 18.4g	8,898	1,432
Mold Pulp 16.6g	9,017	1,551
PLA 20.7g	14,208	6,742
Water Consumption for Sandwich-size Clamshells (gallons per 10,000 average weight clamshells)		
GPPS 4.8g	3,873	
Fluted Ppbd 10.2g	4,951	1,078
PLA 23.3g	15,996	12,123

Notes:

[1]: Franklin Associates, "Life Cycle Inventory of Foam Polystyrene, Paper-Based, and PLA Foodservice Products", 4 February 2011.

[2]: [1] - Equivalent Polystyrene Product Water Consumption in [1]

Table A-3: Greenhouse Gas Emissions Comparison for Polystyrene Foodservice Product Alternatives

Product	Pounds CO2 Equivalents	Net vs. Polystyrene
	[1]	[2]
Greenhouse Gas Emissions for 16-oz Hot Cups (lb CO2 eq per 10,000 average weight cups)		
EPS 4.7g	723	
LDPE Ppbd 13.3g max decomp	987	264
LDPE Ppbd 13.3g 0% decomp	147	-576
LDPE Ppbd + 4.1g sleeve max decomp	1,215	492
LDPE Ppbd + 4.1g sleeve 0% decomp	186	-537
PLA Ppbd 12.7g max decomp	916	193
PLA Ppbd 12.7g 0% decomp	92	-631
PLA Ppbd + 4.1g sleeve max decomp	1,144	421
PLA Ppbd +4.1g sleeve 0% decomp	131	-592
Greenhouse Gas Emissions for 32-oz Cold Cups (lb CO2 eq per 10,000 average weight cups)		
EPS 8.8g	1,309	
LDPE Ppbd 19.8g max decomp	1,555	246
LDPE Ppbd 19.8g 0% decomp	143	-1,166
Wax Ppbd 31.3g max decomp	2,802	1,493
Wax Ppbd 31.3g 0% decomp	185	-1,124
PLA 35g 50% heavier than 32oz PP	1,419	110
PLA 32.6g 39% heavier than 32oz PP	1,314	5
Greenhouse Gas Emissions for 9-inch Plates (lb CO2 eq per 10,000 average weight plates)		
Heavy-Duty Plates		
GPPS 10.8g	1,142	
LDPE Ppbd 18.4g max decomp	1,406	264
LDPE Ppbd 18.4g 0% decomp	206	-936
Mold Pulp 16.6g max decomp	1,712	570
Mold Pulp 16.6g 0% decomp	532	-610
PLA 20.7g	840	-302
Lightweight Plates		
2009 GPPS 4.7g	497	
2009 LDPE Ppbd 12.1g max decomp	927	430
Greenhouse Gas Emissions for Sandwich-size Clamshells (lb CO2 eq per 10,000 average weight clamshells)		
GPPS 4.8g	529	
Fluted Ppbd 10.2g max decomp	681	152
Fluted Ppbd 10.2g 0% decomp	216	-313
PLA 23.3g	1,492	963

Notes:

[1]: Franklin Associates, "Life Cycle Inventory of Foam Polystyrene, Paper-Based, and PLA Foodservice Products", 4 February 2011.

[2]: [1] - Equivalent Polystyrene Product Emissions in [1]

References

CalRecycle, "Waste Reduction Awards Program Winners". Accessed 24 June 2011. <http://www.calrecycle.ca.gov/WRAP/search.asp?VW=APP&BIZID=5848&YEAR=2010&CNTY=>

Courtney Arthur, Joel Baker, and Holly Bamford, editors, "Proceedings of the International Research Workshop on the Occurance, Effects, and Fate of Mircroplastic Marine Debris," Department of Commerce, National Oceanic and Atmospheric Administration, Technical Memorandum NOS-OR&R-30, January, 2009.

DieselNet, "California Fleet Average GHG Emission Standards". Accessed 24 June 2011. <http://www.dieselnet.com/standards/us/ca_ghg.php>

Energy Information Administration, "Household Energy Consumption by Census Region, Selected Years, 1978-2005." Accessed 24 June 2011. <http://www.eia.gov/totalenergy/data/annual/txt/ptb0204.html>

Environmental Resources Planning, LLC. "The Contribution of Polystyrene Foam Food Service Products to Litter." Final Report, May 2012.

Franklin Associates, "Life Cycle Inventory of Foam Polystyrene, Paper-based, and PLA Foodservice Products." Prepared for The Plastic Foodservice Packaging Group, 4 February 2011.

Herrera Environmental Consultants, "Alternatives to Disposable Shopping Bags and Food Service Items: Volume 1." Prepared for Seattle Public Utilities, 29 January 2008.

Integrated Solid Waste Management Board, "Use and Disposal of Polystyrene in California, A Report to the California Legislature," December 2004

Midatlantic Solid Waste Consultants, 2009 National Visible Litter Survey and Litter Cost Study, prepared for Keep America Beautiful, Final Report, September 18, 2009.

Reich, Michael. "Increasing the Minimum Wage in San Jose: Benefits and Costs." Center on Wage and Employment Dynamics, University of California, Berkeley. October 2012.

South Bay Chapter of Surfrider Foundation, Waste Characterization Study 2011.

State of California Integrated Waste Management Board, “Plastics White Paper: Optimizing Plastics Use, Recycling, and Disposal in California.” May 2003.

“The City of San Francisco Streets Litter Audit.” Prepared for the City and County of San Francisco Department of Environment by HDR, Brown Vence & Associates, and MGM Management, June 2007. P. 27. The survey was completed in April 2007, the ban went into effect on June 1, 2007.

United States Geological Survey, “Estimated Use of Water in the United States in 2005.” Accessed 24 June 2011. <http://ga.water.usgs.gov/edu/wateruse/pdf/wudomestic-2005.pdf>

U.S. Census Bureau, *2007 Survey of Business Owners.* “Statistics for All U.S. Firms by Geographic Area, Industry, Gender, Ethnicity, and Race: 2007.” Accessed at http://factfinder2.census.gov.

U.S. Environmental Protection Agency, "Fact Flash" <http://www.epa.gov/superfund/students/clas_act/haz-ed/ff06.pdf>

Author Bios

Mark Berkman

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University of Pennsylvania, Wharton School, Ph.D. in Public Policy Analysis; Harvard University, M.A. in Planning, Policy Analysis and Administration; George Washington University, B.A. in Economics and Urban Affairs

Biography

Dr. Mark Berkman is an expert in applied microeconomics. His experience spans the areas of the environment, energy, and natural resources; environmental health and safety; labor and employment; intellectual property; antitrust; commercial litigation and damages; and public finance. He has assisted both public and private clients and provided testimony before state and federal courts, arbitration panels, regulatory bodies, and legislatures.

His environmental work has involved the review of proposed air, water, solid waste, and worker and product safety regulations. Dr. Berkman has quantified the costs and benefits of these regulations, as well as toxic tort and product liability claims. In addition, he has valued natural and water resources as well as property damages associated with pollution from Superfund sites, landfills, and power plants.

His work on energy matters includes the valuation of coal resources, power plants, and transmission rights-of-way. He has also prepared energy demand and price forecasts. He has extensive experience working with Native American tribes on energy valuation matters.

Clients in a variety of industries ranging from computer chip to shoe manufacturers have sought Dr. Berkman's assistance to value patents, trade secrets, and trademarks. He has also been called on to address questions of market power in a variety of industries including solid waste, computer manufacturing, and medical devices. He has testified regarding market definition and market power and participated in Hart-Scott-Rodino proceedings.

Dr. Berkman also has substantial experience in labor and discrimination litigation. He has conducted statistical analyses of alleged discrimination in hiring, promotion, pay, and contracting, and completed damage analyses regarding these allegations. He has also conducted statistical analyses regarding mortgage lending discrimination.

Prior to joining *Brattle* he was a co-founder and director at Berkeley Economic Consulting and a vice president at both Charles River Associates and NERA Economic Consulting.

David Sunding

Education

University of California, Berkeley, Ph.D. in Agricultural and Resource Economics; University of California, Los Angeles, M.A. in African Area Studies; Claremont McKenna College, B.A. in Economics

Biography

Dr. David Sunding has extensive experience as a researcher, consultant, and expert witness in matters related to natural resources, environmental quality, energy, and the economics of regulation. His expertise includes experience in complex litigation, regulation, and transactions. He has testified in state and federal courts and in regulatory proceedings around the country.

He has assisted corporations, utilities, and government agencies in developing economic testimony in a variety of matters concerning environmental damages, product liability, risk assessment, resource planning, cost allocation, and project financing. Dr. Sunding has played a central role in several prominent water resource matters, including the landmark Quantification Settlement Agreement for the Colorado River, interstate water disputes before the U.S. Supreme Court, and the Federal Energy Regulatory Commission's relicensing of hydropower facilities. He has authored several widely cited studies on the economics of water quality regulation and has served as an expert in cases involving regulation and litigation under the Clean Water Act, the Endangered Species Act, and other statutes.

Dr. Sunding is the Thomas J. Graff Professor in the College of Natural Resources at UC Berkeley, where he is also the co-director of the Berkeley Water Center. He has received numerous awards for his research, including grants from the National Science Foundation, the U.S. Environmental Protection Agency, and private foundations. He is currently a Visiting Professor in the Woods Institute of the Environment at Stanford University.

Prior to joining *The Brattle Group*, Dr. Sunding was a founding director of Berkeley Economic Consulting. Previously, he was a senior consultant at Charles River Associates and NERA. He served as a senior economist for President Clinton's Council of Economic Advisers, and is a member of the American Economic Association, the Association of Environmental and Resource Economists, the Econometric Society, and the American Law and Economics Association.

EXHIBIT 11

COMMENTS ON AMENDMENTS TO STATEWIDE WATER QUALITY CONTROL PLANS TO CONTROL TRASH

Prepared by:

Dr. Angelique White

August 1, 2014

Comment on Proposed Bans of Consumer Plastic Relevant to Ocean Protection

While there is no debate in the scientific community that plastic debris occurs on our coasts and oceans, there is however a broad misrepresentation of the scope of the problem in the media and more importantly a real scarcity of research examining the ecological consequences of various types of plastic debris in our oceans. Some of these myths and the corresponding realities are noted below, with emphasis on polystyrene foam which the California State Water Resources Control Board is considering encouraging local cities to ban in its draft “Amendments to Statewide Water Quality Control Plans to Control Trash”. The prevalence of plastic in the marine habitat is a reflection of growing human population and the increasing manufacturing of plastic goods, many of which are disposable. The ecological consequences of plastic however depend on the type and amount of plastic debris in the marine environment (i.e. will it lead to entanglement? will seabirds mistake it for food? it is toxic to living organisms?). These ecological consequences are poorly understood: A recent NOAA report [1] summarizes our state of knowledge as follows: “*very little research directly focusing on sources and levels of microplastics in the marine environment has been published, and even less published research addresses the impacts of microplastics on marine ecosystems*.”

That is not to say that we need to appreciate the full scope of the problem before taking action. The ecological impacts of plastic on our oceans are not solely related to plastic debris. Another less considered facet of plastic use and proposed bans are the carbon trade-offs that accompany product substitution. As a result of anthropogenic emissions, present-day CO_2 concentrations are higher than previously recorded in the past 800,000 years [2] and are expected to continue to increase in the near future. The ocean has partially mitigated this precipitous rise by absorbing nearly a third of the anthropogenic carbon added to the atmosphere [3, 4]. By removing CO_2, oceanic uptake has slowed the pace of human-induced climate change while creating another problem: a change in ocean carbonate chemistry and a decrease in ocean pH levels. The continued anthropogenic emissions of CO_2 alter the temperature, the pH, sea level, and the structure and function of our oceans [3] in far more profound ways than marine debris does currently. Efforts to protect our oceans should strongly consider carbon content and greenhouse gas emissions that would result from bans and resultant product substitutions. This concern is echoed in Appendix A in the June 2014 Draft Staff Report for Proposed Trash Amendments (pg. A-19) based on life cycle studies [5, 6] that indicate that a ban on polystyrene foam foodservice materials could result in significant increases of greenhouse gas emissions, use of non-renewable energy and waste generation.

Clearly, there is no such thing as environmentally responsible litter. However, policies such as bans that force a switch to alternative materials are likely to merely substitute one littered material for another. In the case of polystyrene foam, there is little to no existing data for deleterious impacts of this specific product on marine organisms; there is the likelihood that substituted products may have similar litter rates and more significantly, product substitutions may lead to enhanced greenhouse gas production that continue to threaten our ocean resources.

Myth 1: There is a massive swirling gyre of plastic, the “Great Pacific Garbage Patch”, between California and Japan that is twice the size of Texas

Reality: This statement refers to the study area not the area of plastic. The term ‘garbage patch’ was initially used to describe a region in the North Pacific where models of ocean circulation suggest that debris would tend to concentrate.

Myth 2: There are islands of plastic in the ocean

Reality: The concentration of plastic recovered from the surface ocean is highly variable, spanning orders of magnitude from 10 to a million pieces per square kilometer [7-12]. This translates to less than 10 pieces of plastic per cubic meter. Rather than a cohesive patch, the convergence zone of the Pacific and other ocean gyres contains a dilute soup of very small pieces of plastic than are largely invisible from the deck of a ship. To put the recorded concentrations of plastic into perspective, if you were to imagine 1000, 1-liter sized Nalgene™ bottles filled with ocean water, between 1 and 10 of these bottles would contain a single piece of plastic roughly the size of a worn down pencil eraser.

Myth 3: Plastic debris is growing in size with each passing year.

Reality: The evidence is mixed. Plastic concentrations are highly variable both in space and in time. There was no trend in plastic concentrations collected from the western North Atlantic Ocean and Caribbean Sea from 1986 to 2008, despite increases in land-based plastic production. In the Pacific, one study [7] found that the concentrations of plastic observed between 1999–2010 in the North Pacific subtropical gyre, were higher than samples collected between 1972–1987. These same authors found no change in plastic levels over time in the California Current or Eastern Tropical Pacific.

Myth 4: Foam is a major contributor to plastic debris in the open ocean.

Reality: Of the very few studies conducted to look at the composition of plastic in the marine environment, foam has never been found to be a primary contributor. In the South Pacific, in a 2011 expedition [13], foam was 0% of the recovered plastic debris. In the Atlantic, analysis of data collected between 1991-2007 found that foam was 0-15% of total plastic by abundance [14]. In the North Pacific, spectroscopic analysis of an assortment of plastic particles revealed that only 8% were polystyrene [15]**.** Rather, polyethylene and polypropylene fragments dominate the surface ocean debris field [15, 16]. Goldstein [16] speculates that polystyrene is a small component of ocean debris because of accelerated weathering. Similarly, Andrady [17] show that when consumer products were exposed to simulated weathering in air and seawater, expanded polystyrene foam was the only type of plastic to degrade faster in seawater than air.

Myth 4: Foam debris leads to death of marine life.

Reality: A variety of marine organisms become entangled in or ingest marine debris. Starvation, suffocation or infection can result from ingestion of trash; both ingestion and entanglement have been documented to cause mortality of marine life [18]. At present no available studies have specifically shown polystyrene foam to be either an entanglement or ingestion hazard in the marine environment.

Myth 5: Plastic debris is a major source of toxins to marine organisms

The weathering characteristics of primary microplastics, the release rate of component chemicals from plastic in seawater, the specificity of pollutant and plastic interactions, and the release of pollutants after ingestion is largely understudied. A recent NOAA report [1] concluded that "*it seems unlikely that the amount of microplastics in the marine environment is currently large enough to be an important geochemical reservoir for persistent organic pollutants…..At current levels in the open ocean, microplastics are unlikely to be an important global geochemical reservoir for historically released POPs such as PCB, dioxins, and DDT."* Gouin et al. [19] also estimate that plastic trash is not a significant vector of organic toxins as compared to more large scale processes such as atmospheric deposition and transport via ocean currents.

References

1. Arthur, C., J. Baker, and H. Bamford, *Proc. International Research Workshop on the occurrence, effects and fate of microplastic marine debris, 9-11 September 2008.* NOAA Technical Memorandum NOS-OR&R30., 2009.
2. Lüthi, D., et al., *High-resolution carbon dioxide concentration record 650,000–800,000 years before present.* Nature, 2008. **453**(7193): p. 379-382.
3. Doney, S., et al., *Ocean acidification: the other CO_2 problem.* Annual Review of Marine Science, 2009. **1**: p. 169-192.
4. Sabine, C., et al., *The oceanic sink for anthropogenic CO_2.* Science, 2004. **305**(5682): p. 367.
5. Quay, B.H., et al., *Life Cycle Inventory of Polystyrene Foam, Bleached Paperboard and Corrugated Paper Foodservice Products,Franklin Associates LTD*, 2006.
6. Hocking, M.B., *Is Paper Better Than Plastic?* Science, 1991. **251**: p. 504-505.
7. Goldstein, M.C., M. Rosenberg, and L. Cheng, *Increased oceanic microplastic debris enhances oviposition in an endemic pelagic insect.* Biology Letters, 2012. **8**(5): p. 817-820.

8. Day, R.H. and D.G. Shaw, *Patterns in the abundance of pelagic plastic and tar in the North Pacific Ocean, 1976–1985.* Marine Pollution Bulletin, 1987. **18**(6): p. 311-316.
9. Day, R.H., D.G. Shaw, and S.E. Ignell, *The quantitative distribution and characteristics of neuston plastic in the North Pacific Ocean, 1985-88.* NOAA Technical Memorandum, 1990(154).
10. Moore, C.J., et al., *A comparison of plastic and plankton in the North Pacific central gyre.* Marine Pollution Bulletin, 2001. **42**(12): p. 1297-1300.
11. Yamashita, R. and A. Tanimura, *Floating plastic in the Kuroshio current area, western North Pacific Ocean.* Marine Pollution Bulletin, 2007. **54**(4): p. 485-488.
12. *Natural Research Council (NRC) Committee on the Effectiveness of International and National Measures to Prevent and Reduce Marine Debris and Its Impacts. Tackling Marine Debris in the 21st Century*, in *National Academies Press*2008: Washington DC.
13. Eriksen, M., et al., *Plastic pollution in the South Pacific subtropical gyre.* Marine pollution bulletin, 2013.
14. Morét-Ferguson, S., et al., *The size, mass, and composition of plastic debris in the western North Atlantic Ocean.* Marine Pollution Bulletin, 2010. **60**(10): p. 1873-1878.
15. Carson, H.S., et al., *The plastic-associated microorganisms of the North Pacific Gyre.* Marine Pollution Bulletin, 2013. **75**(1-2): p. 126-132.
16. Goldstein, M.C., *Abundance and ecological implications of microplastic debris in the North Pacific Subtropical Gyre*, 2012.
17. Andrady, A., *Environmental degradation of plastics under land and marine exposure conditions.* Proceedings of the Second International Conference on Marine Debris, United States Dept. of Commerce, Honolulu, Hawaii, 1989.
18. Hammer, J., M.H. Kraak, and J.R. Parsons, *Plastics in the Marine Environment: The Dark Side of a Modern Gift.* Reviews of environmental contamination and toxicology, 2012: p. 1-44.
19. Gouin, T., et al., *A thermodynamic approach for assessing the environmental exposure of chemicals absorbed to microplastic.* Environmental science & technology, 2011. **45**(4): p. 1466-1472.

This document prepared by Angelicque White, PhD for DART Container Corporation.

GENERAL INFORMATION

Born:	December 16, 1974
Nationality:	US Citizen
Current Position:	Assistant Professor - Oregon State University
Contact Information:	College of Oceanic & Atmospheric Sciences Oregon State University 104 COAS Admin Bldg Corvallis, OR 97331-5503 Phone: (541) 737-6397 Fax: (541) 737-2064 Email: awhite@coas.oregonstate.edu

RESEARCH INTERESTS

Phytoplankton physiology, nitrogen fixation, phosphorus cycling, elemental stoichiometry, hyperspectral absorbance, attenuation and fluorescence, harmful algal blooms, numerical approaches to modeling phytoplankton-mediated processes and utilization of remote sensing tools to explore habitat variability

EDUCATION

Ph.D. Biological Oceanography, Oregon State University, Corvallis, OR. 2001-2006
Advisors: Dr. Ricardo Letelier and Dr. Yvette Spitz

M.S. Biology, University of Alabama in Huntsville, Huntsville, AL. 1999-2001
Advisors: Dr. Ronald Ritschard and Dr. Richard McNider

B.S. Biology, University of Alabama in Huntsville, Huntsville, AL. 1994-1998

ACADEMIC POSITIONS

Assistant Professor, Oregon State University, Corvallis, OR 2009-present
Postdoctoral Research Associate, Oregon State University, Corvallis, OR 2006-2009

FELLOWSHIPS, GRANTS, HONORS, SOCIETIES

National HAB Committee – Elected Member	2014-2016
Interagency Carbon Cycle Scientific Steering Group – Member	2014
Alfred P. Sloan Research Fellowship	2012
National Academy of Science Kavli Fellow	2010
OSU Distinguished Dissertation Award	2007
Agouron Summer Microbiology Course Participant	2006
AGU Outstanding Student Presentation Award	2006
NASA Earth System Science Fellowship	2005-2006

FELLOWSHIPS, GRANTS, HONORS, SOCIETIES (CONTINUED)

Yerex Graduate Fellowship, First Alternate (OSU)	2005
NASA Space Grant (OSU)	2001-2003
Thomas James Dimopoullos Environmental Fellowship (UAH)	2000-2001
American Society of Limnology and Oceanography, member	2004-present
American Geophysical Union, member	2005-present

RESEARCH FUNDING

FUNDED PROPOSALS

"Development and Validation of Satellite Bloom Detection Products for Coastal Oregon", NOAA CIOSS, 4/1/12-3/31/2014, $118,623, PI: White (OSU)

"Taxon-Specific variability of organic matter production and remineralization potential", NSF, 07/10 – 08/14, $413,035. PIs: White (OSU), Paytan (UCSC)

"Primary Productivity as a Function of Absorption, Pigment-based Phytoplankton Diversity and Particle Size Distributions.", NASA, 7/10-6/14, $353,225, PI: White (OSU)

"Center for Microbial Oceanography: Research and Education", NSF, 06/10-05/15, $686,279, PIs: Karl (UH, lead institution); Letelier, White (OSU), et al.

"MERHAB 2007: Integrated HAB Monitoring and Event Response for Coastal Oregon Sponsoring Agency", NOAA MERHAB , 08/07-07/13, $2,861,021, PIs: White (OSU), Wood (UO), Peterson (NOAA), Hunter (ODFW)

"Primary productivity in the Ross Sea: Subcontract through Rutgers", NSF, 6/10- 12/12, $219,777. PIs: Milligan and White (OSU)

PUBLICATIONS

REFEREED ARTICLES

33. McKibben, S.M., K. Watkins-Brandt, S.M. McKibben, M. Wood, M. Hunter, Z. Forster, X. Du, and W. T. Peterson, and A.E. White (2014) Environmental regulation of HAB formation along the Oregon Coast. *Submitted to Harmful Algae*

32. Gradoville, M.R., A. E. White and R.M. Letelier (2014) Physiological effects of enhanced carbon dioxide on high density *Crocosphaera* cultures. *Submitted to PlosOne.*

31. Barone, B., M.J. Church, D.M. Karl, R.M. Letelier and A. E. White (2014) Particle distributions and dynamics from laser diffraction in the North Pacific Subtropical Gyre. *Submitted to Limnology and Oceanography.*

30. Carini, P. A.E. White, E.O. Campbell and S. Giovanonni (2014) Aerobic methanogenesis by phosphate-starved SAR11 chemoheterotrophic marine bacteria. *Nature Communications* **5:** doi:10.1038/ncomms5346.

29. White, A.E., K. Watkins-Brandt, S.M. McKibben, M. Wood, M. Hunter, X. Du, and W. T. Peterson (2014) Persistent blooms of *Akashiwo sanguinea* along the Oregon-Washington coastal margin in 2009. *Harmful Algae* **37**: 38-46**.** doi: 10.1016/j.hal.2014.05.004.

28. Muller-Karger, F. E., M. Kavanaugh, E. Montes, W. M. Balch, M. Breitbart1, F. P. Chavez, S. C. Doney, E. M. Johns, R. M. Letelier, M. W. Lomas, H. M. Sosik, A. E. White (2014). Urgent Need for Creating A Coastal Marine Biodiversity Observing Network (MBON) to Establish Baselines and Monitor Changing Seascapes. *Oceanography* **27(2):** 18-23.

27. Puigcorbe, V., C. Benitez-Nelson, P. Masque, E. Verdeny, A. E. White, B.N. Popp and F. G. Prahl (2014) Summertime carbon and nutrient export in the Gulf of California and the Eastern Tropical North Pacific. *In review: Marine Chemistry.*

26. Burkhardt, B., K. S. Watkins-Brandt, D. Defforey, A. Paytan and A. E. White (2014) Remineralization of phytoplankton-derived organic matter by natural populations of heterotrophic bacteria. *Marine Chemistry* **162:** doi: 10.3389/fmicb.2013.00105.

25. Gradoville, M.R., A. E. White, D. Böttjer. M.J. Church and R.M. Letelier (2014) Diversity trumps acidification: No carbon dioxide enhancement of *Trichodesmium* community nitrogen or carbon fixation at Station ALOHA. *Limnology and Oceanography* **59(3)**: 645-659.

24. Wolhowe, Matthew D., Fredrick G. Prahl, Angelicque E. White, Brian N. Popp, and Anaid Rosas Navarro (2014) A biomarker perspective on coccolithophorid growth and export in a stratified sea. *Progress in Oceanography* **122**: 65-76.

23. Kavanaugh. M.T., B. Hales, M. Saraceno, Y. H. Spitz, A. E. White, R.M. Letelier (2014) Hierarchical and dynamic seascapes: A quantitative framework for scaling pelagic biogeochemistry and ecology. *Progress in Oceanography.* **120**, 291-304.

22. White, A.E. and S. Dyhrman (2013) The marine phosphorus cycle. *Frontiers in Microbiology,* **4** doi: 10.3389/fmicb.2013.00105

21. White, A. E., R. Foster, C. Benitez-Nelson, B.N. Popp, P. Masque, E. Verdeny and F. G. Prahl (2013) Nitrogen fixation in the Gulf of California and the Eastern Tropical North Pacific. *Progress in Oceanography,* **109**, 1-17.

20. McKibben, S.M., P.G. Strutton, D.G. Foley, T.D. Peterson, and A.E. White (2012) Satellite-Based Detection and Monitoring of Phytoplankton Blooms along the Oregon Coast. *Journal of Geophysical Research,* **117**:C12, C12002

19. White, A.E. (2012) The trouble with the bubble. *Nature,* **488**, 291.

18. White, A. E., K. Watkins-Brandt, M. A. Engle, B. Burkhardt, and A. Paytan (2012) Characterization of the rate and temperature sensitivities of bacterial remineralization of dissolved organic phosphorus by natural populations. *Frontiers in Microbiology,* **3** doi: 10.3389/fmicb.2012.00276

17. Luo, Y., et al. (2012). Database of Diazotrophic Abundance, Biomass and Nitrogen Fixation Rates in Global Ocean. *Earth System Science Data,* **5**, 47-106.

16. White, A. E., K. Björkman, E. Grabowski, R. M. Letelier, S. Poulos, B. Watkins, and D. M. Karl (2011) Reply: Challenges remain in the engineering of wave pumps for long term deployment in the open ocean. *Journal of Oceanic and Atmospheric Technology.* **28:** 850-851.

15. Hixon, M., Gregory, S. Robinson, W.D., Baker, S, Batchelder, H., Epps, C. Garcia, T.S., Haig, S. Letelier, R., Lytle, D., Menge, B., Miller, J., Noakes, D. Peterson, W. Rice, J., Rumrill, S., Schreck, C., Suryan, R., Systma, M. and White, A. (2010) Oregon's Fish and Wildlife in a Changing Climate. In: Oregon Climate Change Research Institute, The Oregon Climate Assessment Report K.D. Dello and P.W. Mote (eds). College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, Oregon.

14. Watkins-Brandt, K., R. M. Letelier, Y. H. Spitz, M. Church, D. Bottjer and A. E. White. (2010) Enhancement of nitrogen fixation in the oligotrophic North Pacific via inorganic and organic phosphorus additions. *Marine Ecology Progress Series.* **432:** 17-29.

13. White, A. E., D. M. Karl, K. Björkman, L. J. Beversdorf, and R. M. Letelier (2010) Production of organic matter by *Trichodesmium* IMS101 as a function of phosphorus source. *Limnology and Oceanography.* **55:** 1755-176**7.**

12. Beversdorf, L. J., A. E. White, K. Björkman, R. M. Letelier, and D. M. Karl (2010) Phosphonate metabolism by *Trichodesmium* IMS101 and the production of greenhouse gases. *Limnology and Oceanography.* **55:** 1768-1778.

11. Moisander, P.H., R. A. Beinart , I. Hewson, A.E. White, K. S. Johnson, C. A. Carlson, J. P. Montoya and J. P. Zehr (2010) Unicellular cyanobacterial distributions broaden the oceanic N_2 fixation domain. *Science.* **327:** 1512-1514**.**

10. White, A. E., K. Björkman, E. Grabowski, R. M. Letelier, S. Poulos, B. Watkins, and D. M. Karl (2010) An Open Ocean Trial of Controlled Upwelling Using Wave Pump Technology. *Journal of Oceanic and Atmospheric Technology*. **27:** 385-396**.**

9. White, A. E. (2009) New Insights into bacterial acquisition of phosphorus in the surface ocean*.* *Proceedings of the National Academy of Sciences.* **106:** 21013–21014.

8. Hewson, I., R. S. Poretsky, S. T. Dyhrman, B. Zielinski, A. E. White, H. J. Tripp, J. P. Montoya, and J. P. Zehr (2009) Microbial community gene expression within colonies of the diazotroph, *Trichodesmium*, from the Southwest Pacific Ocean. *The International Society for Microbial Ecology Journal*, **3**: 1286–1300.

7. Hewson, I., R. S. Poretsky, R. A. Beinart, A. E. White, T. Shi, S.R. Bench, P. H. Moisander, R. W. Paerl, H. J. Tripp, J. P. Montoya, M. A. Moran, and J. P. Zehr (2009) In situ transcriptomic analysis of the globally important keystone N_2-fixing taxon *Crocosphaera watsonii*. *The International Society for Microbial Ecology Journal*, **4**: doi: 10.1038/ismej.2009.8

6. White, A. E., Y. H. Spitz, and R. M. Letelier (2007) What factors are driving summer phytoplankton blooms in the North Pacific Subtropical Gyre? *Journal of Geophysical Research-Oceans*, **112**: C12006, doi: 10.1029/2007JC004129.

5. White, A. E., F. G. Prahl, R. M. Letelier, and B. N. Popp (2007) Summer in the Gulf of California: prime habitat for biological N_2 fixation. *Global Biogeochemical Cycles*, **21:** 10.1029/2006GB002779.

4. White, A. E., Y. H. Spitz, and R. M. Letelier (2006) A numerical model of carbohydrate ballasting for *Trichodesmium* spp. at Station ALOHA. *Marine Ecology Progress Series,* **323:** 35-45.

3. White, A. E., Y. H. Spitz, D. M. Karl, and R. M. Letelier (2006) Flexible elemental stoichiometry in *Trichodesmium* spp. and its ecological implications. *Limnology and Oceanography*, **51:** 1777-1790.

2. White, A. E. (2006) Phosphorus physiology and environmental forcing of oceanic cyanobacteria, primarily *Trichodesmium* spp., Oregon State University, Ph.D. Dissertation.

1. White, A. E. (2001) A numerical model of primary productivity and dissolved oxygen dynamics in Mobile Bay. University of Alabama in Huntsville, Master's Thesis.

SELECTED PROFESSIONAL PRESENTATIONS

White, A. E.; Milligan, A.; Kustka, A. (2014) Primary Productivity in the Ross Sea: Results from ^{14}C tracer measurements and models based on continuous flow thru data. Ocean Sciences Meeting, Honolulu, Hawaii, February, 2014

White, A.E., J.P. Zehr, D. Bombar, and D.M. Karl. (2013) Diazotrophy in the South Pacific: Reconciling Habitat, Nitrogen Fixation Rates and Metrics of Diazotrophic Abundance and Diversity. Ocean Sciences Meeting, New Orleans, LA, February 2013 (oral presentation).

White, A.E., A.L. Whitmire, R.M. Letelier, M. T. Kavanaugh, and M.J. Church. (2012) Time-series analyses of primary productivity as a function of absorption, pigment-based phytoplankton diversity and particle size distributions. Ocean Sciences Meeting, Salt Lake City, UT, February 2012 (oral presentation).

White, A.E. et al. (2011) The rise of *Pseudo-nitzchia* concentrations in the coastal Oregon surfzone and the role of coastal upwelling as a control on the severity and extent of domoic acid events. U.S. Harmful Algal Bloom Symposium, Austin, TX, Nov. 2011.

White, A.E. et al. (2011) Primary Productivity as a Function of Absorption, Pigment Based Phytoplankton Diversity And Particle Size Distributions. NASA Carbon Cycle & Ecosystems Workshop. Washington D.C. (October 2011)

White, A.E. et al. (2010) Elemental Stoichiometry of Organic Matter Production by *Trichodesmium* IMS101 as a Function of Phosphorus Source with Emphasis on

Phosphonate Utilization and the Production of Greenhouse Gases. Ocean Sciences Meeting, Portland, OR, February 2010 (oral presentation).

White, A.E. et al. (2010) *Invited:* Nitrogen Fixation in the Gulf of California and the Eastern Tropical North Pacific: Interannual Variability of Diazotrophic Productivity, Community Composition and Potentially Limiting Factors. Ocean Sciences Meeting, Portland, OR, February 2010 (oral presentation).

White, A.E. (2009) Invited Speaker, Salem Progressive Film Series showing of Addicted to Plastic. Salem, Oregon, March 2009.

White, A. E., K. Björkman, E. Grabowski, R. M. Letelier, S. Poulos, B. Watkins and D. M. Karl (2008) Assessing the Feasibility and Risks of Using Wave-Driven Upwelling to Enhance the Biological Sequestration of Carbon in Open Oceans. American Geophysical Union Fall Meeting, San Francisco, CA, December 2008 (oral presentation).

White, A., Spitz, Y., Zehr, J., Björkman, K., Karl, D. and Letelier, R. (2008) Physical and Chemical Forcing of Diazotrophic Biomass along a transect from 23^{o}S to 24.75^{o}N, ASLO Annual Meeting, Orlando, Fl, Mar 2008 (oral presentation).

TEACHING EXPERIENCE

OC407H Oceans, Coasts, and People (Winter 2013-2014, OSU)
OC521 Applications in Ocean Ecology and Biogeochemistry, (Spring 2012-2014, OSU)
Agouron Course in Microbiology, Invited Instructor (May 2012, University of Hawaii)
Invited Speaker, Ecology and Evolution Seminar (Winter 2012, OSU)
Hands-on workshops in Ocean Optics, Saturday Academy Summer Conference (2011,2012, 2013 OSU)
Guest lecturer, Satellite Oceanography (OC 678, Fall 2010, OSU)
Faculty, COSEE Pacific Partnership Summer Workshop for Community College Instructors, Newport, Oregon (2010)
Faculty, Oregon Coastal and Aquatic Marine Science Teachers Workshop (2010)
Teaching Assistant, Exploring the Deep (OC 103, spring 2005, OSU)
Teaching Assistant, Biological Oceanography (OC 540, winter 2003, OSU)
Oregon State University, College of Oceanic & Atmospheric Sciences

STUDENT MENTORING

Morgaine McKibben (OSU, PhD candidate)
Mary-Rose Gradoville (OSU, PhD candidate)
Brian Burkhardt (OSU, MS)
Katie Watkins (OSU, 2010 MS, co-advised by A. White, R. Letelier and Y. Spitz)
Morgan Engle (OSU, Saturday Academy high school intern)
Sara Ackers (OSU, IDES Program, Summer Intern)
Nathaniel Tilp (OSU, Saturday Academy high school intern)
Jin Kyoung Kwon (OSU, Saturday Academy high school intern)

ACTIVITIES, OUTREACH AND SERVICE

INVITED SEMINARS

Pacific Rim Shellfish Sanitation Conference	(2014)
Coastal Marine Resource Committee (OR-WA Joint meeting)	(2013)
University of Oregon	(2013)
University of Hawaii	(2011-2012)
Oregon Institute of Marine Biology	(2010)
Lamont Doherty Ocean Observatory	(2009)
Hatfield Marine Science Center	(2008)
University of California Santa Cruz	(2007)

CONFERENCES, WORKSHOPS

Invited speaker at the C-MORE PDOC Diversity Workshop, ASLO (Feb. 2014)

Participant in an international training workshop for spectroscopic characterization of organic matter in Granada, Spain (May 2010)

Session chair, Nitrogen Cycling Near Oxygen Minima Zones: Linking Observations to Global Models of Nitrogen Fixation in the Anthropocene, Ocean Sciences, Portland, Oregon (Feb. 2010)

Session convener, Phosphorus Cycling in Marine Systems: Biochemical, Genomic and Model Studies, Aquatic Sciences Meeting, San Juan, Puerto Rico (Feb. 2009)

Invited participant, Canadian Institute For Advanced Research (CIFAR) Panel Discussion of Nitrogen cycling in the Anthropocene (July 2009)

OUTREACH/PROFESSIONAL DEVELOPMENT

Journey into Leadership Program, OSU (2014)

Da Vinci Days Festival, Plankton in Art exhibit (2012)

Research highlights covered in Terra and Science360 (2011)

Press for marine plastics research (http://tinyurl.com/2byu667) covered by Earthsky.org, Coast to Coast AM, the Oregonian, Maclean's magazine (Canada), San Jose Mercury News, thebenshi.com, Willamette Week (newpaper, Portland, Oregon), KVAL (television interview with CBS affiliate), Discovery news, Oregon Business magazine, Hawaii Public Radio, Oregon Public Radio and numerous other blogs, print, web and radio that picked up this press release (2011)

Oregon Coastal and Aquatic Marine Science Teachers Workshop (2010)

Saturday Academy Mentor (2010, 2011)

Saturday Academy Summer Workshops (2011, 2012)

SMILE Program High School Challenge Event, Speaker (2011, 2012)

COSEE Pacific Partnership Summer Workshop Faculty, Newport, Oregon (2010)

Participation in Oregon State University Discovery Days (2008, 2009)

Expert Speaker: Salem Sustainability Film Series, "Addicted to Plastic" (2009)

Generation of a web-based image gallery for the C-MORE (2009)

SERVICE

Editor for a special session of Frontiers in Microbiology:
The Oceanic Phosphorus Cycle (2012)

NOAA Global Climate Change Proposal Review Panelist (2009)

OSU Committees: Radiation Safety Committee (2009/2010), Instructional Programs Committee (2005/2006), Promotion and Tenure Committee (2004) and Student Advisory Committee (2005)

Reviewer for *Science, Nature, Aquatic Microbial Ecology, Marine Chemistry, Faculty of 1000, Ecosystems, Limnology and Oceanography, ICES Journal of Marine Science, Limnology and Oceanography: Methods, Marine Ecology Progress Series, Progress in Oceanography, Proceedings of the National Academy of Science, the Long-term Estuary Assessment Group, NOAA, and the National Science Foundation*

FIELD EXPERIENCE

Cruise	*Vessel*	*Year*	*Days at Sea*
State of Oregon RFP: Graduate Student Training	R/V Oceanus	2014	4
C-MORE PhOR-II	R/V Kilo Moana	2013	12
C-MORE HOE DYLAN VII	R/V Kilo Moana	2012	9
Mesocosm deployment off Hawaii, C-MORE BAG1	R/V KOK	2011	13
Hawaii Ocean Time-series 234	R/V Kilo Moana	2011	3
CO_2 control of N_2 fixation in the NPSG	R/V Kilo Moana	2011	6
MCDW and Iron in the Ross Sea	R/V NB Palmer	2011	31
BIG-RAPA, C-MORE	R/V Melville	2010	28
Harmful Algal Bloom Monitoring, Oregon Coast	R/V Elakha	2010	2
Hawaii Ocean Time-series 216	R/V KOK	2009	5
C-MORE ST-15B (NPSG)	R/V Kilo Moana	2009	2
Survey of Underwater Plastic and Ecosystem Response,	R/V Kilo Moana	2008	12
Ocean Productivity Perturbation EXperiment (OPPEX)	R/V Kilo Moana	2008	5
GoCAL-4,Nitrogen fixation in the Gulf of California	R/V New Horizon	2008	29
BLOOMER, C-MORE, NPSG	R/V Kilo Moana	2007	12
Biogeochemistry of the Upper ocean: Latitudinal	R/V Kilo Moana	2007	11
Nitrogen fixation in the South Pacific, NSF	R/V Kilo Moana	2007	17
GoCAL-3,Alkenone production in the Gulf of California	R/V New Horizon	2005	21
NSF Biocomplexity, Pacific Cruise MP09	R/V Revelle	2003	22
NSF Biocomplexity, NW Atlantic MP04	R/V Seward	2002	26
Photoheterotrophy at Station ALOHA, P-3	R/V Kilo Moana	2002	4
Coastal Ocean Advances in Shelf Transport, Oregon	R/V Thompson	2001	23
		TOTAL	**297 days**

EXHIBIT 12

GrassrootsLab

To the State Water Resources Control Board:

I attended the State Board's hearing on July 16 and have reviewed the materials distributed as part of the proposed Amendments to Statewide Water Quality Control Plans to Control Trash (Trash Amendments). Like others who testified at that hearing, I too support clean water and a comprehensive approach to removing trash and other contaminants from state waterways. As described further in my attached bio, in recent years I have worked closely with local governments on these very issues. In addition, I have years of experience working directly with local governments, including three years as the Executive Director the Los Angeles County Division of the League of California Cities.

Based on this experience and on my review of the Trash Amendments, it is my opinion that they will have the unfortunate effect of encouraging many cities to adopt product bans -- which have not been shown to reduce trash in the receiving waters -- instead of investing in proven, effective methods of trash control.

Indeed, that appears to be the intent of the draft Trash Amendments. Under the "Option for Board Consideration," MS4 permittees could obtain an extra year to comply with the Trash Amendments for each "regulatory source control" (which includes bans of a single-use consumer product) they adopt. Even if the State Board rejects this option, the Trash Amendments incentivize MS4 permittees to adopt bans by allowing permittees to claim such bans as trash-reduction methods under "Track 2" of the Trash Amendments. In other words, MS4 permittees could adopt bans, claim that the bans are reducing trash in the receiving waters, and therefore invest less in proven, effective measures that reduce trash in the receiving waters.

It is my opinion that this sets up incentives that will be impossible for many cities to resist. Bans impose costs on consumers, but they are relatively inexpensive for cities to adopt. And cities are under significant financial pressures. Already constrained in their ability to raise revenues for infrastructure, the state's local governments continue to reel from the loss of Redevelopment, mounting pension costs and the lingering effects of the economic downturn.

The cost of implementing proven, effective measures to reduce trash in the receiving waters can be very large. The State Board's own economic analysis estimates that the cost of implementing the Trash Amendments will be up to hundreds of millions of dollars a year over ten years.

And the Trash Amendments come on top of other unfunded mandates on cities. Regulations passed at the regional and state level compel cities to make substantial investments in infrastructure without any regard to the financing of these systems. As an example, the Los Angeles County Flood Control District has cited estimates the City of Pasadena expends more than $17 million annually on stormwater management, and has more than $642 million in projected costs. Some coastal cities, such as Torrance, have more than a $1 billion in estimated costs.[1]

In sum, cities are under large and ever-increasing financial pressures, and implementing proven, effective measures to reduce trash in the receiving waters can be very expensive. Further, cities face fines if they do not comply with stormwater requirements, including the Trash Amendments, if they are

[1] See Staff Report (pg 183-84), City of Commerce Council meeting.
http://www.ci.commerce.ca.us/archives/46/FullAgenda%20Dec182012_0630%20pm.pdf

adopted. Against this backdrop, the Trash Amendments offer cities an out: if cities adopt bans, they can get up to an additional three years to comply. Moreover, they can claim—against evidence that bans don't generally reduce overall trash, and simply substitute one product for another—the bans are part of their implementation under Track 2 of the Trash Amendments and thereby invest less in proven, effective trash-reduction measures.

It is my opinion that many cities will find it impossible to resist these incentives. By adopting bans under the Trash Amendments, cities can -- and will -- then defer investment in proven (though expensive) trash-reduction measures. I respectfully suggest that the State Board revise the Trash Amendments to eliminate this incentive and require investment in proven, effective trash-reduction measures.

Sincerely,

Robb Korinke

GrassrootsLab

Robb Korinke

BIO

Robb Korinke leads GrassrootsLab's client activities in Southern California, and specializes in state and local government, as well as open data and transparency issues. He served 3 years as the Executive Director of the Los Angeles League of Cities and has worked with local governments on key policy issues going back to Proposition 1A in 2004. He is also the Publishing Editor of CaliforniaCityNews.org, CaliforniaCountyNews.org and CaliforniaPropositions.org.

Korinke began his career on Capitol Hill with the Democratic Congressional Campaign Committee. Upon returning to California he worked legislative and local campaigns before signing on with the League of California Cities during their effort to pass Proposition 1A in 2004.

He has also consulted on infrastructure, finance and other policy issues to local governments across the state, including the cities of Agoura Hills, San Luis Obispo, Santa Ana, Goleta and worked specifically on Stormwater compliance with the Los Angeles County Flood Control District.

He is a graduate of the University of Southern California, where he studied English Literature and Public Policy. He lives in Long Beach, California.

EXHIBIT 13

Comments On Draft Amendments to Statewide Water Quality Control Plans to Control Trash

Prepared by:

Mark Grey, Ph.D.

August 1, 2014

I. INTRODUCTION AND PURPOSE

The Draft Amendments to Statewide Water Quality Control Plans to Control Trash (Draft Trash Control Amendment) would encourage permittees under municipal separate storm sewer system (MS4) permits to enact bans of single-use consumer products. The Draft Trash Control Amendment describes such bans as "regulatory source controls." MS4 permittees under Track 2 of the Draft Trash Control Amendment would be allowed to enact such bans, claim that the bans reduce trash in the receiving waters, and invest less in proven trash-reduction methods.

The purpose of this report is to briefly describe the shortcomings in Track 2 based on a review of relevant data. It is my conclusion that by allowing MS4 permittees to rely on bans to achieve compliance, Track 2 will undermine the State Water Board's objectives of reducing trash in the receiving waters. The data from polystyrene foam bans indicate that bans do not reduce trash in the receiving waters; they simply substitute non-banned types of trash for banned materials. And a Track 2 that allows and encourages bans will divert scarce municipal resources from trash-reduction approaches that have been demonstrated to be effective.

This report also describes how Track 2 could be revised to become an effective means of trash control:

- Track 2 should explicitly disallow MS4 permittees from relying on measures that the data show are ineffective to reduce trash in the receiving waters, including polystyrene foam bans.
- Track 2 should have a certification process for non-structural best management practices. Before MS4 permittees rely on such BMPs, the State Water Board should certify them as effective, based on substantial evidence developed in a public process with opportunity for comment.
- Track 2 should be revised to include adequate monitoring to determine that such non-structural BMPs are effective. Monitoring should be based on direct measurements in the storm drain system and receiving waters.

The findings and analysis presented here are based on a review of the Draft Trash Control Amendment and citations contained within the document. In addition, independently collected data on the performance of trash control and collection measures in and by California communities, and a review of data, where applicable and available, was performed.

II. TRACK 2 OF THE TRASH CONTROL AMENDMENT REQUIRES IMPROVEMENT TO MEET THE STATE WATER BOARD'S OBJECTIVE OF REMOVING LITTER AND TRASH FROM THE STORM DRAIN SYSTEM AND RECEIVING WATERS

Track 2 allows MS4 permittees to adopt regulatory source controls (i.e. product bans) and to claim that those product bans result in trash reductions in the receiving waters. But the available data show that bans do not reduce trash or litter, they simply result in the substitution of non-banned products for banned products. Track 2 repeats mistakes made by the San Francisco Bay Regional Water Quality Control Board in its implementation of the 2010 MS4 permit C.10 Trash Reduction Program. There, MS4 permittees have adopted bans and reported them in their long-term trash reduction plans, but have not produced evidence that they are effective in reducing trash in storm drains or the receiving waters.

If the municipalities and cities in California were to examine the effect of a polystyrene foam ban on litter reduction, they would see a substitution effect given the available data. I authored an independent report in 2013 analyzing the City of San Francisco's in-street litter audit data collected between 2007 and 2009 (Attachment 1). This report found that after the City enacted a ban of polystyrene foam in 2007, substitution of non-banned products occurred. And, that same report found that litter substitution occurred in Santa Cruz in 2008 after a polystyrene foam ban was enacted. The available data show that bans of polystyrene foam do not reduce trash in the receiving waters.

The data from the City of San Francisco show that cities in the Bay Area are relying on foam bans as measures that they assert reduce trash and help them meet their trash-reduction obligations under the MS4 permit. But a review of their long-term trash reduction plans show that the cities relying on bans have not taken measurements that would show whether bans reduce trash in the receiving waters.

For example, the City of San Jose's long-term trash reduction plan uses four indicators to determine progress made in reducing trash discharged from MS4s. One of the indicators is "successful levels of trash control measures implementation." As part of this, San Jose's long-term trash reduction plan proposes to evaluate the effectiveness of bans by "Annually tracking and reporting the percentage of businesses in compliance with the ordinance and the percentage requiring a response." (San Jose Long-Term Trash Reduction Plan, at pg. 73) This indicator measures the level of effort San Jose puts into a trash-reduction method that the data indicate is ineffective. It does not provide data that could be used to determine the effectiveness of a ban. A review of tracking methods by other cities in the Bay Area that have adopted bans shows that none of them collect data that would allow them to show that bans are effective in reducing overall trash (Attachment 2). Attachment 2 includes a review of the long-term trash reduction plans that MS4 permittees in the Bay Area submitted to the San Francisco Regional Board, and describes whether each permittee has adopted a foam ban and what monitoring they are doing to determine the effectiveness of such bans. None of the cities that have bans are measuring whether bans result in reductions of overall trash in the receiving waters.

Track 2 also appears to be inadequate in the monitoring that it requires. MS4 permittees enrolling under Track 2 are required to do some monitoring, including to prepare monitoring reports to address:

- Treatment controls, institutional controls, and multi-benefit projects the permittee has used
- Full capture systems installed
- The effectiveness of treatment controls, institutional controls, and multi-benefit projects used
- Has the amount of trash discharged from the MS4 decreased from the previous year, and by how much?
- Has the amount of trash in the receiving waters decreased from the previous year, and by how much?

What is unclear is whether the monitoring requires direct measurement of trash in the storm drains and receiving waters as the method of determining compliance with the proposed trash amendments. The example of the San Francisco Bay Area MS4 permittees is instructive. Under a credit scheme developed by the permittees, the permittees reported trash reductions. But the trash reductions were based on a paper accounting exercise instead of actual measurements in the storm drains and receiving waters. Track 2 as it is currently worded would appear to allow such a credit scheme. Similarly Track 2 does not appear to require monitoring sufficient to determine whether regulatory source controls that MS4 permittees adopt are effective. Instead, the trash amendments appear to assume that regulatory source controls (product bans) are effective and encourage MS4 permittees to implement them.

Contrast this approach with that of CalRecycle, which has a definition of "source control" that requires a demonstration that a ban results in a true reduction of waste and a net environmental benefit before they can be considered source control (14 CCR 18734.3).

Bans of polystyrene foam do not meet this definition of "source control." It should not be assumed that other product bans would reduce trash in the receiving waters and not exhibit a substitution effect. But the trash amendments make just that assumption by encouraging MS4 permittees to ban a variety of single-use consumer products.

III. WITH SOME MODIFICATIONS, TRACK 2 COULD BE AN EFFECTIVE MEANS OF TRASH CONTROL

As described below, with a few important modifications, Track 2 could be an effective means of trash control:

- Track 2 should explicitly disallow MS4 permittees from relying on measures that the data show are ineffective to reduce trash in the receiving waters, including polystyrene foam bans.
- Track 2 should have a certification process for non-structural best management practices. Before MS4 permittees rely on such BMPs, the StateWater Board should certify them as effective, based on substantial evidence developed in a public process with opportunity for comment.
- Track 2 should be revised to include adequate monitoring to determine that such non-structural BMPs are effective and that trash is being reduced in the receiving waters.

1. Track 2 should not allow MS4 permittees to rely on trash-reduction measures that the data show are ineffective.

As described above, the data indicate that bans of polystyrene foam do not reduce trash in the receiving waters. It is common sense that the Draft Trash Control Amendment and Track 2 should not encourage MS4 permittees to adopt measures that the data have shown are ineffective at reducing trash in the receiving waters. The Draft Trash Control Amendment should be modified so that MS4 permittees relying on Track 2 are prohibited from relying on measures, such as polystyrene foam bans, that the data show are ineffective.

2. Require a certification process for some Track 2 non-structural, institutional control elements.

The Draft Trash Control Amendment states for Track 2: "Develop and implement set of monitoring objectives that demonstrate mandated performance results, effectiveness of the selected combination of treatment and institutional controls, and compliance with the equivalency to Track 1."

This should be done before the State Water Board in an open, transparent public process that is informed by public comment. There is successful precedent for this approach: The use of a full capture system, prescribed in Track 1, is subject to certification processes such as the *Procedures and Requirements for Certification of a Best Management Practice for Trash Control as a Full Capture System* used by the Los Angeles Regional Water Quality Control Board. According to the Los Angeles Regional Board, "a full-capture system is any single device or series of devices that traps all particles retained by a 5-millimeter mesh screen (100 percent trash removal) and has a design treatment capacity of not less than the peak-flow rate resulting from a one-year, one-hour, storm in the subdrainage area" (Resolution No. 04-023).

Under a formal certification process for Track 2 institutional control practices, the State Water Board would accept specific proposals from dischargers in order to certify proposed Track 2 combinations of non-structural, institutional control measure as equivalent to Track 1 monitoring. Those proposals would conceivably include a detailed monitoring plan, with substantial evidence, which links the institutional actions taken with a quantifiable reduction in litter load. Unless and until various combinations of non-structural and institutional BMPs used under Track 2 are certified as effective, based on substantial evidence developed through a transparent, public process, cities should not be allowed to implement such BMPs under Track 2 and their programs deemed equivalent with Track 1.

3. **Require additional monitoring to show that MS4 permittees using Track 2 are reducing trash in the receiving waters.**

As described above, the monitoring requirements for Track 2 do not appear to require direct measurements of trash in the storm drains or receiving waters. It is unclear whether the intent of the Draft Trash Control Amendment is to allow a credit scheme similar to one used by MS4 permittees in the San Francisco Bay Area. The Track 2 monitoring should be amended to clarify that monitoring should be based by direct measurement in the storm drains and receiving waters.

IV. CONCLUSION

Littering and trash in California's waters is a serious problem. Structural BMPs are known to be effective for trash control when they are properly installed and maintained. And non-structural BMPs can be an important part of the solution. Unfortunately, by encouraging bans, which are known to be ineffective at reducing trash for products like polystyrene foam and are likely ineffective for other products as well, Track 2 of the Draft Trash Control Amendment is unlikely to meet the State Water Board's objectives or result in significant trash reduction. With the few important changes identified in this report, the Track 2 would be an effective means of trash reduction.

V. REFERENCES CITED

City of San Jose. 2014. Clean Waterways, Healthy City: Long-Term Trash Load Reduction Plan and Assessment Strategy.

Los Angeles Regional Water Quality Control Board. 2004. Procedures and Requirements for Certification of a Best Management Practice for Trash Control as a Full Capture System. Memo from Michael Yang, P.E. to Jonathan Bishop dated August 3, 2004.

Attachment 1

Proposed Polystyrene Foam Food Ware Ban in San Jose Will Not Reduce Trash Loads in Storm Drains and Receiving Waters

Prepared by:
Mark Grey, Ph.D.

August 2013

Presentation of Findings

I. SUMMARY STATEMENT

The City of San Jose's proposed ban of polystyrene foam food ware (PFF) used by restaurants and food vendors will not reduce litter or trash in waterways. Proponents of the ban have asserted that it will have water quality benefits. But this is speculation, unsupported by empirical evidence. Among the data gaps and scientific shortcomings in the proposed ban and the City's asserted justifications for the ban are as follows:

- As described in Exhibit 1 to this report, available data show that bans do not reduce overall litter or trash in water bodies. Rather, substitute products replace banned PFF and are equally likely to be littered and enter water bodies.

- The City of San Jose has not accurately quantified the amount of PFF in litter or in trash in water bodies. This is fundamental baseline data that the City would need before making any empirical claims about a ban.

- The City of San Jose has already implemented a partial ban of PFF, banning the use of PFF at City events. Though the City has claimed a 2% trash-reduction credit under the municipal stormwater permit for this partial ban, there is no evidence that it has reduced litter or trash in water bodies at all. This is further evidence that suggests that a broader ban will not reduce litter or trash in water bodies overall.

- City materials have tried to draw a parallel between the City's plastic-bag ban and a PFF ban. But there is an obvious logical gap in this comparison: there are readily available re-usable (non-disposable) substitutes for plastic bags, while there are not for PFF. Substitutes for PFF are equally likely to be littered and to enter water bodies as PFF. Thus, even if the City's plastic bag ban had been shown to reduce litter and trash overall (which it has not been), this does not support the conclusion that a PFF ban would similarly reduce litter and trash that enters water bodies.

- Effective trash reduction methods exist. In fact, the City of San Jose has had a number of measurable successes employing methods that are demonstrated to be effective in reducing trash in water bodies, including: hot-spot cleanups, the use of full capture devices, and other methods.

- Implementing a PFF ban is expensive, on the order of hundreds of thousands of dollars. By diverting limited municipal funds from proven trash-reduction techniques, adopting a PFF ban is likely to increase the amount of trash the enters water bodies.

II. THE CITY OF SAN JOSE LACKS RELIABLE BASELINE DATA

Valid, reliable baseline data is an essential prerequisite to any claim that a ban of PFF would reduce litter or trash in water bodies. But the City lacks this essential baseline data. Polystyrene foam includes a broad range of materials, one of which is PFF. In addition, only PFF used by food vendors for take-out food would be banned; consumers could still purchase PFF at stores in San Jose or elsewhere and use it in San Jose. Thus, to measure the effect of its proposed PFF ban on litter and on trash in receiving waters, the City would need baseline data on PFF that would actually be covered by the ban. More general information about the amount of polystyrene foam (as opposed to the narrow category of PFF covered by the ban) says nothing about the prevalence of PFF covered by the ban.

My review of available information indicates that PFF is not a significant component of litter (also referred to as trash) in the City of San Jose. Specifically, it is my opinion that the

City's staff reports (authored in 2010, 2011, and 2012)[1] overstate the presence of polystyrene foam (PF) and PFF in litter within the City, and data submitted by the City to the San Francisco Bay Regional Water Quality Control Board (Regional Board) between 2007 and 2012 do not consistently quantify the amount of PFF (or the fraction of PF that is PFF) that is littered in San Jose[2]. Data provided by the City in annual reports between 2007 and 2012, and data from other jurisdictions within the SCVURPPP[3] responsible for urban litter and storm drain management over this same time frame, show that PF has been identified as a component of the litter load on streets, in storm drains, and on water body shorelines, yet the specific types or sources of PF, such as PFF, are inconsistently reported. Even when reported, the amount (count or mass or volume) is not clearly quantified relative to other components of the litter stream.

Moreover, the presence, classification, and accounting of littered PF products in annual reports submitted by the City to the Regional Board have varied over time. In the 2007-2008 and 2008-2009 reporting periods, no PF littered products were identified as elements of litter within the City's storm drain system. Starting in 2009-2010, annual report data have inconsistently identified the type of PF encountered in litter cleanup activities and programs, using such terms as "Styrofoam" (2009-2010), "Polystyrene" (2010-2011), and "Styrofoam" and "Styrofoam (pieces or pellets)" (2011-2012). In other words, while the City has collected some data on the amount of polystyrene foam that is in the waste stream, this is a much larger category than PFF that would be covered by the ban. The City lacks any reliable baseline data on this more narrow category of PFF that would be covered by the ban.

City staff reports prepared for the Transportation and Environment Committee cite to information that they claim supports a PFF ban. However, as detailed below, none of the reports characterizes the component of the urban litter load that specifically consists of PFF and none of the information constitutes adequate baseline data. Even when litter is identified as some type of

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[1] City of San Jose Transportation and Environment Committee Staff Memorandum, November 20, 2012; January 21, 2011, April 16, 2010.

[2] City of San Jose Urban Runoff Management Plan Annual Reports (2007-2012). Submitted to San Francisco Bay Regional Water Quality Control Board.

[3] Santa Clara Valley Urban Runoff Pollution Prevention Program, Annual Reports submitted by City of San Jose, 2007 to 2012.

PF, the specific contribution of that total amount that can be attributed to PFF is generally unreported. And, several data references are made within City staff reports citing the relative contribution of PFF in litter derived from cleanup activities that cannot be verified.

i) Preliminary Baseline Trash Generation Rates for San Francisco Bay Area MS4s (February 2012)[4]

The BASMAA Preliminary Baseline Load Generation Report documents storm drain litter sampling results from portions of the Bay Area MS4 system for the time period of May through September 2011. Sampling done at 143 sites during two separate sampling events found that 6% and 7% of total trash collected (on an uncompressed volume basis) was some type of "Polystyrene Foam." The only distinction that was made among littered foam product types appears within the report text on pages 10 and 11, where "Polystyrene Foam" was identified, and again throughout Appendix C where foam is identified as "Styrofoam Food and Beverage Ware" in a table documenting the presence or absence and volume of foam (and other trash items) at the 143 sampling sites. Of 216 separate sampling events at the sites used in the baseline load generation report, 106 times (49%) the presence of "Styrofoam Food and Beverage Ware" was noted, while on 110 occasions (51%) no "Styrofoam Food and Beverage Ware" was collected. Packaging, packaging peanuts, and other types of PF product litter were not quantified. Inconsistencies and lack of rigor in documenting the specific PF litter types collected means that the BASMAA data cannot be used to draw definitive conclusions concerning the contribution of PFF to the overall litter load in the Bay Area.

ii) City of Santa Cruz River and Beach Litter Cleanup Data, 2007-2012[5]

The City cites data collected by the Santa Cruz NGO Save Our Shores for the proposition that polystyrene foam constituted approximately 12.7% of debris collected at beach cleanups. However, the data provided by Save Our Shores and cited by the City of San Jose in the

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[4] Bay Area Stormwater Management Agencies Association (BASMAA). 2012. Preliminary Baseline Trash Generation Rates for San Francisco Bay Area MS4s. Prepared for BASMAA by EOA, Inc., Oakland, CA.

[5] Save our Shores Litter Clean-up Program Data 2007 to 2012. Accessed from: http://www.saveourshores.org/what-we-do/cleanup-data.php

November 2012 staff report make no distinction between PF litter and PFF litter. Thus it does not provide baseline data for the fraction of PFF that would be covered by a ban.

As described in Exhibit 1, the Save Our Shores data and data from the City of San Francisco litter audits done between 2007 and 2009 demonstrate that bans do not reduce trash or litter overall, but simply result in non-banned products substituting for banned PFF. In addition, the San Francisco litter audits show that PFF is a very small fraction of litter overall, less than 2 %. Even this overstates the fraction of trash that constitutes PFF covered by a ban: a portion, perhaps a significant portion, of the PFF collected could have been purchased at grocery stores, COSCTO, or other outlets, which would not be affected by a ban.

iii) Caltrans Highway Litter Management Pilot Study, 2001[6]

This report was prepared by URS consultants for the California Department of Transportation in 2001 specifically to examine specific litter capture devices in 24 freeway catchments, which varied in size between 0.18 to 0.91 acres and were located in the Los Angeles area of southern California. A paired watershed approach was used for experimental design. Twelve of the catchments were instrumented with one of five best management practices (BMP): increased street sweeping frequency, increased frequency of manual litter pickup, a modified drain inlet, a bicycle grate, and a litter inlet deflector. The remaining twelve catchments were not instrumented with BMPs, and served as paired controls; all treatment and control catchments monitored drained to a single outfall. Increased litter pick up frequency and installation of modified storm drain grates were found to be the most effective control practices. For the litter collected from all catchments, it was found that "Styrofoam" accounted for 15% of total litter by volume, 11% by count, and 5% by mass. No differentiation of PF types was made, and the authors noted that for most litter "origins were not identified because of small size."

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[6] Lippner, G., J. Johnston, S. Combs, K. Walter, and D. Marx. 2001. Results of the Caltrans Litter Management Pilot Study. Presented in: Transportation Research Record 1743.

iv) City of San Jose Transportation and Environment Committee Staff Reports, 11-20-12, 1-21-11, and 4-16-10

City of San Jose staff reports prepared for the Transportation and Environment Committee make several claims regarding the presence of PFF in litter resulting from storm drain cleanout or monitoring or following installation of hydrodynamic separation units in existing storm drains including: i) that 10.4% of total litter collected was expanded polystyrene in targeted San Jose storm inlets in 2011; ii) that as part of the BASMAA Preliminary Baseline Trash Generation Rates for San Francisco Bay Area MS4s, a device capturing trash from 200 acres in central San Jose was cleaned out and 10.8% of the litter was found to be expanded polystyrene foam; and iii) that a Sunnyvale, CA litter study performed over a six-month period at the Remington outfall showed that 16.2% of total litter collected was "polystyrene." My review of the original citations in the staff reports and various documents produced by the City, SCVURPP, and the City of Sunnyvale validate the existence or occurrence of the project or assessment cited in staff reports, yet the data on PFF (or any data on litter composition) cited by staff is not available using internet searches of publically available documents.

In sum, none of the data the City cites provides baseline data about the amount of PFF covered by the proposed ban (as opposed to the broader category of polystyrene foam in general). Based on available data, the actual presence of PFF in litter appears be less than 2%. The fraction of litter that is PFF that would be covered by the ban is likely even less than that.

III. THE EVIDENCE SUGGESTS THAT THE CITY'S EXISTING PARTIAL BAN ON PFF HAS HAD NO EFFECT ON THE OVERALL LITTER RATE OR TRASH THAT REACHES WATER BODIES

In 2010 by the San Francisco Bay Area Regional Water Quality Control Board adopted a stormwater permit that requires permittees, such as the City, to meet specified trash-reduction targets[7]. As of 2012, the City is claiming that it has reduced trash in receiving waters by 2% by having instituted a prohibition on city purchase of PFF products and vendor use of PFF on City-

[7] *See* Municipal Regional Stormwater NPDES Permit for Phase I communities in the San Francisco Bay Region (Order R2-2009-0074) Monitoring and Reporting Program, Provision C.10.

owned property at certain events[8]. From review of annual reports, it appears that the City claimed a 2% trash reduction credit in 2011-2012 for implementing the foam purchase and use prohibition, and calculated the result to be equivalent to a reduction of 3,346 gallons of PFF. It appears that this value was calculated as approximately 2% of the total preliminary baseline trash load estimate of 168,672 gallons reported by the City. However, there is no evidence that PFF covered by the partial ban ever constituted 2% of the trash in receiving waters, and there is no evidence from the City that the partial ban has reduced litter by 2%. Based on my data review and analysis, I find no evidence that would support any litter reduction credit for instituting a PFF ban.

Exhibit 2 to this report documents City of San Jose storm drain and receiving water trash reduction measures and actions, and efforts to quantify the amount of litter removed from urban areas and receiving waters from 2007 to 2012. Noteworthy is the absence of data documenting the types or amounts of littered PF or PFF.

The lack of data showing that the City's partial ban of PFF has had any effect on overall litter rates or the amount of trash that enters receiving waters further undermines claims that the proposed PFF ban would reduce litter or trash in the receiving waters.

IV. THE CITY'S EXPERIENCE WITH THE PLASTIC BAG BAN DOES NOT SUPPORT A BAN OF PFF

The perceived success of the single use plastic bag ban in San Jose was cited in a November 2012 staff report as a reason for enacting a ban on PFF. However, the City's own data do not show any effect on overall litter found in the City as a result of the plastic bag ban. Furthermore, City residents could substitute reusable bags or other materials for single use carry out plastic bags, such that a change in behavior may occur as a result of a plastic bag ban. By contrast, a business serving food cannot practically offer an option for consumers to use their own packaging (analogous to asking a consumer to bring their own bag) when purchasing food. Thus, the most likely result of a PFF ban is that a carry-out restaurant would substitute single-use containers made of alternative materials, an action that is unlikely to change the behavior of the

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[8] City of San Jose. 2012. City Administrative Policy 5.1.13, Prohibition of City Funding for Purchase of Expanded Polystyrene Food Service Ware, effective June 28, 2012.

customer, who is the end user of the product and who will likely dispose of the alternative materials in the same way he or she would have disposed of PFF. Thus, products made of substitute materials can logically be expected to replace the fraction of PFF that is littered in San Jose. Data from Save Our Shores trash cleanups and the City of San Francisco litter audits also provide empirical evidence to support this substitution effect.

The City's experience with the plastic bag ban does not support a ban on PFF.

V. BY DIVERTING SCARCE MUNICIPAL RESOURCES FROM PROVEN TRASH-REDUCTION METHODS, A BAN IS LIKELY TO INCREASE THE AMOUNT OF TRASH THAT REACHES RECEIVING WATERS

While the data indicate that PFF bans do not reduce litter or trash entering water bodies, proven trash-reduction techniques are available and well-known. Full capture trash interception devices are considered the best available control technology for prevention of litter entry into receiving waters, and in southern California, where there are more than 20 trash total maximum daily loads (TMDLs), installation of full capture trash interception devices fully meets the Los Angeles Regional Water Quality Control Board's Trash TMDL receiving water compliance requirement of zero trash[9]. Research and monitoring evaluations conducted in the Los Angeles and San Francisco Bay Area document the performance of these systems under a range of hydrologic and urban litter loading conditions.

Table 1 identifies the actions the City taken since 2007 to install full capture trash interception devices in San Jose. Some actions have been done in cooperation with SCVURPPP, the City of Sunnyvale, and the San Francisco Estuary Institute (SFEI). Exhibit 3 describes a range of full-capture devices available and their performance with respect to trash and litter.

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[9] Los Angeles River Trash TMDL. 2005. Los Angeles Regional Water Quality Control Board.

Table 1. Summary of actions taken by City of San Jose to install full capture devices

Fiscal Year	Actions	Location/Contributing Area
2007-2008	Installed 85 catch basin insert screens (connector pipe screens)	Various locations
2008-2009	Produced "Pilot Trash Structural Treatment Control Study", March 2008; monitored 80 of the devices installed in FY 2007-2008	No new areas instrumented
2009-2010	No actions SFEI receives $5 EPA Grant to support full capture device purchase by Bay Area cities	All 58 SF Bay Area Cities Eligible
2010-2011	Installed 37 connector pipe screens Installed hydrodynamic separator	Various locations; 149 acres Wool Creek Drive; 48 acres with discharge to Coyote Creek
2011-2012	Installed hydrodynamic separator	Bulldog Boulevard; 181.7 acres
Efforts Underway	Install 7 continuous deflection separators Install 25 connector pipe screens	Various locations; 1,016 acres Various locations; 51 acres

Structural best management practices and full-capture devices are not the only trash-reduction techniques that are proven to be effective. Measures such as education, litter cleanup programs, street and storm drain cleanups, river and shoreline cleanups, can also be effective, and result in measurable reductions of trash in water bodies.

Existing litter control programs performed by the City for at least the past six years (beginning in 2007) are reported by City staff to be effective in reducing litter that could be discharged into receiving waters. Existing litter cleanup and storm drain cleanout efforts, begun as early as 2003, provide data that: i) quantify amounts and general type of litter collected, and ii) identify source generation areas.

Between 2007 and 2012, the City of San Jose reported litter reduction actions resulting in collection of 789 tons, 131,192 cubic yards, 45,414 gallons, and 9,445 bags of littered materials (Table 2). Year to year, litter removal actions have generally resulted in increasing amounts (mass and volume) of litter collected.

The City reports that data collected pursuant to the action-oriented elements of the program result in removal of litter from the City on a consistent basis from areas known to produce urban litter, and that these targeted efforts collect an array of litter types. Efforts to comprehensively address “Hot Spot” litter generation areas, and to install full capture litter control devices within the existing storm drain system are also known to be effective in treating known sources of litter and reducing trash volumes (see Table 2). In fact, the City’s hot spot identification program element has been successful in removing “hot spot” areas from the target list of sites, and cleanup efforts are now focused on new areas.

The trash reduction measures and actions taken by San Jose and other SF Bay Area co-permittees and documented in annual reports between 2007 and 2012 have resulted in verifiable, quantifiable reductions in trash loads and volumes.

Table 2. Summary of Litter Collected in San Jose, 2007-2012

	2007-2008			2008-2009			2009-2010			2010-2011			2011-2012			Totals			
Trash Load Reduction Activity	Tons	CY	Bags	Tons	CY	Bags	Tons	CY	Bags	Tons	CY	Bags	Tons	CY	Gal	Tons	CY	Bags	Gal
Problem/Hot Spot Cleanup	28			150				24			130			199		178	353		
Creek/River/Shoreline/ Volunteer Cleanup			1,845			1,987	130		4,213	171		1,400	309		44,076	611		9,445	44,076
Street Sweeping and Storm Drain/Pump Station O&M		30,938			27,751			24,554			23,504			24,445	1,338		131,192		1,338
Data Sources:	City of San Jose Annual Reports, 2007-2012																		
	Santa Clara Valley Urban Runoff Pollution Prevention Program Annual Reports, 2007-2012																		

The city of San Jose reported that annual program costs of up to $190,000 per year are required to enact and support a ban. Even if the cost were much less than this, implementing a ban still uses scarce municipal funds. When a ban is implemented, these funds are used for community and business outreach, on-going education efforts, and conducting day-to-day enforcement activities. Bans are ineffective to reduce litter and trash entering receiving waters. And bans divert scarce municipal resources away from proven trash-reduction techniques—including full-capture devices, hot-spot cleanups, education, and increased enforcement of anti-litter laws. Because cities have finite funds, every dollar spent on a ban is dollar that cannot be spent on these proven trash-reduction techniques. As such, more trash is likely to reach receiving waters if the City enacts a PFF ban than if it does not ban PFF.

Exhibit 1

Technical Memorandum:
Polystyrene Foam Food Ware Substitution Effect Analysis

Technical Memorandum

By: Mark Grey, Ph.D, Mark Grey Consulting

Date: August 9, 2013

Polystyrene Foam Food Ware Substitution Effect Analysis

Summary

Polystyrene foam food ware (PFF) bans have been adopted in more than 60 cities in California, and one of the main arguments stated in support of these bans is that they reduce the amount of litter that reaches water bodies. However, I am not aware of any study done in California in which a jurisdiction analyzed whether bans of PFF actually reduce litter or simply result in non-banned products replacing PFF as litter on land or in water bodies. The results of this analysis using data from two locations in California demonstrate there is a substitution effect after PFF is banned. PFF products have readily available substitutes, and logic suggests that bans could result in this type of litter substitution effect.

Litter is a consequence of humans failing to properly dispose of their waste, and thus can be reduced by changes in human behavior or by reduction in the amount of waste generated; however, PFF products have readily available substitutes, and logic suggests that bans could result in a type of substitution effect in which other products replace PFF in the litter stream. This notion is echoed by CalRecycle, whose regulations provide that a local ban of products may constitute source reduction only when the ban "will result in reduction in waste at the source, rather than substitution by another product or package of equivalent or greater volume." Cal. Code Regs. tit. 14, § 18734.3. Based on the available evidence, PFF bans do not reduce waste at the source, but simply result substitution by other products. Thus, PFF bans should not be considered source reduction.

Substitution Analysis

This technical memorandum reviews available data from the City of San Francisco and the City of Santa Cruz and analyzes whether PFF bans reduce litter and trash overall or whether bans simply result in non-banned products replacing banned PFF in urban litter and in receiving waters. Both cities have enacted PFF bans, and have conducted litter assessments in urban areas and receiving waters before and after the PFF bans came into effect.

San Francisco's data on litter generation were obtained by collecting litter classified by size and type in City streets for three successive years between 2007 and 2009 (including before and after a ban on

PFF was enacted in 2008), while Santa Cruz's data were derived from river and beach cleanup events conducted annually between 2007 and 2011, with a PFF ban enacted in 2007 and enforcement beginning in 2008. The data reported from these two areas suggest that a PFF ban had no clear effect on reducing litter generation overall.

In the case of the City of San Francisco, a PFF ban approved in 2007 did not lead to a reduction of litter in city streets; instead it resulted in product substitution. The count of whole items and fragments of PFF litter and polystyrene foam pieces and pellets (PF) collected during three years of in-street litter audits have remained relatively constant and vary over a relatively small range from year to year. However, substitute products for specific types of PFF increased both in count and in percentage of the overall litter load after the City enacted a PFF ban.

In the City of Santa Cruz, a PFF ban was enacted in 2007 and enforced in 2008. Litter collection data from once per year collection events at beach and river locations near Santa Cruz was compiled by the NGO Save our Shores between 2007 and 2011 and made available for review on their web site. In addition, as part of these annual cleanup events at beach locations, the number (count) of polystyrene foam litter items was recorded, along with other litter types. Polystyrene foam litter counts recorded during annual cleanup events increased between 2007 and 2008, and decreased in the following years through 2011, while the total mass of trash on the beach have remained relatively constant since a ban was enacted in 2007 and enforced in 2008. During the entire period from 2008 to 2011 the amount (mass) of total litter collected during similar river cleanup events exceeded baseline (2007) levels, suggesting that the PFF ban did not have the intended effect of decreasing litter generation.

Based on these two examples, I conclude that banning PFF does not reduce litter on land or in receiving waters. Instead, there is substitution effect; after a ban, PFF may go down in the litter stream and receiving waters, but it is replaced by alternative non-PFF products and the total amount of litter does not change.

<u>City and County of San Francisco</u>

A ban on PFF was enacted by the City of San Francisco in 2008, based on the claim that such a ban reduces litter. The ban prohibits use of PFF within the City and County limits. Before and after the PFF ban was enacted, the City conducted a three-year effort to characterize (audit) the amount and type of litter on City streets. The audit was performed for the City by a consulting team consisting of HDR, BVA, and MGM Management using established urban street litter audit methods. The year 2007 was considered the "baseline" year (pre-ban) for comparison with 2008 and 2009 data (post-ban). Litter collected during the study was classified as large (>4 square inches) or small (<4 square inches), and was then categorized into 89 different types of large or small litter and counted (whole items or a fraction of a larger piece). Large litter originating from PFF was included in the classification scheme as polystyrene cups, clamshells/boxes, plates, and trays, while small polystyrene foam litter was classified as "other polystyrene pieces" and "polyfoam peanuts."

Table 1 summarizes data from 2007 to 2009 and presents a comparison of individual large litter types (11 products within four categories), substitute product data pooled into four use categories, and PFF data for these same four categories. Table 1 also presents audit data from 2007 to 2009 for small litter (<4 square inches), which includes "other polystyrene pieces" and "polyfoam peanuts."

All four large litter product categories that contained a PFF substitute showed an increasing trend from 2007 to 2009. Of the 11 individual litter types documented in three consecutive years of litter audits, nine of the product types show an increasing trend each year in litter count and in percentage of the total number of large litter items collected. The other two types of substitute product litter showed a decrease from 2007 to 2008, followed by an increase over baseline in 2009. Examined collectively, the data indicate that the overall contribution of food service products to urban large litter is increasing (from 2.6 to 4.7 percent in 2007 and 2009, respectively) and that substitution for PFF is occurring for all four food ware categories, and that this trend is recognized in the City's data.

These data also show that PFF (and overall polystyrene product litter) were a small fraction of the litter generated in 2007 and remained a small fraction of the litter generated in the City after the ban. Notably, the count of two types of large litter (plates and trays) and two types of small litter (other polystyrene pieces and polyfoam peanuts) increased over baseline each year, while two types of large litter (polystyrene cups and clamshells) showed a decrease over baseline, with item count stabilizing between 2008 and 2009 (Table 1). This suggests the PFF ban has had only a limited effect on the generation of PFF litter.

<u>City of Santa Cruz, California</u>

The Santa Cruz NGO Save Our Shores conducted litter clean-up efforts on river shorelines and beaches near Santa Cruz in between 2007 and 2011, thus including periods both before and after a PFF ban was adopted in 2007 and became effective in 2008. Save Our Shores collected litter annually and reported litter count and mass in 10 litter categories during these collection events. Specific river reaches or beach areas were not identified in documents reviewed for this analysis, but presumably are in or near the City of Santa Cruz.

The Santa Cruz data show an apparent reduction in “Styrofoam” collected on beaches near Santa Cruz of 44% after the ban on PFF was adopted (Figure 1). This value is potentially misleading, however, as the decrease in number of pieces collected per cleanup has varied over a very small range — ranging from 13 and 6 pieces of beach “Styrofoam” reported for each year’s clean-up. Further, there is not enough information to establish that collection and quantification methods were consistent from year to year, and it is likely that environmental variables such as precipitation may have influenced the amount of litter on beaches. When annual precipitation is compared to total litter collected each year, it appears there is a positive correlation between mass of river litter collected and precipitation, such that in wetter years there was generally more trash collected than in drier years. When coupled with other unknowns (e.g., management practices that may have been employed to control litter, potentially including implementation of urban runoff BMPs or increased urban clean-up efforts), this difference in Styrofoam collected pre- and post-ban does not appear to be especially meaningful. Further, the data provided by Save Our Shores and cited by the City of San Jose in the November 2012 staff report make no distinction between other types of polystyrene litter and PFF litter. Thus, there is little evidence to support a claim that the ban materially reduced PFF litter.

The data presented by Save Our Shores also show that the PFF ban had no discernible effect on overall litter generation rates at the two river and beach locations examined. Total litter mass (pounds) collected at beach and river locations has remained relatively constant from 2008 to 2011, suggesting that product substitution is occurring. In the case of river litter, the total mass collected during each of the three years of data collection that followed the PFF ban was greater than the pre-ban amount collected in 2007, with an influence of rainfall on litter collected noted. Ultimately, the data suggest that food ware service products were substituted after the PFF ban was enacted.

Conclusion

Based on data from San Francisco and Santa Cruz, PFF bans have little effect on the amount of polystyrene foam litter. Moreover, PFF bans appear to do nothing to reduce litter or litter found in receiving waters overall. Rather, bans result in the substitution of other non-banned products, which are equally likely to be littered and to enter water bodies.

Table 1. Summary of San Francisco Street Litter Audit Data, 2007 to 2009

	2007		2008		2009	
Litter Category	Item Count	% of Total	Item Count	% of Total	Item Count	% of Total
Large Individual Litter (>4 sq. in.) Product Types--No Polystyrene						
Paper Cups (Hot)	36	0.94%	56.5	1.42%	87	1.94%
Paper Cups (Cold)	32	0.84%	37	0.93%	72	1.61%
Plastic Drink Cups	29.5	0.77%	31	0.78%	51	1.14%
Paper Fast Food Plates	3	0.08%	4	0.10%	18	0.40%
Other Material Trays	0	0.00%	0	0.00%	11.5	0.26%
Other Plastic Shells/Boxes	7.5	0.20%	16	0.40%	10	0.22%
Paper Clamshells	1	0.03%	12	0.30%	6	0.13%
Paper Trays	4	0.10%	0	0.00%	6	0.13%
Plates_Other Materials	0	0.00%	0	0.00%	5.5	0.12%
Other Plastic FF Plates	0	0.00%	4	0.10%	5	0.11%
Other Paper Cups	1	0.03%	3	0.08%	2.5	0.06%
Large Pooled Litter Categories--No Polystyrene						
Cups_All	98.5	2.58%	127.5	3.21%	212.5	4.74%
Clamshells/Boxes_All	8.5	0.22%	28	0.70%	16	0.36%
Trays_All	4	0.10%	0	0.00%	17.5	0.39%
Plates_All	3	0.08%	8	0.20%	28.5	0.64%
Large Individual Polystyrene Foam Foodware Types/Categories						
Polystyrene Cups	43	1.13%	31	0.78%	27.5	0.61%
Polystyrene Clamshells	20	0.52%	7.5	0.19%	7	0.16%
Polystyrene Trays	1	0.03%	2.5	0.06%	7	0.16%
Polystyrene Plates	3	0.08%	4	0.10%	5.5	0.12%
Total # of Items Collected	3812.5		3972.5		4485.5	
Sites	105		130		132	
Small Litter (<4 sq. in.)						
Other Polystyrene Pieces	5	0.21%	6	0.26%	54	1.60%
Polyfoam Peanuts	8	0.33%	2	0.09%	31	0.92%
Total # of Items Collected	2393		2335		3370	
Sites	105		130		132	

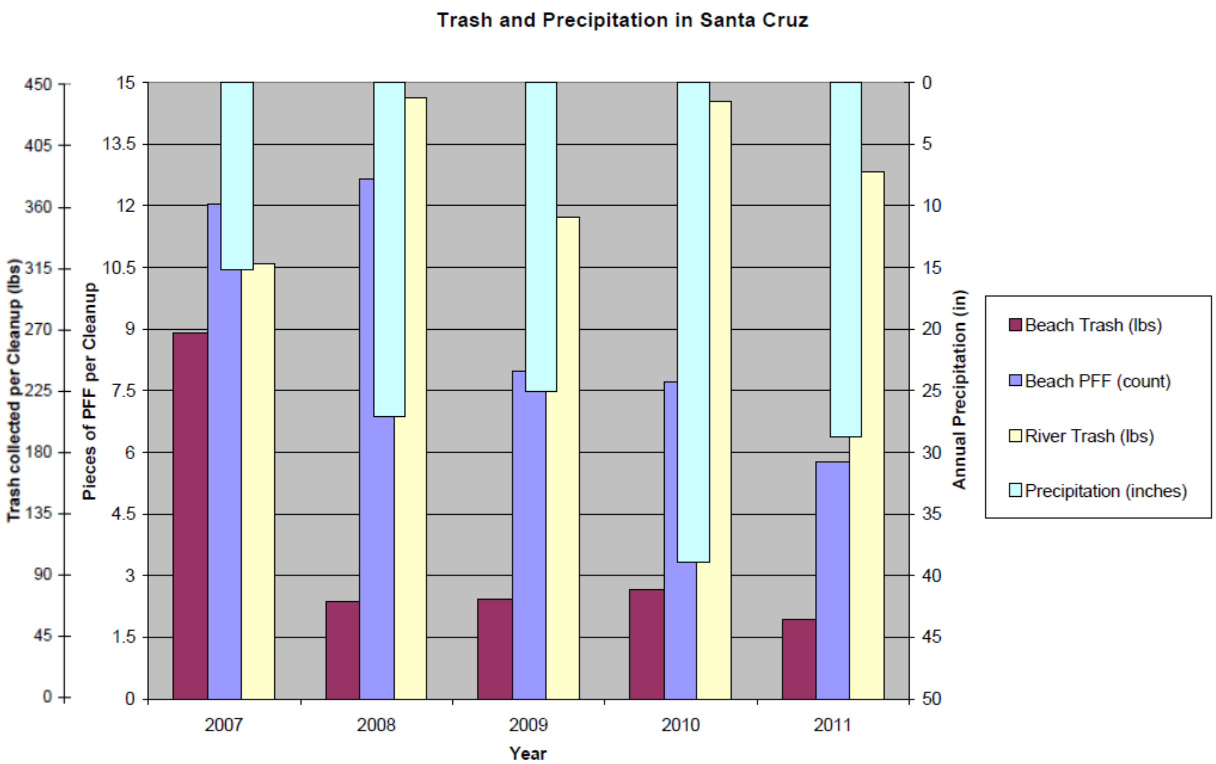

Figure 1. Litter (Trash) mass and count recorded during annual litter clean-up events, and annual precipitation for Santa Cruz, CA, 2007-2011.

Exhibit 2

City of San Jose Trash Management Summary, 2007-2012

City of San Jose Trash Management Program Summary 2007-2012

Summary of Program Elements
San Jose Trash Workplan Evaluation (2007-2012)
San Jose Trash Prevention and Removal Activities 2007 to 2009
Trash Load Reduction Program Results 2007-2008
Trash Load Reduction Program Results 2008-2009
2009-2010 Trash Load Reduction Program Changes
Trash Load Reduction Program Results 2009-2010
Trash Load Reduction Program Results 2010-2011
Trash Load Reduction Program Results 2011-2012

San Jose Trash Workplan Evaluation (2007-2009)

Plan Activity	Findings
1. Inventory, Document, and Evaluation Trash Management Practices	Completed program survey of existing trash management practices
2. Document and Map Known Trash Problem Areas	Identified creek/urban stream problem areas and illegal encampments Used Trash Prevention and Removal MOA
3. Conduct Trash Evaluations	Selected methods and provided training; ID of Coyote Creek and other locations/high priority areas
4. Develop Standardized Documentation and Reporting Format	Process completed 2003-2004; Updated periodically
5. Document and Analyze Evaluation Results; Identify and Prioritize Trash Problem Areas	Problem areas along creeks documented as part of Trash Prevention and Removal MOA—Coyote Creek and Other Locations
6. Identify and Implement Trash Management Practices	Collected trash in some locations Used Trash Prevention and Removal MOA
7. Review and Update Performance Standards and Develop Long Term Strategy for Trash Management	Vague report findings
8. Implement a Pilot Demonstration Project	Started program; collaboration with Santa Clara co-permittees; hired contractor to build 80 inlet screens and install

San Jose Trash Prevention and Removal Activities 2007 to 2009

Activities	Data Collection Opportunity	Description/Actions	# of Times Data Reported
Encampment and Illegal Dumping Activities	6	Trash Prevention/Removal MOA Illegal Encampments 5 Creeks Alternative Work Program Roads City Parcels	2
O&M Activities	5	Neighborhood Cleanups Storm Drain Inlet Street Sweeping Parks Maintenance	1
Clean Up Activities Volunteer-based	6	Hotspot Park/Trail/Street/Creek Cleanup Days	3
Other Activities	None	Collaboration/media	None

Trash Load Reduction Program Results 2007-2008

Program/Action	Result
5 Assessments; 2 protocols used for scoring sites: KAB 1-5) and RTA (1-20); type and sources of trash identified	Documented problem areas; Coyote Creek, Guadalupe River; 28 tons of trash removed; 75% increase from 06-07
City anti-litter program; streets, parks, and waterways; 150 litter hot spots	1,472 bags of litter 373 bags of litter from hot spots
Catch Basin Inserts Structural Trash Pilot Project	Installed 85 catch basin inserts (screens)
Trash Prevention and Removal Activities	Trash Prevention and Removal MOU
<u>Polystyrene or Styrofoam presence/absence not noted</u>	-Illegal encampments on waterways -Weekly encampment cleanup -10 monthly cleanups of large and active illegal encampments -5 per year City-District partnered cleanups

Trash Load Reduction Program Results 2008-2009

Program/Action	Result
Trash Prevention and Removal MOU + Additional Cleanups outside MOU	Documented problem areas; Coyote Creek, Guadalupe River; 60 tons of trash removed; 184.6 tons; 5.5 tons
City anti-litter program Juvenile Weekend Detention	572 bags of litter 1,415 bags of litter
Catch Basin Inserts Structural Trash Pilot Project	No new installations Sizing difficulties noted
Enacted smoking ban within 25 feet of City property **Polystyrene or Styrofoam presence/absence not noted**	Trash Prevention and Removal MOU -Illegal encampments on waterways -Weekly encampment cleanup -10 monthly cleanups of large and active illegal encampments -5 per year City-District partnered cleanups

2009-2010 Trash Load Reduction Program Changes

- New, 4th Term MS4 Permit Reporting Structure
- Began collaborating on Short-term Trash Loading Reduction Plan (TLRP)with SCVURPPP
- Worked with SCVURPPP to develop baseline Load and Trash Load Reduction Tracking Method
- Monitoring 84-87 previously installed full capture devices; stated plan to expand monitoring to include additional data to inform Baseline Trash Load assessment and tracking methodology
- Finalized technical report detailing results of pilot trash structural treatment control study

Trash Load Reduction Program Results 2009-2010

Program Element	Data Collected
Trash Hot Spot Assessment	6 sites selected; reported volume of material collected = 23.72 CY 4 sites reported "Styrofoam" present
Trash Load Reduction Actions (17 actions listed) Anti-Litter Volunteer Program Anti-Litter Juvenile Program SJ-SCVWD MOU Creek Connection Action Group	Trash load quantification given for four programs: 1,230 bags of litter 2,983 bags of litter 110.9 tons of trash 38,732 pounds of trash (estimated)
New Trash Load Reduction Reporting Format:	i. Short Term Trash Loading Reduction Plan ii. Baseline Trash Load and Trash Load Reduction Method iii. Minimum Full Trash Capture iv. Trash Hot Spot Assessment v. Summary of Trash Load Reduction Actions

Trash Load Reduction Program Results 2010-2011

Program Element	Data Collected
Trash Hot Spot Assessment	32 site cleanups in 2010; 80.78 CY 16 sites reported "Polystyrene" present 12 site cleanups in 2011; 49.2 CY 5 sites reported "Polystyrene" present
Trash Load Reduction Actions: Anti-Litter Volunteer Program SJ-SCVWD MOU Street Sweeping/Storm Drain O&M/Pump Station O&M	Trash load quantification given for five programs: 1,400 bags of litter 170.45 tons of trash 23,504 cubic yards of material No polystyrene noted
Minimum Full Trash Capture **Enacted ban of City-purchase of polystyrene foam foodware; enacted single use bag ban**	Installed HDS unit on Wool Creek Drive 48 acre catchment area Installed 37 small full capture trash devices (connector pipe screens) 118 total devices installed thru 2011, with total area treated = 342 acres (estimated)

Trash Load Reduction Program Results 2011-2012

Program Element	Data Collected
Trash Hot Spot Assessment	32 site cleanups in 2011; 160.5 CY 16 sites reported "Styrofoam" present 12 site cleanups in 2011; 38.9 CY 7 sites reported "Styrofoam (pieces or pellets)" present
Trash Load Reduction Actions On-land Trash Cleanup Full capture treatment devices Creek/Channel /Shoreline Cleanups; (SJ-SCVWD MOU and Creek Connection Action Group activity)	Trash load quantification given for four programs: 22,628 gallons 1,338 gallons 21,448 gallons (66.7 tons and 242.7 CY of trash also reported)
Minimum Full Trash Capture	Installed HDS unit on Bulldog Boulevard 181.7 acre catchment area No new small full capture trash devices (connector pipe screens--CPS) installed 116 total devices installed thru fiscal year 2011-2012; total area treated = 149.3 acres (differs from area reported in 2010-2011) 7 CDS units/25 small CPS units planned

Exhibit 3

Full Capture Trash Interception System Operating Principles and Performance Data

Exhibit 3

Full capture trash interception system operating principles and performance data

The San Francisco RWQCB and the Los Angeles RWQCB have certified several stormwater treatment technologies, and specific products that use these technologies, as “full capture systems.” The San Francisco Regional Water Quality Control Board defines a full capture device as “any single device or series of devices that traps all particles retained by a 5 mm mesh screen and has a design treatment capacity of not less than the peak flow rate Q resulting from a one-year, one-hour storm in the subdrainage area.”[1] The Los Angeles Regional Water Quality Control Baord elaborates on the definition of the peak flow rate, stating that, “The rational equation is used to compute the peak flow rate: Q = C x I x A, where Q = design flow rate (cubic feet per second, cfs); C = runoff coefficient (dimensionless); I = design rainfall intensity (inches per hour), and A = subdrainage area (acres).”[2] The fact that a treatment unit is certified as a full capture system means that it has been proven to be effective in both the laboratory and the field settings. Thus, these systems represent an efficient way to remove trash, including EPS, from stormwater and to prevent trash from reaching receiving water bodies.

The discussion below outlines various treatment mechanisms and specific products that utilize those mechanisms.

Swirl Concentration Technology[3]

Commercial Examples:

- KriStar Enterprises, Inc. – Downstream Defender
- KriStar Enterprises, Inc. – FloGard Dual-Vortex Hydrodynamic Separator

Description of Device

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[1] California Regional Water Quality Control Board, San Francisco Bay Region. Municipal Regional Stormwater NPDES Permit (Order R2-2009-0074), October 14, 2009. Page 85.

[2] California Regional Water Quality Control Board, Los Angeles Region. Attachment to Resolution No. R11-XXX: Basin Plan Updated September 2011. Chapter 7—TMDLs (Total Maximum Daily Loads)

[3] Brueske, Christopher C. *Technology Review: Ultra-Urban Stormwater Treatment Technologies*. Department of Civil and Environmental Engineering, University of Washington. September 1, 2000. pp. 12-25.

There are two general designs that use this technology. In the first, water enters a "grit chamber" through a tangential inlet and initiates the swirling fluid field. Water flows downward and towards the center of the grit chamber, and settleable solids are removed and deposited in the center of the chamber. Effluent then exits through an orifice outside of the grit chamber wall, and oil, grease and other floatables collect at the surface and are prevented from exiting by an underflow baffle.

The other general design consists of two concentric annular spaces; stormwater enters the outer space through a tangential inlet and again flows downward in a rotating fluid field. Floatables accumulate on the surface, while water exits this outer chamber by passing under a dip plate into the inner annular space. In this space, it flows upwards, while settleable solids are deposited; a center cone directs flow in the inner annular space to protect against re-entrainment.

<u>Treatment Mechanism</u>

Solids are removed from stormwater by two mechanisms: 1) gravity settling, which draws settleable solids to the floor of the unit and floatable materials to the top of the unit; and 2) secondary currents, which concentrate settleable solids in the center of the unit. These secondary currents are the primary removal mechanism, making swirl concentration technology significantly more efficient than purely gravitational treatment units. These secondary currents are generated by conservation of vorticity (a vector quantity that describes a local spinning motion) near the floor of the treatment units. The non-uniform vertical velocity profile, created by friction at the bottom of the unit, generates a transverse (perpendicular to flow) component of vorticity. As the fluid moves around a curve, this vector rotates in one direction; in order to conserve vorticity, the transverse vorticity vector must rotate in the opposite direction, resulting in a streamwise (parallel to flow) component of vorticity. Note that this is the same phenomenon that causes river flow to scour sediment from the outside bend of a river channel and deposit it onto the inside bank. Figure 1, below, illustrates this process.

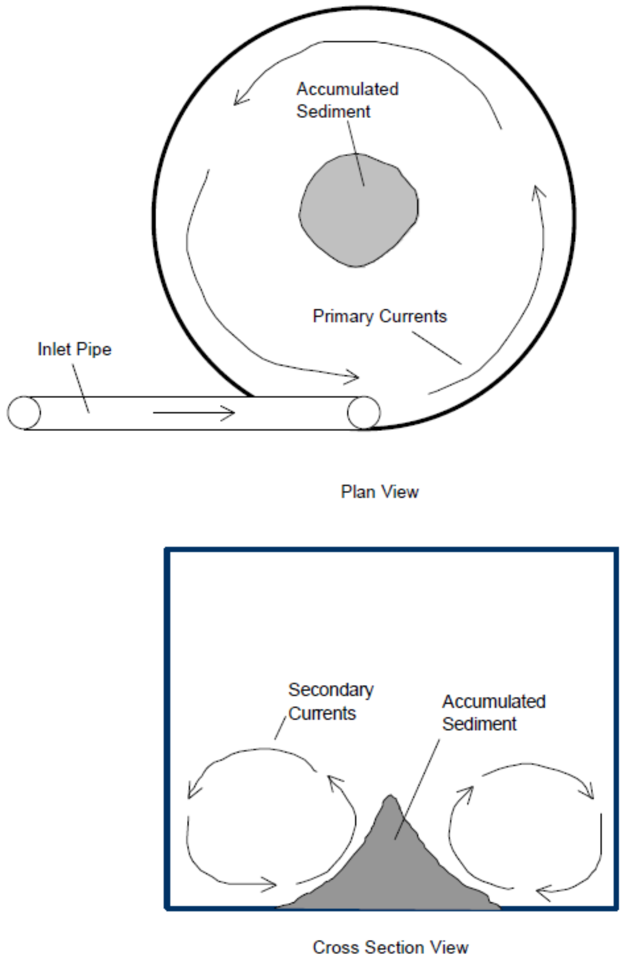

Figure 1. Schematic of the development of secondary currents in swirl concentration full-capture devices. Image from Brueske, Christopher C. *Technology Review: Ultra-Urban Stormwater Treatment Technologies*, p. 20.

Because the primary current is continuous, these secondary currents are maintained, and sediment concentrates in the middle of the treatment units. Accumulated sediment and floatable contaminants need to be removed by a vacuum truck.

Trash Removal Performance

This technology has been proven to be extremely efficient for low flows and for large particles. However, particles with a slow settling velocity (less than 0.1-0.14 cm/sec, generally particles smaller than 10-20 μm) may persist in the effluent if they do not settle into the zone of influence of the secondary current or if they become re-suspended during high flows. At very low flow rates (and thus increased residence time), a decline in removal efficiency is not observed even for large particles, as gravity separation becomes the primary removal mechanism. Figure 2, below, shows removal efficiency as a function of particle size and flow rate:

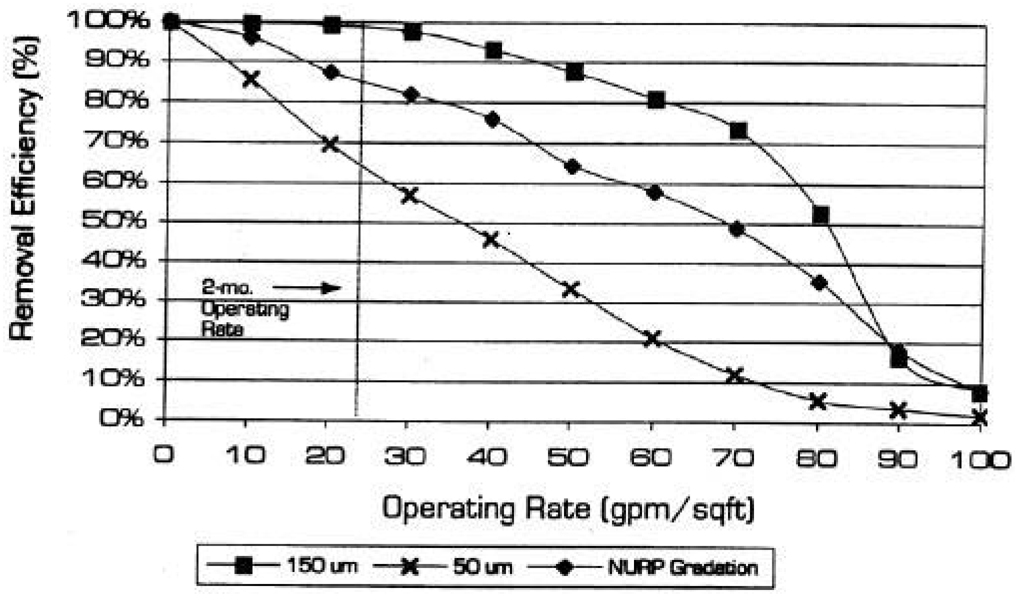

Figure 2. Removal efficiency of swirl concentration full capture devices. Image from Brueske, Christopher C. *Technology Review: Ultra-Urban Stormwater Treatment Technologies*, p. 21.

Connector Pipe Screen[4]

Commercial Examples:

- Advances Solutions Inc. – Stormtek ST3
- Bio Clean Environmental Services, Inc. – Gate Inlet Skimmer, Modular CPS
- United Stormwater, Inc. – Connector Pipe Screen
- West Coast Storm, Inc. – Connector Pipe Screen
- G2 Construction, Inc. – Collector Pipe Screen

Description of Device:

[4] West Coast Storm, Inc. *West Coast Storm Screen Connector Pipe Screen (CPS) Equipment Design and Specification Report*. http://www.docstoc.com/docs/116063313/West-Coast-Storm-Screen-Connector-Pipe-Screen-_CPS_-Equipment

A Connector Pipe Screen (CPS) is a vertical screen with 5 mm openings, installed directly upstream of the connector pipe in such a manner that all water entering the basin must pass through the device. It is constructed of a box-like, structural frame whose walls are composed of 5 mm mesh screen. The bottom and sides of the unit are securely fabricated to conform to the catch basin with a maximum gap of 5 mm. A vertical opening is provided around the perimeter at the top of the screen to allow storm water to bypass in the event of a large storm or if the screen becomes clogged.

Treatment Mechanism:

Particles are intercepted by the screen as stormwater enters the connector pipe; when flows are small enough such that the water level is below the flood bypass, CPS units retain all particles larger than 5 mm in the catch basin. Because the American Society of Civil Engineers (ASCE) defines litter as human derived trash *greater than* 4.75 mm in size[5], all litter will be removed via a CDS full capture unit.

Trash Removal Performance:

The capacity of trash that can be captured is determined by the dimensions of the catch basin, which stores trash and debris. Maintenance must be performed regularly to remove trash from the catch basin and from the mesh screen. If maintenance does not occur frequently enough, organic material and articles of trash can be trapped in the screens; this causes the mesh to be clogged, reduces the flow capacity through the device, and thus increases the likelihood of flow through the flood bypass.

Continuous Deflective Separation[6]

Commercial Examples:

- Contech Construction Products – Continuous Deflective Separator
- KriStar Enterprises Inc – FlowGard Swirl-Flo Screen Separator

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5 Allen, Vaikko and James, Roger. *Effectiveness of Trash Control Measures*. Presentation, CASQA 2012.

6 Brueske, Christopher C. *Technology Review: Ultra-Urban Stormwater Treatment Technologies*. Department of Civil and Environmental Engineering, University of Washington. September 1, 2000. pp. 26-32.

Description of Device and Treatment Mechanism:

Continuous Deflective Separation (CDS) involves the removal of solids from stormwater by an indirect, non-blocking, and non-mechanical screening mechanism. Stormwater enters the treatment unit through a tangential inlet and flows in a circular path across a stainless steel screen; screen apertures range from 0.6-4.7 mm (generally 4.7 mm for stormwater treatment). All particles larger than the screen apertures are restricted from passing to the outlet.

The screen surface area is large relative to the inlet pipe area, resulting in a radial flow velocity though the screen that is an order of magnitude slower than the inlet pipe velocity; the tangential velocity is highest adjacent to the separation screen, and maintains a constant shear force across the screen. Because the radial velocity of water through the screen is slow, the pressure differential—forcing particles into the screen—is much less than tangential shear force, which pushes particles in a direction tangent to the screen. This mechanism prevents particles from blocking the screen, and allows them to eventually settle into a sump below the unit. Particles smaller than the screen aperture size are also removed, although the mechanism is not well understood.

Trash Removal Performance:

Table 1, below, states the removal efficiency as a function of screen aperture and particle size. As the numbers illustrate, this device removes all particles larger than the screen aperture, and a high percentage of smaller particles. Based on ASCE's definition of litter as being greater than 4.75 mm in size, all litter will be removed via a CDS full capture unit.

Table 1. Screening Efficiencies as a Function of Particle Size (S.G. = 2.65) for 1.2 mm and 4.7 mm Screen Apertures for a CDS Unit.

4.7 mm Screen		1.2 mm Screen	
Average Particle Size (μm)	Particle Removal Efficiency (%)	Particle Size Range (μm)	Particle Removal Efficiency (%)
>4,700	100	>1,200	100
2,350	100	420-600	93
1,567	93	300-420	85
940	50	144-300	30
		84-144	22

Reproduced from Brueske, Christopher C. *Technology Review: Ultra-Urban Stormwater Treatment Technologies*, p. 30.

Trash Nets[7]

Commercial Examples:

- KriStar Enterprises, Inc. – Nettech Gross Pollutant Trap—End of Line
- Fresh Creek Technologies, Inc. – End of Pipe Netting Trash Trap

Description of Device and Treatment Mechanism:

These modular units consist of disposable, 5 mm mesh nets that face the direction of flow; all particles larger than the aperture size of the mesh are retained in the net. These nets are held in place by a steel framework fabricated specifically for the site; depending on the height above grade, the nets are either installed directly to the steel framework (called the "fixed frame" installation) or are held within a removable "basket" (the "basket" installation) to facilitate maintenance. A fixed bypass screen above the nets is provided when 100% screening of the flow is required; this provides additional flow capacity to prevent surcharging of the storm drain.

Trash Removal Performance:

Because of their scalable design, these systems can be matched exactly to the outfall size and flow requirements. End of pipe trash nets have been documented by the EPA as achieving a capture efficiency of 95%. The city of Signal Hill tested a pilot program at the Hamilton Bowl, which confirmed the effectiveness of the system. Frequent maintenance is required to maintain high flows through the devices.

Linear Radial Gross Solids Removal Devices

Commercial Examples:

- Roscoe Moss Company – Storm Flo Screen

Description of Device and Treatment Mechanism:

A Linear Radial Gross Solids Removal Device consists of a circular stainless steel pipe with 5 mm louvers that is contained in a concrete vault. Stormwater enters through the interior steel pipe and exits through the other end of the concrete vault, into another pipe; pollutants are

[7] Fresh Creek Technologies, Inc. website

filtered by the louvers and accumulate within the stainless steel pipe. These devices can also be installed at the end-of-pipe; under this type of installation, the effluent exits directly to receiving water. Accumulated litter and organic matter can be removed from within the stainless steel casing by a vacuum truck.

Trash Removal Performance:

Based on ASCE's definition of litter as being greater than 4.75 mm in size, all litter will be removed by a Linear Radial Gross Solids Removal Device. The capacity of trash that can be captured and retained is determined by the dimensions of the internal stainless steel pipe, which stores the trash and debris. Frequent maintenance (removal of debris) is required to allow high flows through the device, to prevent the device from overflowing, and to prevent localized flooding elsewhere in the system. A pilot project by the California Department of Transportation confirmed the performance of these devices.[8]

Full Capture Trash Removal Device Economic Data (capital and annual O&M costs)

The cost to install and operate and maintain various types of full capture litter interception practices is documented in various technical reports and other sources. In Table 2 below Regional Water Quality Control Board approved full capture devices are listed, and capital and annual O&M costs presented. The data shows some range in costs for the various devices, and this range is a function of differences in the sizing of each device for a given contributing catchment area and its physical, hydrological and trash/pollutant load characteristics. Most of the devices except for trash nets, are sized at a minimum to capture litter greater than 4.75 mm up to the peak flow produced by a one-year, one-hour storm intensity before bypass would occur. Costs shown in Table 4 are unadjusted for inflation.

[8] California Department of Transportation. Phase 1 Gross Solids Removal Device Pilot Study: 2000-2002. Final Report October 2003. pp. 55-56.

Table 2. Capital and O&M Costs for Full Capture Trash Interception Devices

Technology	Device Manufacturer	Cost: Capital Installation ($/unit)	Cost: Annual O & M ($/unit/yr)	Source
Swirl Concentration	--	$4{,}000^{a}$-$332{,}000^{b}$: treatment capacity dependent	$2{,}000^{c}$	a) USEPA. Innovative Technology Inventory (ITI) KriStar FloGard® Dual-Vortex Hydrodyanmic Separator (DVS). November 20, 2006. (2006 Dollars) b) Larry Walker Associates, Inc. 1999. Investigation of Structural Control Measures for New Development. Final Report. Sacramento Stormwater Management Program. (1999 Dollars) c) LARWQCB. Trash Total Maximum Daily Loads for the Los Angeles River Watershed. (1999 Dollars)
Connector Pipe Screen	--	300	330	Hildebrand, Gary. LA Trash TMDL: Achieving Compliance. www.lawatersheds.org (2011 Dollars)
Continuous Deflective Separation	Contech Construction Products	65,471		City of Los Gatos. NPDES compliance, Project 10-17. March 27, 2012 (2012 Dollars)
Continuous Deflective Separation	Contech Construction Products	$95{,}857^{d}$	$5{,}000$-$20{,}000^{e}$	d) City of Palo Alto. NPDES compliance, Park Blvd Project. July 23, 2012 (2012 Dollars) e) SCVURPPP Trash Evaluation and Management Fact Sheet, April 2008 (2008 Dollars)
Continuous Deflective Separation	--	10,000-80,000: treatment capacity dependent	2,500-30,000	Hildebrand, Gary. LA Trash TMDL: Achieving Compliance. www.lawatersheds.org (2011 Dollars)
Trash Nets	Fresh Creek Technologies -- Trash Trap	75,000-300,000: depends on site conditions. Typical two-net system for 50 cubic feet, 500 lbs of trash would be $125,000.	25,000-75,000	USEPA: Combined Sewer Overflow Technology Fact Sheet: Netting Systems for Floatables Control. Spetember 1999. (1999 Dollars)
Trash Nets	Fresh Creek Technologies -- Trash Trap		32,600	Department of Environmental Programs, Metropolitan Washington Council of Governments. DC-WASA Combined Sewer Overflow Anacostica River Trash Reduction Demonstration Project: Fresh Creek Netting TrashTrap System. October 2001 (2001 Dollars)
Linear Radial Gross Solids Removal Device	Roscoe Moss Company -- Storm Flo Screen	10,295-25,905: size dependent	7,752	Letter from Kevin McGillicuddy, Roscoe Moss Company, to Ziad Mazboudi, City of San Juan Capistrano. June 11, 2012 (2012 Dollars)

Attachment 2

ATTACHMENT 2
Summary of Polystyrene Bans and Assessment Strategies for Polystyrene Bans Reported in Long Term Plans

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
ALAMEDA		
Alameda County	**None listed.**	Outcome-based indicators include amount of polystyrene food ware entering storm drains. Alameda Countywide Clean Water Program ("ACCWP") will conduct follow-up study to assess the effectiveness of EPS food ware bans at reducing amount of EPS entering storm drain system. ACCWP will assess volume and number of disposable EPS food ware items from all of approximately 100 full trash capture inlet devices included in study to compare between cities that have adopted bans versus those that have not.
Alameda	**Internal City ban adopted 2007, effective July 2008.** Ordinance prohibits food vendors and contractors and vendors doing business with the City from distributing polystyrene foam food service ware. Also bans use of polystyrene foam food service ware on all City-owned facilities, at City sponsored events, and on City projects.	Outcome-based indicators include amount of polystyrene food ware entering storm drains. ACCWP will conduct follow-up study to assess the effectiveness of EPS food ware bans at reducing amount of EPS entering storm drain system. ACCWP will assess volume and number of disposable EPS food ware items from all of approximately 100 full trash capture inlet devices included in study to compare between cities that have adopted bans versus those that have not.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
Albany	**City-wide ban adopted in 2008, effective September 2008.** The City of Albany adopted an ordinance banning polystyrene foam food service ware at the point-of-sale by all food vendors, City Facilities, City franchises, and contractors and vendors doing business within City limits.	Outcome-based indicators include amount of polystyrene food ware entering storm drains. ACCWP will conduct follow-up study to assess the effectiveness of EPS food ware bans at reducing amount of EPS entering storm drain system. ACCWP will assess volume and number of disposable EPS food ware items from all of approximately 100 full trash capture inlet devices included in study to compare between cities that have adopted bans versus those that have not.
Berkeley	**City-wide ban adopted in early 1980s.** The City was one of the first government agencies in the country to regulate polystyrene foam containers in restaurants; the ban has been in place since the early 1980s.	Outcome-based indicators include amount of polystyrene food ware entering storm drains. ACCWP will conduct follow-up study to assess the effectiveness of EPS food ware bans at reducing amount of EPS entering storm drain system. ACCWP will assess volume and number of disposable EPS food ware items from all of approximately 100 full trash capture inlet devices included in study to compare between cities that have adopted bans versus those that have not.
Dublin	**Internal City ban adopted December 15, 2009; may be expanded.** The City of Dublin has adopted policies that ban polystyrene foam food service ware at Dublin sponsored events. On September 21, 2010, the Dublin City Council adopted a Resolution establishing a policy	Outcome-based indicators include amount of polystyrene food ware entering storm drains. ACCWP will conduct follow-up study to assess the effectiveness of EPS food ware bans at reducing amount of EPS entering storm drain system.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	that bans the City's purchase and use of single-use plastic bottles and polystyrene products at City sponsored activities. In FY 14-15, City staff will be exploring expanding the polystyrene foam food service ware ban to include restaurants in the City.	ACCWP will assess volume and number of disposable EPS food ware items from all of approximately 100 full trash capture inlet devices included in study to compare between cities that have adopted bans versus those that have not.
Emeryville	**Ban adopted May 2007.** City's food service waste reduction ordinance has banned disposable food service ware that the City deems is not recyclable or compostable.	Outcome-based indicators include amount of polystyrene food ware entering storm drains. ACCWP will conduct follow-up study to assess the effectiveness of EPS food ware bans at reducing amount of EPS entering storm drain system. ACCWP will assess volume and number of disposable EPS food ware items from all of approximately 100 full trash capture inlet devices included in study to compare between cities that have adopted bans versus those that have not.
Fremont	**City-wide ban adopted January 1, 2011.** On January 1, 2011, the City adopted an ordinance banning polystyrene foam food service ware at the point-of-sale of any establishment, located within the City of Fremont that provides prepared food or beverages including supermarkets, delicatessens, restaurants, retail food vendors, caterers, sales outlets, shops, cafeterias, catering trucks, outdoor vendors, and city facility users. Banned items include expanded polystyrene (#6) food service ware (commonly known as Styrofoam) such as plates, cups, bowls, and lids.	Outcome-based indicators include amount of polystyrene food ware entering storm drains. ACCWP will conduct follow-up study to assess the effectiveness of EPS food ware bans at reducing amount of EPS entering storm drain system. ACCWP will assess volume and number of disposable EPS food ware items from all of approximately 100 full trash capture inlet devices included in study to compare between cities that have adopted bans versus those that have not.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
Hayward	**City-wide ban adopted in July 2011.** The City adopted a polystyrene foam food service ware ban on July 1, 2011. This ban prohibits the use of polystyrene foam food service ware for food establishments within the City's jurisdiction. The City's Solid Waste Program enforces the polystyrene ban staff with the assistance of the City's commercial/industrial inspection program, which reports use of polystyrene within food establishments during the City's routine business inspections.	Outcome-based indicators include amount of polystyrene food ware entering storm drains. ACCWP will conduct follow-up study to assess the effectiveness of EPS food ware bans at reducing amount of EPS entering storm drain system. ACCWP will assess volume and number of disposable EPS food ware items from all of approximately 100 full trash capture inlet devices included in study to compare between cities that have adopted bans versus those that have not. In addition to County's assessment of the ban, the City will continue to use its own resources to inspect businesses and take appropriate enforcement action against the illegal distribution of banned items. The Program in coordination with Stopwaste.org is planning a study to measure the volume of single-use plastic bags, polystyrene containers, and predominant items of trash such as cigarette butts, in selected full trash capture devices during the winter of 2013/14 and compare it to the volume found during the pre-ban assessment.
Livermore	**City-wide ban in effect July 1, 2011.** As of July 1, 2011, City of Livermore's ordinance banning Styrofoam 'to-go' containers (expanded polystyrene disposable foodservice ware) for foodservice businesses officially took effect. Enforced by City staff.	Outcome-based indicators include amount of polystyrene food ware entering storm drains. ACCWP will conduct follow-up study to assess the effectiveness of EPS food ware bans at reducing amount of EPS entering storm drain system.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
		ACCWP will assess volume and number of disposable EPS food ware items from all of approximately 100 full trash capture inlet devices included in study to compare between cities that have adopted bans versus those that have not.
Newark	**No ban.** The City has not adopted a polystyrene foam food service ware policy and does not have any immediate plans to do so. However, the City has said it would strongly consider participation in a county-wide ordinance similar to the Single-Use Bag Ban Ordinance.	
Oakland	**Internal City and City-wide bans adopted in 2008.** In 2008, the City adopted an Ordinance to Prohibit the Use of Polystyrene Foam Disposable Food Service Ware and Require the Use of Biodegradable or Compostable disposable Food Service Ware by Food Vendors and City Facilities (Oakland Municipal Code Chapter 8.07 Polystyrene Foam Food Service Ware, Ordinance No. 12747). The ordinance prohibits food vendors from serving food or beverages in polystyrene containers. Additionally, vendors doing business with the City, City facilities and City staff are prohibited from purchasing and using polystyrene to serve food. Implementation of the Polystyrene Foam Ban was accompanied by significant outreach to consumers as well as businesses.	Outcome-based indicators include amount of polystyrene food ware entering storm drains. ACCWP will conduct follow-up study to assess the effectiveness of EPS food ware bans at reducing amount of EPS entering storm drain system. ACCWP will assess volume and number of disposable EPS food ware items from all of approximately 100 full trash capture inlet devices included in study to compare between cities that have adopted bans versus those that have not.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
Piemont	**Ordinance passed—no specifics.**	Outcome-based indicators include amount of polystyrene food ware entering storm drains. Output-based indicators include compliance with product bans.
Pleasanton	**No information in Long Term Plan, but County Long Term Plan indicates that ban was adopted since completion of BASMAA baseline study.**	County Long Term Plan indicates that since ban was adopted post-baseline study, ACCWP will compare volume and number of EPS food ware items in full trash capture devices before and after implementation of bans (will need to resample 27 of the 47 sites included in Baseline Study that were located in Pleasanton and San Leandro).
San Leandro	**Internal City ban in effect November 1, 2012.** The City of San Leandro banned the use of polystyrene foam food service ware. The City of San Leandro's Polystyrene Foam Food Service Ware Ordinance went into effect on November 1, 2012. The Ordinance requires City departments and local food establishments to discontinue the use of polystyrene foam food service ware products. Polystyrene foam food service ware products include cups, bowls, plates, clamshell containers, soup containers and trays made from expanded foam polystyrene typically labeled #6.	Outcome-based indicators include amount of polystyrene food ware entering storm drains. Since ban was adopted post-baseline study, ACCWP will compare volume and number of EPS food ware items in full trash capture devices before and after implementation of bans (will need to resample 27 of the 47 sites included in Baseline Study that were located in Pleasanton and San Leandro).
Union City	**No ban, but considering.** The City Staff is considering recommending to the City Council a product ban on polystyrene and styro-foam containers.	
CONTRA COSTA		
Contra Costa County	**Plans for ban postponed to draft Long Term Plan.** Short Term Plan committed County to enact an	The primary method for determining the effectiveness of trash reduction strategies implemented within a trash

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	ordinance to prohibit free distribution of polystyrene foam food and beverage containers, but the County chose to postpone the development of these ordinances to the Long Term Plan. The County now proposes to adopt the foam polystyrene food container ordinance, currently in development by RecycleMore (West Contra Consta's integrated waste management authority, covering El Cerrito, Hercules, Pinole, Richmond, San Pablo, and El Sobrante), within six months of its approval by the Board of Directors. The County will pursue a polystyrene food and beverage container ordinance for unincorporated portions of the County by July 1, 2022.	management area will be the use of BASMAA's On-Land Visual Trash Assessment Protocol. Product Bans Evaluation Method Details: Track compliance of stores. Track volume of product in creeks, trash capture devices, and found during on-land cleanups.
Concord	**No ban.**	
Danville	**No ban.**	
El Cerrito	**Ban adopted September 2013 and effective January 1, 2014.**	The City will rely on the assessment framework outlined in Section 3.F in order to determine the relative impacts of the Ordinances on the actual generation litter/trash attributable to single use bags and EPS foam food ware.
Hercules	**Currently has anti-littering and polystyrene use ordinance in place; plans to adopt and implement City-wide polystyrene foam food service ware policy.**	
Lafayette	**No ban.**	

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
Martinez	**City-wide ban proposed.** The City is proposing a regulation ordinance that would prohibit the use of polystyrene foam food service ware within the City limits, unless otherwise the State has adopted a similar State-wide law. It is anticipated that these regulation will be in effect by July 2014. In general, food providers using disposable food ware for prepared food to customers would be required to use bio-degradable or combustible food ware. Food providers are strongly encouraged to use reusable food ware in place of disposable food ware, where practical.	Enforcement and effectiveness: The City Manager (or his/her designee) would have primary responsibility to enforce this ordinance. City staff would be trained to observe, quantify and document trash collected. Staff would evaluate the percentages of polystyrene food ware collected in trash from specified locations, hotspots, trash capture devices. Plastic bags ban and polystyrene food serve wares ban ordinances: • Track compliance of stores and required reporting by owners. • Track volume of product in creek and on-land cleanups, etc.
Moraga	**No ban.**	
Orinda	**No ban.**	
Pinole	**No ban, but the City would consider a ban.** With regards to policies and product bans, the City of Pinole plans to be receptive to how these work in other communities that reflect needs similar to that of Pinole.	
Pittsburg	**City-wide ban adopted in 1991, to be updated.** On November 4, 1991 the City Council adopted Ordinance 1019, "Prohibited Food Packaging" to address several of the City's goals at that time to make recycling a mandatory duty on both residential and commercial property owners and to require retail food establishments to increase the use of returnable or recyclable packaging materials in take-out food. Through this act, the City also included a section of the	

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	ordinance to prohibit the use of polystyrene CFC-processed take-out food packaging. The ordinance requires the food establishment to maintain documentation regarding the recyclable nature of their packaging and use of non-CFC processed take out containers. The City has not aggressively enforced this ordinance. An update to the ordinance clarifying the ban for all polystyrene take-out food packaging, rather than CFC-processed packaging will be forthcoming once sufficient time has passed after the onset of the plastic bag ban ordinance has taken place. It is anticipated there will be mandatory reporting requirements to the City to ensure conformance with the ordinance.	
Pleasant Hill	**No ban.**	
Richmond	**City-wide ban effective August 2010.** City of Richmond adopted an ordinance banning polystyrene foam food service ware at the point-of-sale. The food ware ordinance prohibits the distribution of polystyrene foam single-use food and beverage ware at all food service vendors. The ordinance became effective in August 2010. Effectiveness will be assessed at hot spots. Presently the city has in place bans on non-compostable food ware, all polystyrene products that can compromise creek trash impairment, and plastic bags from retail stores.	Assessments will be made by audits of both full trash capture devices and on land visual assessments.
San Pablo	**Plans to adopt City-wide ban in 2014 for**	Enforcement for this action will include checking

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	implementation in 2015. The City plans on working on the polystyrene ban in 2014 for an implementation date of January 2015. In addition to just polystyrene food ware, staff is proposing that the sale of all polystyrene in the City also be banned. The ordinance would be similar to the one adopted by the City of Richmond.	compliance as part of the City's NPDES restaurant inspections and also inspecting the few stores that sell polystyrene. Staff will evaluate the effectiveness of the program by the number of enforcement actions taken against the non-compliant business (or the percentage of compliant businesses) and by evaluating the hot spot location data.
San Ramon	**No ban.** The City of San Ramon closely tracks local efforts to reduce the use of single-use plastic bags and polystyrene/foam food service containers. Through the Contra Costa Clean Water Program (CCCWP), staff has participated in the development of a model ordinance banning the use of plastic bags and polystyrene/foam food service containers. City staff has discussed the implementation of a county-wide ban with Contra Costa County Staff.	
Walnut Creek	**Seeking to pass City-wide ban.** The City is currently seeking to pass ordinances that will ban the distribution of polystyrene-based food and beverage ware at all food service vendors. Enforcement of the product ordinances will be included in the City's ongoing commercial and industrial inspection program.	Evaluation Method Details for polystyrene-based food service ware ordinance: Track compliance of stores as part of the City's ongoing Commercial and Industrial inspection program. Track volume of product in creek and on-land cleanups.
SAN MATEO		
San Mateo County	**Internal City ban adopted in 2008; City-wide ban adopted in 2011.** On May 6, 2008, the County Board of Supervisors adopted Ordinance No. 04421 restricting the County's use of polystyrene foam and solid disposable food service ware products and requiring the use of	Currently, food inspectors monitor businesses for municipal code compliance. To ensure that facilities are abiding by the polystyrene food ware ordinance, polystyrene was added to the activity areas checklist on the standard stormwater facilities inspection report form. The success of polystyrene removal as a trash

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	biodegradable, compostable, reusable food service ware by all County of San Mateo departments and food service providers on property owned or leased by the County. On March 1, 2011, the County Board of Supervisors adopted Ordinance No. 04542 prohibiting food vendors from using polystyrene-based disposable food service ware.	source in the MS4 for unincorporated County is measured by percent compliance as inspectors verify the removal of polystyrene foodware from regulated facilities. Violations may result in fines: 1st = $100, 2nd = $200, 3rd = $500 (each day observed using polystyrene = 1 violation). Complaints and inspection records are maintained in the CEH EnvisionConnect electronic database. Violations may result in fines: 1st = $100, 2nd = $200, 3rd = $500 (each day observed using polystyrene = 1 violation). Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.
Atherton	**No ban.**	
Belmont	**City-wide ban implemented on July 1, 2011, effective October 1, 2012.** There was no polystyrene foam food service ware policies pre-MRP. New/Enhanced post-MRP actions initiated/planned: The City adopted the County-wide “Prohibition on The Use of Polystyrene Based Disposable Food Service Ware by Food Vendors.” This ordinance went into effect October 01, 2012.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.
Brisbane	**City-wide ban being developed.** Pre-MRP there was no policy on polystyrene foam food service ware. In 2013 the City Council directed its	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances –

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	Open Space and Ecology Committee to develop a citywide ordinance for their review. This ordinance is expected in 2014.	Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.
Burlingame	**City-wide ban adopted May 2011, effective January 1, 2012.** On May 16, 2011, the City adopted ordinance 1861 and added Chapter 8.10 to the Burlingame Municipal Code which prohibits food vendors from using polystyrene based disposable food service ware. The ordinance took effect on January 1, 2012. The County of San Mateo Environmental Health (CEH) Division enforces the ordinance within the city limits. Enforcement and outreach activities by CEH staff begun during FY 12-13. Actions planned for future implementation between July 2014 and July 2022: The city will continue to support restrictions on the use of polystyrene based disposable food service ware as stated in the aforementioned ordinance.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.
Colma	**Ban adopted March 2013, effective August 1, 2013.** The Town adopted the Polystyrene Ban Policy on March 13th 2013. Town Staff met with business owners and restaurant operators and provided program outreach. Outreach was also provided through the "Colma Works" newsletter that's sent to all business in Town.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.
Daly City	**Internal City ban adopted pre-MRP; City-wide ban adopted in 2012.** Polystyrene foam food service ware at City-owned facilities and City-sponsored events was banned via a City Manager directive prior to the adoption of the	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	MRP. On July 23, 2012 the Daly City, City Council adopted added Chapter 8.62 to the Daly City Municipal Code prohibiting food vendors in Daly City from using polystyrene-based takeout food containers. The ordinance prohibits all food vendors in Daly City, including restaurants, delis, cafes, markets, fast food establishments, vendors at fairs, and food trucks from dispensing prepared food in polystyrene containers. The ordinance will be enforced by the San Mateo County Department of Environmental Health.	measure performance.
East Palo Alto	**No ban; City will consider a future ban.** The City will consider a polystyrene foam food service ware policy as a future action if there is an avenue for adoption of such a policy with another agency taking the lead on the development of the EIR, or at such a time as the City finds another avenue for ensuring CEQA compliance for this action.	
Foster City	**City-wide ban adopted 2011, effective April 1, 2012.** The City of Foster City adopted an ordinance October 17, 2011 banning polystyrene foam food service ware at the point-of-sale effective April 1, 2012.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.
Half Moon Bay	**City-wide ban adopted 2011, effective August 2011.** The City adopted Ordinance C-6.11 on June 7, 2011, adding Chapter 7.30, Sections 7.30,010 and 7.30.020, to the City of Half Moon Bay Municipal Code. The new sections add by reference Chapter 4.107 of the San Mateo County Code, banning the use of polystyrene foam containers and authorizing enforcement by the	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	County of San Mateo. The ban went into effect in August 2011. Enforcement is provided by San Mateo County Division of Environmental Health under the MRP Section C.4 business inspections.	
Hillsborough	**City-wide ban adopted in 1990.** The Town does not have any businesses and has adopted Ordinance 475 amending Chapter 8.10 of the Municipal Code supporting the international, federal and state bans of all uses of chlorofluorocarbons and polystyrene foam packaging products used in the food services industry. This ordinance was adopted in 1990 before the MRP requirements and has been effective July 1, 1990. As a result, the Town sponsored events or events on Town property are prohibited from using polystyrene based disposable food service packaging materials.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.
Menlo Park	**City-wide ban effective November 2012; possibility of future expansion.** On August 28, 2012, the Menlo Park City Council adopted San Mateo County's Polystyrene Food Ware Ordinance. The ordinance applies to all food vendors in the City and officially became effective on November 1, 2012. The ordinance prohibits food vendors, including restaurants, delis, cafés, markets, fast-food establishments, and vendors at fairs from dispensing prepared food in polystyrene containers labeled with a No. 6. Food vendors must provide alternative food ware products, such as biodegradable/compostable plates, cups, and take out containers.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	In 2016, the City will explore regulating utensils and/or refining the ordinance to only allow compostable food ware to be used instead of other types of recyclable plastic. In addition, the city may explore prohibiting expanded polystyrene (EPS) food ware and ice chests sold at retail establishments.	
Millbrae	**City-wide ban adopted 2007, effective January 1, 2008.** The City of Millbrae adopted the Sustainable Food Service Ware Ordinance, No. 717, adding section 6.40 to the Millbrae Municipal code prohibiting the use of polystyrene foam and solid disposable food service ware requiring the use of biodegradable, compostable, reusable or recyclable food service ware by food vendors in the City.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.
Pacifica	**City-wide ban effective January 1, 2010.** The City of Pacifica adopted an ordinance banning polystyrene foam food service ware at the point-of-sale. Food vendors are prohibited from providing prepared food to customers in foam polystyrene or solid polystyrene disposable food service ware. No foam polystyrene or solid polystyrene disposable food service ware shall be used in any City facilities. No city department or agency will purchase or acquire foam polystyrene or solid polystyrene disposable food service ware for use at City facilities. All individuals, entities or organizations using City facilities for public or private events shall comply with the requirements in this article. Potential vendors are provided information during Planning and Building permit review. The	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	ordinance became effective on January 1, 2010.	
Portola Valley	**City-wide ban effective October 25, 2012.** The Town of Portola Valley has adopted a Prohibition on the Use of Polystyrene Based Disposable Food Service Ware by Food Vendors ordinance 8.04.040 by reference to San Mateo County's Prohibition on the Use of Polystyrene Based Disposable Food Service Ware by Food Vendors. This ordinance bans food vendors from providing prepared food in disposable food service containers made from expanded polystyrene foam. Food vendors are defined as any vendor, business, organization, entity, group or individual, including a licensed retail food establishment that provides prepared food at a retail level. The ordinance became effective October 25, 2012.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.
Redwood City	**City-wide ban effective January 1, 2013.** In May 2012, the City Council added Article II (Polystyrene Based Disposable Food Service Ware Prohibition) to Chapter 13 (Environmental Health Code) of the Redwood City Municipal Code. The ordinance prohibits food vendors (i.e., any establishment located or providing food within the City) from dispensing prepared food to customers in disposable food service ware made from polystyrene (foam and solid) and requires disposable food service ware to be biodegradable, compostable, reusable or recyclable. Lids, plates, bowls, cups, utensils and straws made of polystyrene are also governed by the ordinance. The Polystyrene Based Disposable Food	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	Service Ware Prohibition Ordinance became effective on January 1, 2013.	
San Bruno	**City-wide ban adopted January 2009, effective April 1, 2010.** In January 2009, the City Council added Chapter 10.21 (Sustainable Food Packaging) to Title 10 (Municipal Services) of the San Bruno Municipal Code. The ordinance prohibits food vendors (i.e., any establishment located or providing food within the City) from dispensing prepared food to customers in disposable food service ware made from polystyrene (foam and solid) and requires disposable food service ware to be biodegradable, compostable, reusable or recyclable. Lids, plates, bowls, cups, utensils and straws made of polystyrene are also governed by the ordinance. The Sustainable Food Packaging Ordinance became effective on April 1, 2010.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.
San Carlos	**City-wide ban adopted March 2012, effective July 1, 2012.** On March 12, 2012 the San Carlos city council adopted Ordinance 1442 which adopts the San Mateo County model ordinance that bans Polystyrene Foodware by food vendors. The ordinance went into effect July 1, 2012. Food vendors have been notified in writing and were provided information on alternative products. Compliance with this ordinance is overseen by San Mateo County Environmental Health.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.
San Mateo	**City-wide ban adopted May 2013, effective June 2013.**	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	On May 6, 2013, the City Council adopted an Ordinance adding Chapter 5.89, Polystyrene Based Disposable Food Service Ware, to the San Mateo Municipal Code Title 5 – Business License and Regulations Code. The Ordinance became effective June 5, 2013.	implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.
South San Francisco	**City-wide ban effective October 2008.** Polystyrene Ban: The City adopted this ordinance in 2008. The ordinance bans all types of polystyrene foodware and requires compostable or recyclable foodware. Enforcement is complaint driven and also done by the City's Code Enforcement division when doing business inspections. City Code Enforcement Staff will continue to enforce the polystyrene food ware packaging ban within the city.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.
Woodside	**No ban; proposed in Short Term Plan but not approved by City Council.** Control Measures 1, 2 [polystyrene foam food service ware ordinances], and 7 were introduced as ordinances to the Town Council and did not receive approval.	
	SANTA CLARA	
Santa Clara County	**City-wide ban effective February 1, 2013.** The County of Santa Clara has adopted an Expanded Polystyrene Restriction, which became effective on February 1, 2013. The Ordinance prohibits all food vendors from providing prepared food in disposable food service ware made from expanded polystyrene foam. In addition, all disposable food service ware used by food vendors are required to be recyclable. The	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	ordinance excludes the following items from this prohibition: 1. Foods prepackaged outside unincorporated Santa Clara County; 2. Coolers and ice chests that are intended for reuse; 3. Trays used to hold fresh meat, poultry, fish, produce and eggs that require additional preparation prior to consumption, or are not intended for immediate consumption.	
Campbell	**Internal City ban in place FY 2012-2013; considering expanding.** As required by its Short-Term Plan, the City adopted and implemented in fiscal year 2012-2013 an internal ban for City facilities and events prohibiting the purchase and distribution of polystyrene food service ware by City staff and event vendors. In 2014 the City will consider implementing a city-wide ban on polystyrene foam food service ware at food service establishments (i.e. sit-down restaurants and fast food or single-serve to-go places). Implementing a ban will be dependent on available funding for an EIR, if required, and staff time to develop an ordinance and outreach campaign. In addition, the City would evaluate the progress of other West Valley and Santa Clara County cities in implementing a polystyrene foam foodware ban.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.
Cupertino	**Internal City ban adopted November 2010; City-wide ban adopted January 2014, effective July 1, 2014.**	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances –

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	The City adopted an internal no-foam food ware policy in November 2010, banning expanded polystyrene (EPS) food packaging and service ware on City property. In 2013, the City participated in San José's regional environmental study for a Polystyrene Foam Disposable Food Service Ware Ordinance. Cupertino's City Council unanimously approved a Citywide EPS food service ware ordinance on January 21, 2014 which will go into effect on July 1, 2014. The ordinance prohibits the distribution of EPS food service ware by restaurants, mobile food trucks and caterers doing business within the City of Cupertino.	Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.
Los Altos	**Ban adopted January 2014, effective July 4, 2014.** Staff went to Council with the Polystyrene (EPS) ban on December 10, 2013. City Council requested that staff research expanding the ban to additional venues, therefore the first reading was introduced on January 14, 2014. The EPS ban ordinance was adopted at the January 28, 2014 City Council meeting with an effective date of July 4, 2014. Enforcement of the EPS ordinance will be completed by the City's code enforcement officer. Outreach and education will be completed by the City and its hauler.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.
Los Altos Hills	**Internal City ban adopted April 2012, effective June 15, 2012.** In April 2012, the Town of Los Altos Hills passed an ordinance prohibiting the use of expanded polystyrene and non-recyclable food service containers at Town-sponsored events or on Town-owned property. This ordinance became effective on June 15, 2012.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
Los Gatos	**Internal City ban implemented FY 2012-2013; expansion considered.** In fiscal year 2012-13, the Town of Los Gatos implemented an internal ban for Town facilities and events prohibiting the purchase and distribution of polystyrene food service ware by Town staff and event vendors. As of February 1, 2014, no known violations involving the purchase or use of polystyrene foam were observed at Town facilities or internal staff related functions. A Town-wide polystyrene ordinance will be considered by the Town Council in 2014, once implementation of the Reusable Bag Ban has been completed.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.
Milpitas	**Ban proposed in Short-Term Plan postponed.** After presenting a Milpitas-specific study in April 2011 and receiving concerns of negative impacts to small businesses, staff decided to postpone presenting this ordinance to the Milpitas City Council. Staff may seek Council approval to conduct an EIR to again present a modified ordinance within the time frame of the upcoming permit.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.
Monte Sereno	**Internal City ban implemented FY 2012-2013; considering expansion.** In fiscal year 2012-13, the City of Monte Sereno implemented an internal ban for City facilities and events prohibiting the purchase and distribution of polystyrene food service ware by City staff and event vendors.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	By 2016 the City will consider adopting a resolution to encourage residents to stop using polystyrene in other cities and bringing it into Monte Sereno, similar to its bag ban resolution. The resolution will be accompanied by outreach via the City's website and e-mail distribution list.	
Mountain View	**City-wide ban proposed.** On or after July 1, 2014, the proposed ordinance prohibits the use of foam food ware at any establishment located or operating in the City of Mountain View which provides ready-to-consume food and beverage for dine-in, take-out, or complimentary service, whether or not a charge is imposed. It also applies to establishments providing food and beverage: (1) to the public for consumption on or off its premises; (2) as a catered event; and/or (3) at cafeterias of private schools and places of employment, regardless if such establishments are open to the general public. This includes, but is not limited to, restaurants, retail food establishments, caterers, cafeterias, stores, shops, sales outlets, grocery stores, delicatessens, fraternal clubs serving the public, mobile food vendors, vehicles or carts, or roadside stands. Actions planned for future implementation between July 2014 and July 2022: • On or after July 1, 2014, a food provider, located in or operating within the city of Mountain View, shall not dispense prepared food to a customer using polystyrene foam food service ware.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	• The proposed ordinance and Administrative Instruction would ban the use of polystyrene foam food service ware (foam food ware) for ready-to-consume food and beverages throughout the City and at all City facilities and events. This would apply to dine-in, take-out, or complimentary service, whether or not a charge is imposed. • The implementation adoption and implementation of the ordinance is contingent upon approval by the City Council. That said, staff is hopeful that the ordinance can be adopted and fully implemented prior on or shortly after July 1, 2014.	
Palo Alto	**City-wide and internal city bans adopted May 2009, effective April 2010; to be expanded.** The Council approved an Expanded Polystyrene ("EPS") Restriction Ordinance in May 2009. The City's ordinance number 5039 (Palo Alto Municipal Code Chapter 5.30) bans food vendors from providing prepared food in disposable food service containers made from expanded polystyrene or non-recyclable plastic. The ordinance also prohibits all City facilities, City-managed concessions, City-sponsored events, and City-permitted events from using disposable food service containers made from EPS or non-recyclable plastic. The ordinance became effective on April 22, 2010. Complaints and routine restaurant inspections include checking for compliance and any enforcement is documented in the stormwater database. In 2014, the City's staff will ask the Council to amend this ordinance to prohibit the sale of EPS foodware and ice	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	chests at retail establishments.	
San Jose	**Internal City ban effective May 1, 2010; City-wide ban adopted September 2013.** Effective May 1, 2010, the City of San José adopted a policy prohibiting food vendors from distributing polystyrene foam food and beverage ware at large events on Permittee-owned property. On April 24, 2012, City Council approved an amendment to the City's Environmentally Preferable Procurement Policy, or EP3, to provide guidelines for a prohibition on the purchase of EPS foam food ware. The new policy incorporates prohibitions on purchases of EPS foam food ware into the City's established EP3 policy. The new EP3 policy language covers all City facilities and the use of City funds regarding the purchase of food service ware containers and take-out food packaged in containers made from EPS such as cups, plates, and bowls. In September 2013, Council approved an ordinance to phase-out the use of polystyrene food ware in restaurants. San José is the largest city to adopt such an ordinance to date. The ordinance will be effective January 1, 2014 for multi-state restaurants. The polystyrene phase-out ordinance will be effective January 1, 2015 for all remaining food service vendors in San José. Ordinance evaluation and amendments as necessary.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the percentage of businesses in compliance with the ordinance and the percentage requiring a response.

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
Santa Clara	**Ban proposed.** The City Council directed Staff to commence the CEQA process for an EPS foam food ware ban as one of its 6-Month Strategic Objectives that were adopted in September 2013. On February 25, 2014, the City Council will be asked to approve an EPS foam food service ware ordinance that mirrors the requirements of the City of San Jose's EPS ban. The proposed ordinance will prohibit food service providers from providing EPS foam food ware. The effective date is projected to be in June/July of 2014. If approved, Staff will develop a post-adoption public education component, perform some data collection to evaluate the effectiveness of the ordinance, and develop and implement an enforcement plan.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.
Saratoga	**Internal City ban implemented FY 2012-13; City-wide ban considered.** In fiscal year 2012-13, the City of Saratoga implemented an internal ban for City facilities and events prohibiting the purchase and distribution of polystyrene food service ware by City staff and event vendors. In the future, the City may consider implementing a city-wide ban on polystyrene foam food service ware at food service establishments (i.e. sit-down restaurants and fast food or single-serve to-go places).	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.
Sunnyvale	**Ban adopted November 2013; ban on use by retail**	Indicators of progress and success for Long Term Plan

Jurisdiction	Polystyrene Ban	Assessment Strategies for Polystyrene Ban
	food establishments effective April 22, 2014; ban on all commercial sales effective April 22, 2015. The ordinance was adopted by the City Council on November 19, 2013. The effective date for the ordinance will be April 22, 2014 (Earth Day). The ordinance includes three components: • Implementation of a ban on the use of expanded polystyrene food containers by retail food establishments; • Codifying the city's existing practice of no EPS food container use as part of city business; and • Establishing a ban on all commercial sales of EPS food containers beginning April 22, 2015.	includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Description of outreach efforts, tracking and reporting business compliance rates, or other metrics of control measure performance.
SOLANO		
Fairfield	**No ban, but City is exploring.** The City is further researching the possibility of adopting a ban in the future.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the % of businesses in compliance with the ordinance and the percentage requiring a response.
Suisan	**No ban, but City is exploring.** The City is further researching the possibility of adopting a ban in the future.	Indicators of progress and success for Long Term Plan includes successful levels of trash control measures implementation. E.g., for Product-related Ordinances – Annually tracking and reporting the percentage of businesses in compliance with the ordinance and the percentage requiring a response.

Bio

Mark Grey, Ph.D.
Principal, Mark Grey Consulting

Dr. Grey has nearly 30 years of experience in water quality and waste recycling science in Washington State and California. Currently, he consults and advises on solid waste management issues in addition to representing contractors and builders in California on water quality and stormwater management issues. His work on trash, organics in the waste stream, and water quality goes back to 1988 and includes performing some of the original waste characterization work at composting facilities to identify trash and debris sources and improve feedstock quality in the Seattle, Washington area. In the past eight years, Dr. Grey has worked extensively on municipal separate storm sewer permit issues throughout California, primarily developing regulatory policy affecting land planning and development activities, and performing or collaborating on technical studies to support policy development.

He has extensive experience in compost site operations activities including all phases of the composting process, from material acceptance and quality control to end product evaluation to meet customer specifications and demands. Notable is his work at Synagro Technologies troubled Temescal Canyon 500 ton per-day biosolids composting facility near Corona, California, which was beleaguered by odor and leachate management problems. Dr. Grey, working with a team of environmental professionals, dramatically reduced odors, improved material mass balance and product quality, and re-worked permits, operating procedures and facility design to manage millions of gallons of compost leachate that was contributing to off-site odors and causing operational difficulties during winter months. He served as Technical Services Director for Synagro Technologies West Coast Division from 1999 to 2005, where he was directly responsible for environmental compliance at several large composting facilities in California and Arizona and at biosolids land application sites across five western states.

Dr. Grey has published several peer-reviewed papers in the fields of water quality and atmospheric science. Dr. Grey holds a Ph.D. in Soil Chemistry and M.S. in Forest Ecosystem Analysis from the University of Washington in Seattle, WA and a B.A. in English from Eastern Washington University in Cheney, WA.

EXHIBIT 14

STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD

ORDER: WQ 2000 - 11

In the Matter of the Petitions of
THE CITIES OF BELLFLOWER, ET AL., THE CITY OF ARCADIA, AND WESTERN STATES PETROLEUM ASSOCIATION
Review of January 26, 2000 Action of the Regional Board
and
Actions and Failures to Act
by both the
California Regional Water Quality Control Board,
Los Angeles Region and Its Executive Officer
Pursuant to Order No. 96-054,
Permit for Municipal Storm Water and Urban Run-Off Discharges Within
Los Angeles County
[NPDES NO. CAS614001]

SWRCB/OCC FILES A-1280, A-1280(a) and A-1280(b)

BY THE BOARD:

On July 15, 1996, the Los Angeles Regional Water Quality Control Board (Regional Water Board) issued a revised national pollutant discharge elimination system (NPDES) permit in Order No. 96-054 (permit) to the 85 incorporated cities and the county within Los Angeles County (the County).[1] The permit covers storm water discharges from municipal separate storm sewer systems throughout the County.[2]

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[1] This was the second storm water permit adopted for Los Angeles County and its cities. The first permit was the subject of an earlier Order. (In the Matter of Natural Resources Defense Council, Inc., Order WQ 91-04). In this permit, the County is designated as the Principal Permittee, and each city is designated as a permittee. The County is required to submit various documents on behalf of all of the permittees.
[2] The Regional Water Board has since issued a separate permit for one city, Long Beach. The relevant provisions of the Long Beach permit are similar to those in Order No. 96-054.

The permit contains provisions for the regulation of storm water discharges from development planning and construction.[3] Pursuant to these provisions, the County was required to submit Standard Urban Storm Water Mitigation Plans (SUSMPs).[4] The SUSMPs are plans that designate best management practices (BMPs) that must be used in specified categories of development projects. The County submitted SUSMPs, but the Regional Water Board approved the SUSMPs only after making revisions. The Executive Officer issued the revised SUSMPs on March 8, 2000.[5]

On February 25, 2000, the State Water Resources Control Board (State Water Board or Board) received a petition for review of the actions and failures to act regarding the SUSMPs from a number of cities, the Building Industry Association of Southern California and the Building Industry Legal Defense Foundation (jointly referred to as Cities). A second petition was received from the City of Arcadia. And a third petition was received from the Western States Petroleum Association (WSPA). On April 7, 2000, the petitioners filed amendments to their petitions, concerning the March 8, 2000 issuance of the SUSMPs. The Cities' amendment also revised the list of cities included in the petition. The Cities' petition now includes 32 cities. The petitions are legally and factually related, and have therefore been consolidated for purposes of review.[6] The petitioners also requested a stay of the SUSMPs. This request was denied by letter, dated May 11, 2000.

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[3] Permit, Part 2.III. These provisions focus more on post-construction impacts of development than on discharges from construction activities.
[4] Permit, Part 2.III.A.1.c.
[5] These are referred to herein as the Final SUSMPs. The Final SUSMPs also apply to Long Beach, even though it is subject to a separate permit.
[6] Cal. Code of Regs., tit. 23, section 2054.

On June 7 and 8, 2000, the Board held a hearing in Torrance. Several entities, including the petitioners, the Regional Water Board, and several environmental groups[7], were designated parties. The evidence from that hearing has been included in the record before the Board. The record for comments on the petition was kept open until the end of the hearing. The parties were allowed to submit post-hearing briefs.[8]

I. BACKGROUND

In prior Orders[9] this Board has explained the need for the municipal storm water programs and the emphasis on BMPs in lieu of numeric effluent limitations. The emphasis for preventing pollution from storm water discharges is still on the development and implementation of effective BMPs, but with the expectation that the level of effort will increase over time. In its Interim Permitting Approach[10], the United States Environmental Protection Agency (U.S. EPA) stated that first-round permits should include BMPs, and expanded or better-tailored BMPs in subsequent permits where necessary to attain water quality standards. Dischargers, consultants, and academic institutions in California and nationwide have conducted numerous studies on the effectiveness of BMPs and appropriate design standards. While many questions are still

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[7] The environmental groups are Natural Resources Defense Council, Inc., Santa Monica BayKeeper, and Heal the Bay.

[8] There are several documents that were not timely received and, therefore, are not made a part of the record before the Board. The hearing notice specified that all evidence from parties must be received by May 31, 2000. The Regional Water Board submitted documents on June 6, 2000. The hearing notice specified that policy statements were due by the close of the hearing. Several comment letters were received June 12, 13, and 19, 2000. None of these submittals are a part of the record. The post-hearing briefs were subject to a 10-page limit. The environmental groups submitted objections to the post-hearing brief submitted by the Cities. First, the environmental groups challenge the length of the brief. All briefs were subject to a 10-page limit. The Cities submitted a 10-page brief, with a 22-page attachment showing extensive proposed revisions to the SUSMPs. This submittal violates the page limit, and only the brief is considered part of the record. Second, the environmental groups claim that an e-mail message referred to by the petitioners is subject to attorney-client privilege and should not have been used in this hearing. This e-mail message, from the Regional Water Board's counsel to one of its engineers, was placed in the Regional Water Board's administrative record and submitted to the State Water Board. Any privilege that may have attached to the message has been waived and no longer exists. Finally, the post-hearing brief from the City of Arcadia was received late and will not be considered. Documents submitted late for interim deadlines (such as the deadline for submitting responses to the petitions), have been included in the record.

[9] See, especially Orders WQ 91-03 (In the Matter of Citizens for a Better Environment et al.) and WQ 91-04.

[10] Interim Permitting Approach for Water Quality-Based Effluent Limitations in Storm Water Permits. (61 Federal Register 57425.)

outstanding, more is expected of municipal dischargers, and many are implementing more effective programs.

While storm water management plans are improving, our knowledge of the impacts is also growing. Urban runoff has been determined to be a significant contributor of impairment to waters throughout the state. In Los Angeles specifically, beach closures are sometimes associated with urban runoff. In adopting the SUSMPs, the Regional Water Board took note of the urgent need for preventing further pollution from urban runoff and storm water discharges.

It is important to emphasize the role of the SUSMPs within the totality of regulating storm water discharges, and the purpose of these particular control measures. The requirement to prepare SUSMPS was part of the development controls in the permit. In addition to development controls, the permit requires education, public outreach, programs to restrict illicit connections and discharges, and controls on public facilities. In the context of the entire effort required by the permit, the development controls can be seen as preventing the existing situation from becoming worse.

The Final SUSMPs include a list of mandatory BMPs for nine categories of development. There are provisions that are applicable to all categories and lists of BMPs for individual categories. Requirements applicable to all categories include provisions to limit erosion from new development and redevelopment, requirements to conserve natural areas, protection of slopes and channels, and storm drain stenciling. Examples of BMPs specific to categories of discharge include design of loading docks for commercial projects and design of fueling areas for retail gasoline outlets. In most respects, the Final SUSMPs were similar to those proposed by the County. The significant departures were the inclusion of a numeric design standard for structural or treatment control BMPs, and the inclusion of certain types of projects that were not covered in the County's proposal. The design standard creates objective and measurable criteria for the amount of runoff that must be treated or infiltrated by BMPs.

The record indicates that the purpose of the development controls, including the SUSMPs, is not simply to prevent pollution associated with construction runoff. As the petitioners point out, construction discharges are already subject to this Board's Statewide Construction Permit. The development controls in the SUSMPs, on the other hand, focus on post-construction runoff. They are aimed at limiting not just the pollutants in runoff from the new development, but also the volume of runoff that enters the municipal storm sewer system. By limiting runoff from new development, the SUSMPs prevent increased impacts from urban runoff generally. There is adequate technical information in the record to show that by controlling the volume of runoff from new development, BMPs can be effective in reducing the discharge of pollutants in storm water runoff.

<u>The Procedure for Adopting the SUSMPs</u>

The permit requires a program for controls on Development Planning and Construction. It involved a number of submissions by the County in consultation with the Cities. The first step was submission of a checklist for determining priority projects and exempt projects. The checklist was due on January 30, 1998. A list of recommended BMPs for development projects was also due on that date. The SUSMPs were due within six months of approval of the BMP list, and were to incorporate BMPs for certain categories of development. Following approval of the SUSMPs, the cities and County were to implement development programs for priority projects, consistent with the BMP list and the SUSMPs.

The BMP list was not approved until April 22, 1999. Thereafter, the County submitted proposed SUSMPs on July 22, 1999. The Regional Water Board held a public workshop on

August 10, 1999. Following the workshop, the County submitted revisions to the SUSMPs on August 12, 1999. On August 16, 1999, the Regional water Board gave notice that it would discuss the SUSMPs in a public meeting on September 16, 1999. There was significant discussion at that meeting regarding the intent of the Executive Officer to approve the SUSMPs, but with revisions including a numeric design standard. At the conclusion of the meeting, the Regional Water Board members asked the Executive Officer to revise the SUSMPs and bring them back to another meeting. On December 7, 1999, the Executive Officer circulated revised SUSMPs for public review. This document incorporated a numeric design standard and made other revisions to the permittees' proposal. The Regional Water Board held a hearing on the SUSMPs on January 26, 2000. At that meeting, the Regional Water Board endorsed the SUSMPs revised by the Executive Officer, but directed him to make further changes. The Executive Officer issued the Final SUSMPs on March 8, 2000.

The Contents of the Final SUSMPs

The permit provides that the SUSMPs must incorporate the appropriate elements of the BMP list and, at a minimum, apply to seven development categories: 100-plus home subdivisions; 10-plus home subdivisions; 100,000-plus square foot commercial developments; automotive repair shops; retail gasoline outlets; restaurants; and hillside single-family dwellings.

The SUSMPs proposed by the County applied to these seven categories. Various BMPs applied to the different categories, and the SUSMPs contained narrative mitigation requirements for source control and treatment. The July proposals stated:

> "The development must be designed so as to mitigate (infiltrate and/or treat) the site runoff generated from impervious directly connected areas that may contribute pollutants of concern to the storm water conveyance system."

There were no numeric design criteria for mitigation. According to various participants, earlier County drafts had included design standards to mitigate flows from 0.6-inch storm events. But any numeric criteria had been removed from the version that was submitted.

In its revised SUSMPs, submitted on August 12, the County explained in its cover letter that the mitigation language did not mean that all runoff must be mitigated. Rather, the County's intent was to omit a numerical standard from the SUSMPs. The revised SUSMPs no longer referred to mitigation at all. Instead, the following language replaced the mitigation requirement:

> "The development must be designed so as to minimize, to the maximum extent practicable (MEP), the introduction of pollutants of concern that may result in significant impacts, generated from site runoff of directly connected impervious areas (DCIA), to the storm water conveyance system as approved by the building official."

The Final SUSMPs, as approved by the Executive Officer and the Regional Water Board, included several revisions from the County's submittal. The revision that is of greatest concern to the petitioners is the addition of Design Standards for Structural or Treatment Control BMPs.[11] The design standards require that developments subject to the SUSMPs shall be designed to mitigate storm water runoff (by treatment or infiltration) from one of the following:

> "1. The 85th percentile 24-hour runoff event determined as the maximized capture storm water volume for the area…, or
>
> 2. The volume of annual runoff based on unit basin storage water quality volume, to achieve 80 percent or more volume treatment…, or
>
> 3. The volume of runoff produced from a 0.75 inch storm event, prior to its discharge to a storm water conveyance system, or
>
> 4. The volume of runoff produced from a historical-record based reference 24-hour rainfall criterion for "treatment" (0.75 inch average for the Los Angeles County area) that achieves approximately the same reduction in pollutant loads achieved by the 85th percentile 24-hour runoff event."

[11] The Final SUSMPs also include the narrative language quoted from the County's August 22, 1999 proposal.

The Final SUSMPs also applied to two additional categories of development: parking lots over 5,000 square feet or with 25 or more spaces and exposed to storm water, and to developments in environmentally-sensitive areas. Other revisions included application to all projects in the categories instead of discretionary projects only and the definition of redevelopment.

II. CONTENTIONS AND FINDINGS[12]

Contention: The petitioners contend that the Regional Water Board erred in not complying with the Administrative Review Process within the permit, and acted arbitrarily and capriciously and in violation of the Clean Water Act and state law.

Finding: The permit required the County, in consultation with the cities subject to the permit, to submit SUSMPs. The permit includes some general minimum requirements for the SUSMPs.[13] The Executive Officer is granted authority to approve the SUSMPs.[14]

The permit also contains an administrative review process.[15] The permit states that the administrative review process "formalizes the procedure for review and acceptance of reports and documents" and "provides a method to resolve any differences in compliance expectations between the Regional Board and Permittees, prior to initiating enforcement action."[16] Following this introductory statement, the permit includes two procedures. The first is for review and approval or disapproval of reports and documents. The second is the dispute resolution section that must be followed prior to enforcement action.

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[12] This Order does not address all of the issues raised by the petitioners. The Board finds that the issues that are not addressed are insubstantial and not appropriate for State Water Board review. (See *People v. Barry* (1987) 194 Cal.App.3d 158, [239 Cal.Rptr. 349], Cal. Code Regs., tit. 3, § 052.)
[13] Permit, Part 2, III.A.1.c.
[14] Permit, Part 2, III.A.2.
[15] Permit, Part 2, I.G.
[16] *Id*.

The process for review of documents that are subject to the Executive Officer's approval is that the Executive Officer will notify the permittees of the results of the review and approval or disapproval within 120 days. If the Executive Officer does not do so, the permittees must notify the Regional Water Board of their intent to implement the documents without approval. The Executive Officer then has 10 days to respond, or the permittees may implement the program and the Executive Officer may not make modifications.

The dispute resolution procedure is to be used when the Executive Officer determines that a permittee's storm water program is insufficient to meet the permit's provisions. The Executive Officer must send a "Notice of Intent to Meet and Confer" with the permittee. A meet and confer period then ensues, resulting in a written "Storm Water Program Compliance Amendment (SWPCA)." The permittee is provided time to comply with the SWPCA. The Executive Officer is not allowed to take enforcement action against a permittee until the Executive Officer notifies the permittee in writing that the administrative review process has been exhausted and that a violation exists warranting enforcement.

The petitioners contend that the Executive Officer failed to notify the permittees that their SUSMPs were inadequate within 120 days of its submittal. The petitioners also argue that, by revising the SUSMPs without pursuing the dispute resolution process, the Regional Water Board "violated" the terms of the permit.

The provision for review of documents, which clearly includes the SUSMPs, requires that the Executive Officer notify the permittees of the results of the review and approval or disapproval within 120 days. The County submitted the revised SUSMPs on August 12, 1999. Within 120 days, the Regional Water Board held a workshop where staff expressed their concerns with the SUSMPs. Also within 120 days the Regional Water Board itself held a public meeting where there was extensive discussion and concern by board members that the SUSMPs did not include a numeric standard. And, prior to any notification by the permittees that they would proceed with implementing their SUSMPs, the Regional Water Board held a hearing January 26, 2000, where it directed the Executive Officer to issue the SUSMPs with revisions. The Executive Officer did so on March 8, 2000.

It is clear from the record that the Executive Officer, and the Regional Water Board itself, did inform the permittees that the SUSMPs were inadequate. There was no requirement for a specific form for expressing disapproval of documents. The extensive discussion and meetings on the need for revisions to the SUSMPs, and the Executive Officer's approval of revised SUSMPs, plainly refutes the allegation that the Regional Water Board never notified the permittees of its disapproval of the County's proposed SUSMPs.

The permittees also claim that the Regional Water Board "violated" the permit by failing to institute the meet and confer process.[17] The dispute resolution process, which includes meet and confer, did not apply to the decision to disapprove the proposed SUSMPs. That process is only required when the Regional Water Board ultimately takes an enforcement action against a permittee. It is separate from the process for review and approval or disapproval of documents, and does not even appear to relate to possible enforcement actions for submission of inadequate documents. This is illustrated by the fact that the provision regarding documents refers to submittals from both the Principal Permittee and the individual permittees, while the dispute resolution provision refers only to the permittees. This distinction is relevant because the County is charged with submitting the documents, while the individual permittees are responsible for compliance. A fair reading of the entire section on the administrative review process is that the

[17] We note that permits are issued to permittees to allow discharges to waters of the state. It is only permittees, and not Regional Water Boards, who can be charged with violating permits.

review and approval or disapproval of documents applies to submission of documents by the County on behalf of the cities, while the dispute resolution process applies to enforcement actions against any permittees for failing to implement adequate programs.

Contention: The petitioners contend that the Regional Water Board was not authorized to revise the SUSMPs to add more stringent requirements.

Finding: The petitioners contend that the mitigation standards in the SUSMPs are more stringent than the requirement in the permit to reduce pollutants in storm water runoff to the maximum extent practicable (MEP)[18]. The issue of what level of protection constitutes MEP will be discussed *Infra,* in the discussion of the reasonableness of the numeric standards. But the petitioners also make certain procedural claims on this point. They argue that in approving the BMP list, the Regional Water Board determined that those BMPs constituted MEP and that the Board could not add additional BMPs in the SUSMPs. They also contend the Regional Water Board itself had no authority to "usurp" the Executive Officer's role in reviewing the SUSMPs.[19] Finally, the petitioners contend that the Regional Water Board was not authorized to mandate a program for the permittees without amending the permit.

The permit requires the County to submit a list of BMPs for approval. The Regional Water Board approved this list. Following approval of the list, the County was required to submit the SUSMPs, which must "incorporate the appropriate elements of the recommended BMPs list."[20] The petitioners contend that by approving the list, the Regional Water Board determined that those BMPs constituted MEP, and that under the terms of the permit the Regional Water Board could not require additional BMPs.

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[18] The technology-based standard for controls under municipal storm water permits is MEP. For a fuller discussion of this standard, see Order WQ 91-03.

[19] It is undisputed that, at its January 26, 2000 meeting, the Board directed the Executive Officer to make additional revisions to the SUSMPs.

[20] Permit, Part 2, III.A.1.c.

In addressing this contention, we face what appears to be a fundamental misunderstanding of the numeric design standards on the part of the petitioners. The design standards are objective criteria that developers must achieve in designing their BMPs. The design standards are not separate BMPs. The standards tell what magnitude of storm event the BMPs must be designed to treat or infiltrate. They do not specify the BMPs that must be employed.

The SUSMPs as submitted by the County specify BMPs for various categories of development. Many of these BMPs are designed to minimize the pollutants in storm water runoff, by reducing flow through infiltration or by treatment. Examples of BMPs proposed by the County include infiltration basins and trenches, oil/water separators, and media filtration. The County's proposed SUSMPs also included language requiring minimizing the introduction of pollutants to the storm water conveyance system. That language remains unchanged in the Final SUSMPs. The only significant difference between the two versions of the SUSMPs was that the Regional Water Board established numeric criteria for designing the BMPs.

In adopting the Final SUSMPs, the Regional Water Board based its decision on the MEP standard.[21] The Regional Water Board did not significantly revise the BMP list or specify further the actions that developers must take to comply with the SUSMPs. Thus, we find that the Regional Water Board did not inappropriately revise its determination of what constituted MEP.

The Regional Water Board is the political body responsible for water quality control in the Los Angeles region.[22] While the Regional Water Board may delegate specified powers and duties to its Executive Officer,[23] it can at any time act on its own behalf. The fact that the Board authorized its Executive Officer to approve the SUSMPs in the permit did not mean that the Board thereby denied itself the opportunity to provide direction to the Executive Officer in his

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[21] Resolution R-00-02.
[22] Water Code sections 13200 and 13225.
[23] Water Code section 13223.

approval. Such an interpretation of its delegation authority would result in an improper failure of the Board to assume responsibility for water quality in the region.

We also find that the Regional Water Board was authorized to revise the SUSMPs to achieve compliance with the permit's requirements. The SUSMPs are a part of implementation of the permit. Because the permit regulates storm water discharges throughout the entire Los Angeles region and it is implemented by 85 cities and the County, it is obvious that the permit could not spell out every detail of the program for the five-year term of the permit. Instead, the implementation is through the submission, review and approval, and implementation of various programs, including the SUSMPs.[24] Where it receives a submission that it finds is not consistent with the requirements of the permit, it is reasonable for the Regional Water Board to be able to require revisions. The Regional Water Board is not required to amend the permit each time it approves a submittal or approves a submittal with revisions. On the other hand, if the Regional Water Board's action in requiring revisions is inconsistent with the terms of the permit, then the Board should not act without first amending the permit. While the Regional Water Board could have required the County to make the revisions rather than making them itself, we see no harm in the Regional Water Board's approach.

As will be discussed below, in most respects the Final SUSMPs are consistent with the permit. But there are some portions of the SUSMPs that are not consistent, and in those cases the SUSMPs provisions are further revised in this Order.

Contention: The petitioners make various procedural claims, including that they were denied due process, and that the Regional Water Board violated the Administrative Procedure

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[24] A fuller discussion of the use of storm water management plans to incorporate a developing program is found in Order No. WQ 91-03.

Act, the California Environmental Quality Act (CEQA), and the California Constitution, Article XIII B, section 6 (regarding state mandates).

Finding: The petitioners point out that at the January 26, 2000 Regional Water Board hearing, there was some confusion over late changes to the SUSMPs and they contend they were not provided adequate opportunity to comment. There was significant discussion of the SUSMPs over several months. We do not agree with the petitioners that a program of this magnitude must necessarily take years to develop. But we are concerned that at the January 26, 2000 hearing, interested persons and permittees were not given adequate time to review late revisions or to comment on them. Given the intense interest in this issue, the Regional Water Board should have diverged from its strict rule limiting individual speakers to three minutes and conducted a more formal process. Such a process should provide adequate time for comment, including continuances where appropriate.[25] But to the extent the Regional Water Board's process caused any harm, this Board cured those harms. We held a two-day hearing in Los Angeles County, where all parties were allowed significant time to present their positions and testimony. In addition, we allowed the introduction of new evidence that had not been presented to the Regional Water Board. At this point, all parties have been afforded a full opportunity to review the Final SUSMPs, to present their positions and evidence, and to engage in cross-examination. The petitioners' due process rights have been protected.

The Board has already addressed the contentions regarding compliance with other laws in prior decisions. The Administrative Procedure Act exempts the adoption of permits from its requirements.[26] While the SUSMPs are not a permit, they are implementing documents for a

[25] For future adjudicative proceedings that are highly controversial or involve complex factual or legal issues, we encourage regional water boards to follow the procedures for formal hearings set forth in Cal. Code of Regs., tit. 23, section 648 et seq.
[26] Government Code section 11352; See, Order No. 95-4 (In the Matter of the City and County of San Francisco).

permit, and are therefore subject to the exemption. Moreover, they are relevant only to this permit, and are not a general rule of application. The constitutional provisions regarding state mandates also do not apply to NPDES permits.[27] As will be explained below, the SUSMPs as revised herein, are consistent with MEP and therefore are federally mandated. The provisions of CEQA requiring adoption of environmental documents also do not apply to NPDES permits.[28] Again, as an implementing document for the permit, there is no requirement for a separate CEQA analysis.[29]

Contention: The petitioners contend that the SUSMPs do not properly apply the maximum extent practicable standard.

Finding: The permit, consistent with Clean Water Act section 402(p)(3)(B)(iii), requires controls to reduce the discharge of pollutants to the maximum extent practicable, or MEP.[30] In approving the Final SUSMPs, the Regional Water Board acknowledged that one of the primary objectives of the municipal storm water program is the requirement to reduce the discharge of pollutants from storm water conveyance systems to the MEP.[31] While all parties appear to agree that the standard for the SUSMPs is MEP, they disagree about what level of effort is necessary to comply with that standard.

The petitioners approach this issue from two angles. First, they contend that the SUSMPs will not provide water quality benefits that reflect MEP. Second, they contend that there could be adverse impacts on groundwater quality that have not been adequately evaluated.

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[27] See, Order No. WQ 90-3 (In the Matter of San Diego Unified Port District).
[28] Water Code section 13389.
[29] We do note with interest the environmental groups' comment that if the permittees believed it was necessary to comply with the APA and CEQA prior to adoption of the SUSMPs, then they themselves would have violated those acts in their submissions of the proposed SUSMPs.
[30] Permit, Finding 13.
[31] Final SUSMPs, at page 2; Resolution No. R-00-02, at page 3.

Storm Water Design Standards as MEP

In adopting the Final SUSMPs, the Regional Water Board found that many rivers and streams in Los Angeles County are impaired for pollutants found in storm water and urban runoff, and that storm water runoff carries pollutants from nearly all types of developed properties.[32] Pollutant loading from the aggregate of development in the basin results in impairments from sediments, metals, complex organic compounds, oil and grease, nutrients, and pesticides.[33] The Final SUSMPs reflect two goals: to reduce the amounts of these pollutants in runoff and to reduce the ability of runoff to act as a conveyance system to deliver more pollutants to receiving waters. The Final SUSMPs, which include lists of BMPs and design standards requiring treatment or infiltration, address these two goals.

Clean Water Act section 402(p)(3)(B)(iii), which sets forth the requirements for establishing MEP in municipal storm water permits, provides that such permits "shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants." The United States Environmental Protection Agency (U.S. EPA), in a guidance document, explains that BMPs should be used in first-round storm water permits, and "expanded or better-tailored BMPs in subsequent permits, where necessary, to provide for the attainment of water quality standards."[34] The Clean Water Act, as interpreted by U.S. EPA, does require that, in a second-round permit,[35] expanded BMPs may be appropriate. In light of the number of water

[32] Resolution No. R-00-02.
[33] *Id*.
[34] Interim Permitting Approach for Water Quality-Based Effluent Limitations in Storm Water Permits, 61 Federal Register 57425 (1996).
[35] The original permit was issued in 1990. The 1996 permit is a second-round permit.

bodies impaired by runoff in Los Angeles County, it was appropriate to expand the scope of BMPs during the permit term.

The regulations implementing section 402(p) specifically require municipalities to have controls to reduce the discharge of pollutants from their storm sewer systems that "receive discharges from areas of new development and significant redevelopment," including post-construction discharges.[36] Clearly, it was appropriate for the Regional Water Board to require BMPs for new development and significant redevelopment. The permittees, who submitted their own version of SUSMPs with listed BMPs for categories of development, appear to have no real quarrel with this general mandate.

This Board has already endorsed requirements to limit the flow of the "first flush" of storm water, which may contain more significant pollutants.[37] The permittees' own version of the SUSMPs required mitigation of storm water runoff by treatment or infiltration, thus conceding the propriety of these two approaches to lessening the impact of storm water discharges. The crux of the disagreement is that the Regional Water Board added numeric design standards to establish the amount of runoff that must be treated or infiltrated, and required the mandatory application of these standards to categories of development.

The addition of measurable standards for designing the BMPs provides additional guidance to developers and establishes a clear target for the development of the BMPs. The U.S. EPA guidance manual suggests the use of design criteria and performance standards for post-construction BMPs.[38] The numeric criteria the Regional Water Board adopted essentially

[36] 40 CFR section 122.26(d)(2)(iv)(A)(2).
[37] In the Matter of National Steel and Shipbuilding Company, et al., Order WQ 98-07, at slip opinion 7.
[38] Guidance Manual for the Preparation of Part 2 of the NPDES Permit Applications for Discharges from Municipal Separate Strom Sewer Systems, at page 6-4 (November 1992).

requires that 85 percent of the runoff from the development be infiltrated or treated.[39] In adopting these standards, the Regional Water Board based its decision on a research review of standards in other states and a statistical analysis of the rainfall in the area. The standard was set to gain the maximum benefit in mitigation while imposing the least burden on developers.[40] In light of the evidence of the use of this or more stringent standards in other states, the expert testimony supporting this standard, the endorsement by U.S. EPA in its comments, and the cost-effectiveness of its implementation (discussed below), the Regional Water Board acted appropriately in determining that the standards reflect MEP.[41]

We also find that the Regional Water Board appropriately applied these standards to seven of the categories listed in the SUSMPs: single-family hillside residences, 100,000 square foot commercial developments, automotive repair shops, restaurants, home subdivisions with 10 to 99 housing units, home subdivisions with 100 or more housing units, and parking lots with 5,000 square feet or more or with 25 or more parking spaces and potentially exposed to storm water runoff.[42] These categories, except for parking lots, were already targeted for special treatment in the permit. The evidence shows that each listed category can be a significant source of pollutants and/or runoff following development. It is appropriate that the design standards apply so that BMPs for these categories of development result in the infiltration or treatment of a significant about of the runoff.

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[39] Four different methods of calculation are permitted, so the percentage of capture may vary slightly.

[40] At the hearing in this matter, Regional Water Board staff explained that the standard was set at the bottom of the "knee" of the curve where the benefits of the mitigation requirements decrease and the cost increases. Other states have set the standard higher along this curve, requiring 90 to 95 percent mitigation.

[41] This conclusion in no way departs from our acceptance of BMPs in lieu of numeric effluent limitations in storm water permits. (See, e.g., Order WQ 91-03 and Order WQ 91-04.) The numeric standard is a design standard for BMPs. It does not quantify or limit the pollutants in the effluent. It also does not specify which of the listed BMPs must be employed.

[42] As discussed below, this Board is revising the SUSMPs to delete the application of the design standards to retail gasoline outlets and to locations within or directly adjacent to or discharging directly to environmentally-sensitive areas.

Potential Impacts on Ground Water

The petitioners contend that infiltration of runoff may lead to ground water pollution, and that the Regional Water Board did not properly consider such potential impacts. The mitigation standards provide for a waiver where there is a risk of ground water contamination because a known unconfined aquifer lies beneath the land surface or an existing or potential underground source of drinking water is less than ten feet from the soil surface.[43] The Final SUSMPs also include a discussion on how to use infiltration so that the risk of contamination of groundwater is reduced, and where infiltration is not appropriate.[44]

The Regional Water Board did consider the potential impacts to groundwater from infiltration, and included appropriate limitations and guidance on its use as a BMP. These provisions will ensure adequate protection of groundwater from any adverse impacts due to infiltration.

Contention: The petitioners contend the Regional Water Board failed to show that the SUSMPs as adopted are cost-effective and that the benefits to be obtained outweigh the costs.

Finding: The petitioners refer to the Preamble to the Phase II storm water regulations[45] as the basis for their economic argument. The quoted language, however, does not wholly support the petitioners' contention. The Preamble states that President Clinton's Clean Water Initiative clarifies "that the maximum extent practicable standard should be applied in a site-specific, flexible manner, taking into account cost considerations as well as water quality effects."[46] It is clear that cost should be considered in determining MEP; this does not mean that

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[43] Final SUSMP, page 14.
[44] *Id.*, at page 15.
[45] 64 Federal Register 68722 and following. These regulations do not apply to the permit, but the general language on MEP is relevant to EPA's interpretation of the standard.
[46] 64 Federal Register 68722, 68732 (December 8, 1999).

the Regional Water Board must demonstrate that the water quality benefits outweigh the economic costs.

While the standard of MEP is not defined in the storm water regulations or the Clean Water Act, the term has been defined in other federal rules. Probably the most comparable law that uses the term is the Superfund legislation, or CERCLA, at section 121(b). The legislative history of CERCLA indicates that the relevant factors, to determine whether MEP is met in choosing solutions and treatment technologies, include technical feasibility, cost, and state and public acceptance.[47] Another example of a definition of MEP is found in a regulation adopted by the Department of Transportation for onshore oil pipelines. MEP is defined as to "the limits of available technology and the practical and technical limits on a pipeline operator . . . ."[48]

These definitions focus mostly on technical feasibility, but cost is also a relevant factor. There must be a serious attempt to comply, and practical solutions may not be lightly rejected. If, from the list of BMPs, a permittee chooses only a few of the least expensive methods, it is likely that MEP has not been met. On the other hand, if a permittee employs all applicable BMPs except those where it can show that they are not technically feasible in the locality, or whose cost would exceed any benefit to be derived, it would have met the standard. MEP requires permittees to choose effective BMPs, and to reject applicable BMPs only where other effective BMPs will serve the same purpose, the BMPs would not be technically feasible, or the cost would be prohibitive. Thus while cost is a factor, the Regional Water Board is not required to perform a cost-benefit analysis.

In reviewing the record, it is apparent that the Regional Water Board did evaluate the cost of the SUSMPs. While the petitioners claim there is no evidence in the record to show the

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[47] 132 Cong. Rec. H 9561 (Oct. 8, 1986).
[48] 49 CFR section 194.5.

SUSMPs are necessary and cost effective, the opposite is true. The record is replete with documentation of costs of pilot mitigation projects, studies from similar programs in other states, and research studies. The Regional Water Board complied with the requirement to consider cost.

The Regional Water Board found that the cost to include BMPs that will meet the mitigation criteria will be one to two percent of the total development cost. This amount appears reasonable, especially in light of the amount of impervious surface already in Los Angeles County and the impacts on impaired water bodies. In considering the cost of compliance, it is also important to consider the costs of impairment. The beach closures in the Los Angeles region, well documented in the evidence, have reached critical proportions. These beach closures clearly have a financial impact on the area, and should be positively affected by the SUSMPs.

We do note that there could be further cost savings for developers if the permittees develop a regional solution for the problem. We recommend that the cities and the County, along with other interested agencies, work to develop regional solutions so that individual dischargers are not forced to create numerous small-scale projects. While the SUSMPs are an appropriate means of requiring mitigation of storm water discharges, we also encourage innovative regional approaches.[49]

Contention: The petitioners have raised contentions regarding details of the SUSMPs, including the amount of time allowed for inclusion of SUSMPs in local ordinances, and their application to both “discretionary” and “non-discretionary” projects. In addition, during the hearing certain ambiguities in the wording of the Final SUSMPs became apparent, including the provisions regarding redevelopment and environmentally-sensitive areas. In this portion of the

[49] We note that the SUSMPs as written do not in any way preclude the development of regional solutions approved by the Regional Water Board as a means to comply with the BMP and design standard requirements.

Order we address these issues and also the application of the design standards to retail gasoline outlets (RGOs) and the waiver funding requirements.

Finding: The testimony at the hearing in this matter revealed that there are specific provisions of the SUSMPs that create confusion as to the types of development projects subject to the mitigation design standards. The petitioners also contend that application of the standards to specific types of development either is unreasonable or is inconsistent with the terms of the permit. The specific requirements are discussed below.

Retail Gasoline Outlets

Petitioner WSPA contends that RGOs should be excluded from the SUSMPs. Its petition raised the same general contentions as the other petitioners, but at the hearing WSPA presented evidence specific to RGOs. In particular, WSPA raised questions about the propriety of applying the design standards for BMPs to RGOs. In considering this issue, we conclude that construction of RGOs is already heavily regulated and that owners may be limited in their ability to construct infiltration facilities. Moreover, in light of the small size of many RGOs and the proximity to underground tanks, treatment may not always be feasible, or safe. The mandatory BMPs that are included in the SUSMPs may be adequate to achieve MEP at RGOs, but the Regional Water Board should add additional mandatory BMPs, such as use of dry cleanup methods (e.g. sweeping) for removal of litter and debris, use of rags and absorbents for leaks and spills, restricting the practice of washing down hard surfaces unless the wash water is collected and disposed of properly, annual training of employees on proper spill cleanup and waste disposal methods, and the inclusion of BMPs to address trash receptacle areas and air/water supply areas.[50] We conclude that because RGOs are already heavily regulated and may be limited in their ability to construct infiltration facilities or to perform treatment, they should not be subject to the BMP design standards at this time, and recommend that the Regional Water Board undertake further consideration of a threshold relative to size of the RGO, number of fueling nozzles, or some other relevant factor. This Order should not be construed to preclude inclusion of RGOs in the SUSMP design standards, with proper justification, when the permit is reissued.

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Redevelopment Projects

The SUSMPs were written to apply to new development and to some types of redevelopment in nine categories of projects. The definition of "redevelopment" reflected the intent of the Regional Water Board to define the scope of redevelopment projects subject to the requirements. That definition[51], however, was somewhat confusing, and it was apparent from testimony at the hearing that the parties had different understandings of the scope of redevelopment subject to the SUSMPs. In their post-hearing briefs, the various parties appeared to agree on the actual intent of the Regional Water Board in including redevelopment in the SUSMPs. This intent was to include redevelopment that adds or creates at least 5,000 square feet of impervious surface to the original development and, where the addition constitutes less than 50 percent of the original development, to limit the application of the BMP design standards to the addition.

[50] These BMPs are from a list of BMPs in a publication of the California Storm Water Quality Task Force. (Best Management Practice Guide – Retail Gasoline Outlets. March 1997.) This publication includes BMPs in addition to those listed in the SUSMPs. All BMPs recommended in this publication should be mandated.

[51] The SUSMPs state: "Redevelopment" means, on an already developed site, the creation or addition of at least 5,000 square feet of impervious surfaces or the creation or addition of fifty percent or more of impervious surfaces or the making of improvements to fifty percent or more of the existing structure. Redevelopment includes, but is not limited to: the expansion of a building footprint or addition or replacement of a structure; structural development including an increase in gross floor area and/or exterior construction or remodeling; replacement of impervious surface that is not part of a routine maintenance activity; and land disturbing activities related with structural or impervious surfaces.

While some parties requested further requirements for development, it appears that the Regional Water Board's original intent was relatively simple to apply and results in a fair and appropriate application of the SUSMPs' requirements to redevelopment. Therefore, we will revise the definition in the SUSMPs accordingly.

Environmentally-Sensitive Areas

The permit required that the SUSMPs address at least seven development categories.[52] The final SUSMPs added two more categories: parking lots of 5,000 square feet or more or with 25 or more parking spaces and potentially exposed to storm water runoff; and location within or directly adjacent to an environmentally-sensitive area (ESA). The petitioners contend that the addition of ESAs was inappropriate because the permit refers only to "development categories"[53] and ESA is a location category.

Whether or not the Regional Water Board went beyond the permit's terms in including this category, we find a fundamental problem with the language of the SUSMPs regarding ESAs. All of the other categories are relatively simple to apply because they describe the types of development that fall within the category. For instance, the threshold for a commercial development is 100,000 square feet. If the development is smaller, it is not subject to the SUSMPs. But for developments within ESAs, the SUSMPs contain no threshold. This absence led to speculation by the petitioners that something as small as a new patio on a home in an ESA would make the SUSMPs applicable. The Regional Water Board, at the hearing and in its post-hearing brief, conceded that there should be some threshold. While the Regional Water Board

[52] The categories listed in the permit are: single-family hill residences, 100,000 square-foot commercial developments, automotive repair shops, retail gasoline outlets, restaurants, home subdivisions with 10 to 99 housing units, and home subdivisions with 100 or more housing units. Permit, Part 2, III.A.1.c.
[53] *Id.*

did recommend a specific threshold, we believe that it is inappropriate for this Board to add a threshold that has not been fully discussed by all interested persons.

While it may be appropriate to include more stringent controls for developments in ESAs, we also note that such developments are already subject to extensive regulation under other regulatory programs. Moreover, in light of the permit language limiting the SUSMPs to development categories, ESAs are not an appropriate category within the SUSMPs. The Regional Water Board may choose to consider the issue further when it reissues the permit.

Discretionary and Non-Discretionary, or Ministerial, Projects

The petitioners contend that the SUSMPs should apply only to projects that are considered "discretionary" within the meaning of California Environmental Quality Act (CEQA).[54] They argue that the inclusion of non-discretionary, or ministerial, projects is inconsistent with the terms of the permit.

The permit provisions on development projects do refer to "discretionary" projects in several places. The permittees are directed to develop a checklist for determining priority and exempt projects.[55] Priority projects are defined as development and redevelopment projects requiring discretionary approval, which may have a potential significant effect on storm water quality.[56] The permittees are also required to develop a BMP list.[57] In developing the SUSMPs, the permittees are required to incorporate appropriate elements of the BMP list.[58] Next, the permittees must develop a program on planning control measures for priority projects (which are limited to projects requiring discretionary approval), consistent with the list of BMPs and the

[54] Public Resources Code section 21000 *et seq*.
[55] Permit, Part 2, III.A.1.a.
[56] *Id*.
[57] Permit, Part 2, III.A.1.b.
[58] Permit, Part 2, III.A.1.c.

SUSMPs.[59] The permit further states that, in order to assure compliance with these requirements, the permittees must develop guidelines on preparing CEQA documents that link mitigation conditions to "local discretionary project approvals."[60]

Taken as a whole, the provisions of the permit appear to link the development requirements for SUSMPs to developments that receive discretionary approval by local governments, as defined in CEQA. The SUSMPs are an implementation tool for the permit and must be consistent with the permit. While the limitation of the SUSMPs to discretionary projects may not be sufficiently broad for an effective storm water control program, the Regional Water Board acted inappropriately in expanding the SUSMPs to include non-discretionary projects. The Regional Water Board may consider expanding the development controls beyond CEQA discretionary projects when it reissues the permit. But at this time, the SUSMPs must be revised so that they are limited to development projects requiring discretionary approval within the meaning of CEQA.[61]

Waiver Funding Requirement

Where a waiver is granted from the design standard requirements, the Final SUSMPs provide that the permittee must require the project proponent to transfer the cost savings to a storm water mitigation fund. The fund is to be operated by a public agency or a non-profit entity, to promote regional or alternative solutions for storm water pollution in the same storm watershed. The petitioners contend that the funding requirement will create an additional administrative burden.

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[59] Permit, Part 2, III.a.2.
[60] Permit, Part 2, III.a.3.b.
[61] We note that the Final SUSMPs already include a definition of "discretionary project" consistent with the definition in the CEQA guidelines. Final SUSMPs at page 4 of 25; Title 14, California Code of Regulations, section 15357. Apparently this definition was inadvertently retained after the Regional Water Board decided to expand the SUSMPs beyond discretionary projects.

The concept of a mitigation fund or "bank" is a positive idea for obtaining regional solutions to storm water runoff. As a long-term strategy, municipal storm water dischargers should work to establish regional mitigation facilities, which may be more cost-effective and more technically effective than mitigation structures at individual developments. But at this point there are not sufficient resources in place to require all permittees to establish such funds or to find appropriate non-profit organizations. Before mandating funding, preliminary questions should be answered, including who will manage the fund, what types of projects it will be used for, what entities can legally operate such funds, and how permittees will determine the amount of the assessments. It would be appropriate for the County to consider developing a program with the appropriate flood control agency, or as a model for the separate cities to develop. There may be suitable agencies to administer such funds, but the development of programs may take some time. The Regional Water Board should consider adopting such a program when it reissues the permit, after consultation with the appropriate local agencies.

III. CONCLUSIONS

Based on the discussion above, the Board concludes that:

1. The Regional Water Board complied with the procedural requirements of the permit, including the Administrative Review Process, in approving the Final SUSMPs.
2. The Regional Water Board was authorized to revise the SUSMPs by including more stringent requirements than the permittees had proposed.
3. The Regional Water Board complied with did not violate the Administrative Procedure Act, CEQA, or the Constitutional provisions on state mandates. The petitioners' due process rights have been protected
4. The Regional Water Board considered the costs of the SUSMPs, and acted reasonably in requiring these controls in light of the expected benefits to water quality.

5. The Final SUSMPs reflect a reasonable interpretation of development controls that achieve reduction of pollutants in storm water discharges to the maximum extent practicable.
6. The SUSMPs include adequate protections of groundwater quality from any impacts from infiltration.
7. The SUSMPs will be revised to clarify the intent of the Regional Water Board and to make them consistent with the permit. Specifically, retail gasoline outlets should not be subject to the BMP design standards because they are already heavily regulated and may be limited in their ability to construct infiltration facilities or to perform treatment. Redevelopment projects should be subject to the SUSMPs only if they result in creation or addition of 5,000 square feet of impervious surfaces. Environmentally-sensitive areas should not be listed as a category in the SUSMPs. The SUSMPs should only apply to discretionary projects. The requirement for funding by project proponents who receive waivers should be deleted. The SUSMPs will be amended as shown in the attachment to this Order.
8. In light of the revisions of the SUSMPs made by this Order, and to allow the permittees adequate time to adopt implementing ordinances, the deadline for adopting ordinances will be revised to January 15, 2001, and the effective date of the Final SUSMPs will be revised to February 15, 2001.

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IV. ORDER

IT IS HEREBY ORDERED that the Standard Urban Storm Water Mitigation Plans for Los Angeles County and Cities in Los Angeles County is revised consistent with the amendments attached hereto. In all other respects the petitions are dismissed.

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of an order duly and regularly adopted at a meeting of the State Water Resources Control Board held on October 5, 2000.

AYE: Arthur G. Baggett, Jr.
Mary Jane Forster
John W. Brown

NO: None

ABSENT: Peter S. Silva

ABSTAIN: None

/s/
Maureen Marché
Administrative Assistant to the Board

AMENDMENTS TO SUSMPS

[These amendments are to the Final SUSMP, as published March 8, 2000]

Page 3 of 25

First full paragraph:

All **discretionary development and redevelopment** projects that fall into one of ~~seven~~ **the following** categories are ~~identified in the Los Angeles County MS4 Permit as requiring~~ **subject to these** SUSMPs. These categories are:

- Single-family Hillside Residences
- 100,000 Square Foot Commercial Developments
- Automotive Repair Shops
- Retail Gasoline Outlets
- Restaurants
- Home Subdivisions with 10 to 99 housing units
- Home Subdivisions with 100 or more housing units
- **Parking lots 5,000 square feet or more or with 25 or more parking spaces and potentially exposed to storm water runoff**

Second full paragraph:

~~The Regional Board Executive Officer has designated two additional categories subject to SUSMP requirements for the Los Angeles County MS4 Permit. These categories are:~~

- ~~Location within or directly adjacent to or discharging directly to an environmentally sensitive area, and~~
- ~~Parking lots 5,000 square feet or more or with 25 or more parking spaces and potentially exposed to storm water runoff~~

Fourth full paragraph:

Permittees shall amend codes<u>, if necessary,</u> not later than ~~September 8, 2000~~ **January 15, 2001**, to give legal effect to the SUSMP requirements. The SUSMP requirements for projects identified herein shall take effect not later than ~~October 8, 2000~~ **February 15, 2001**.

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Delete definition of "Environmentally Sensitive Area"

Revise Definition of "Redevelopment":

"Redevelopment" means, on an already developed site, the creation or addition of at least 5,000 square feet of impervious surfaces ~~or the creation or addition of fifty percent or more of impervious surfaces or the making of improvements to fifty percent or more of the existing structure~~. Redevelopment includes, but is not limited to: the expansion of a building footprint or addition or replacement of a structure; structural development including an increase in gross floor area and/or exterior construction or remodeling; replacement of impervious surface that is not part of a routing maintenance activity; and land disturbing activities related with structural or impervious surfaces. **Where redevelopment results in an increase of less than fifty percent of the impervious surfaces of a previously existing development, and the existing development was not subject to these SUSMPs, the Design Standards apply only to the addition, and not to the entire development.**

Page 10 of 25

Add to "Limited Exclusion": Retail Gasoline Outlets

Page 15 of 25

Delete the first full paragraph (storm water mitigation funding)

EXHIBIT 15

STATE WATER RESOURCES CONTROL BOARD

RESOLUTION NO. 68-16

STATEMENT OF POLICY WITH RESPECT TO
MAINTAINING HIGH QUALITY OF WATERS IN CALIFORNIA

WHEREAS the California Legislature has declared that it is the policy of the State that the granting of permits and licenses for unappropriated water and the disposal of wastes into the waters of the State shall be so regulated as to achieve highest water quality consistent with maximum benefit to the people of the State and shall be controlled so as to promote the peace, health, safety and welfare of the people of the State; and

WHEREAS water quality control policies have been and are being adopted for waters of the State; and

WHEREAS the quality of some waters of the State is higher than that established by the adopted policies and it is the intent and purpose of this Board that such higher quality shall be maintained to the maximum extent possible consistent with the declaration of the Legislature;

NOW, THEREFORE, BE IT RESOLVED:

1. Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies.

2. Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.

3. In implementing this policy, the Secretary of the Interior will be kept advised and will be provided with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act.

BE IT FURTHER RESOLVED that a copy of this resolution be forwarded to the Secretary of the Interior as part of California's water quality control policy submission.

CERTIFICATION

The undersigned, Executive Officer of the State Water Resources Control Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on October 24, 1968.

Dated: October 28, 1968

Kerry W. Mulligan
Executive Officer
State Water Resources
Control Board

EXHIBIT 16

Assembly Bill No. 1879

CHAPTER 559

An act to add Sections 25252, 25252.5, 25253, 25254, 25255, and 25257 to the Health and Safety Code, relating to hazardous materials.

[Approved by Governor September 29, 2008. Filed with Secretary of State September 29, 2008.]

LEGISLATIVE COUNSEL'S DIGEST

AB 1879, Feuer. Hazardous materials: toxic substances.

(1) Existing law establishes the Department of Toxic Substances Control, in the California Environmental Protection Agency, with powers and duties regarding, among other things, hazardous waste disposal, underground storage of hazardous substances and waste, and the handling and release of hazardous materials.

This bill would require the department by January 1, 2011, to adopt regulations to establish a process by which chemicals or chemical ingredients in products may be identified and prioritized for consideration as being chemicals of concern. The bill would specify a procedure for the adoption of those regulations, including requiring that the department, in adopting those regulations, prepare a multimedia life cycle evaluation, as defined, and submit the regulations and the multimedia life cycle evaluation to the California Environmental Policy Council for review.

The department would also be required to adopt, by January 1, 2011, regulations to establish a process by which chemicals of concern in products, and their potential alternatives, are evaluated to determine how best to limit exposure or to reduce the level of hazard posed by a chemical of concern. The regulations would be required to specify actions that the department may take following the completion of the analysis, including imposing requirements to provide additional information, requirements for labeling or other types of product information, controlling access to or limiting exposure, managing the product at the end of its useful life, or funding green chemistry challenge grants, restrictions on the use of the chemical of concern in the product, or prohibitions on use.

The bill would require the department to establish a Green Ribbon Science Panel to advise the department and the council.

The bill would establish a procedure for the protection of information submitted to the department that is claimed to be a trade secret. Because a violation of the regulations adopted by the department pursuant to the bill would be a crime, this bill would impose a state-mandated local program.

This bill would become effective only if SB 509 is enacted on or before January 1, 2009.

(2) The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement.

This bill would provide that no reimbursement is required by this act for a specified reason.

The people of the State of California do enact as follows:

SECTION 1. Section 25252 is added to the Health and Safety Code, to read:

25252. (a) On or before January 1, 2011, the department shall adopt regulations to establish a process to identify and prioritize those chemicals or chemical ingredients in consumer products that may be considered as being a chemical of concern, in accordance with the review process specified in Section 25252.5. The department shall adopt these regulations in consultation with the office and all appropriate state agencies and after conducting one or more public workshops for which the department provides public notice and provides an opportunity for all interested parties to comment. The regulations adopted pursuant to this section shall establish an identification and prioritization process that includes, but is not limited to, all of the following considerations:

(1) The volume of the chemical in commerce in this state.

(2) The potential for exposure to the chemical in a consumer product.

(3) Potential effects on sensitive subpopulations, including infants and children.

(b) (1) In adopting regulations pursuant to this section, the department shall develop criteria by which chemicals and their alternatives may be evaluated. These criteria shall include, but not be limited to, the traits, characteristics and endpoints that are included in the clearinghouse data pursuant to Section 25256.1.

(2) In adopting regulations pursuant to this section, the department shall reference and use, to the maximum extent feasible, available information from other nations, governments, and authoritative bodies that have undertaken similar chemical prioritization processes, so as to leverage the work and costs already incurred by those entities and to minimize costs and maximize benefits for the state's economy.

(3) Paragraph (2) does not require the department, when adopting regulations pursuant to this section, to reference and use only the available information specified in paragraph (2).

SEC. 2. Section 25252.5 is added to the Health and Safety Code, to read:

25252.5. (a) Except as provided in subdivision (f), the department, in adopting the regulations pursuant to Sections 25252 and 25253, shall prepare a multimedia life cycle evaluation conducted by affected agencies and coordinated by the department, and shall submit the regulations and the multimedia life cycle evaluation to the council for review.

(b) The multimedia evaluation shall be based on the best available scientific data, written comments submitted by interested persons, and information collected by the department in preparation for adopting the regulations, and shall address, but is not limited to, the impacts associated with all the following:

(1) Emissions of air pollutants, including ozone forming compounds, particulate matter, toxic air contaminants, and greenhouse gases.

(2) Contamination of surface water, groundwater, and soil.

(3) Disposal or use of the byproducts and waste materials.

(4) Worker safety and impacts to public health.

(5) Other anticipated impacts to the environment.

(c) The council shall complete its review of the multimedia evaluation within 90 calendar days following notice from the department that it intends to adopt regulations. If the council determines that the proposed regulations will cause a significant adverse impact on the public health or the environment, or that alternatives exist that would be less adverse, the council shall recommend alternative measures that the department or other state agencies may take to reduce the adverse impact on public health or the environment. The council shall make all information relating to its review available to the public.

(d) Within 60 days of receiving notification from the council of a determination of significant adverse impact, the department shall adopt revisions to the proposed regulation to avoid or reduce the adverse impact, or the affected agencies shall take appropriate action that will, to the extent feasible, mitigate the adverse impact so that, on balance, there is no significant adverse impact on public health or the environment.

(e) In coordinating a multimedia evaluation pursuant to subdivision (a), the department shall consult with other boards and departments within the California Environmental Protection Agency, the State Department of Public Health, the State and Consumer Services Agency, the Department of Homeland Security, the Department of Industrial Relations, and other state agencies with responsibility for, or expertise regarding, impacts that could result from the production, use, or disposal of consumer products and the ingredients they may contain.

(f) Notwithstanding subdivision (a), the department may adopt regulations pursuant to Sections 25252 and 25253 without subjecting the proposed regulation to a multimedia evaluation if the council, following an initial evaluation of the proposed regulation, conclusively determines that the regulation will not have any significant adverse impact on public health or the environment.

(g) For the purposes of this section, "multimedia life cycle evaluation" means the identification and evaluation of a significant adverse impact on public health or the environment, including air, water, or soil, that may result from the production, use, or disposal of a consumer product or consumer product ingredient.

SEC. 3. Section 25253 is added to the Health and Safety Code, to read:

25253. (a) (1) On or before January 1, 2011, the department shall adopt regulations pursuant to this section that establish a process for evaluating chemicals of concern in consumer products, and their potential alternatives, to determine how best to limit exposure or to reduce the level of hazard posed by a chemical of concern, in accordance with the review process specified in Section 25252.5. The department shall adopt these regulations in consultation with all appropriate state agencies and after conducting one or more public workshops for which the department provides public notice and provides an opportunity for all interested parties to comment.

(2) The regulations adopted pursuant to this section shall establish a process that includes an evaluation of the availability of potential alternatives and potential hazards posed by those alternatives, as well as an evaluation of critical exposure pathways. This process shall include life cycle assessment tools that take into consideration, but shall not be limited to, all of the following:

(A) Product function or performance.

(B) Useful life.

(C) Materials and resource consumption.

(D) Water conservation.

(E) Water quality impacts.

(F) Air emissions.

(G) Production, in-use, and transportation energy inputs.

(H) Energy efficiency.

(I) Greenhouse gas emissions.

(J) Waste and end-of-life disposal.

(K) Public health impacts, including potential impacts to sensitive subpopulations, including infants and children.

(L) Environmental impacts.

(M) Economic impacts.

(b) The regulations adopted pursuant to this section shall specify the range of regulatory responses that the department may take following the completion of the alternatives analysis, including, but not limited to, any of the following actions:

(1) Not requiring any action.

(2) Imposing requirements to provide additional information needed to assess a chemical of concern and its potential alternatives.

(3) Imposing requirements on the labeling or other type of consumer product information.

(4) Imposing a restriction on the use of the chemical of concern in the consumer product.

(5) Prohibiting the use of the chemical of concern in the consumer product.

(6) Imposing requirements that control access to or limit exposure to the chemical of concern in the consumer product.

(7) Imposing requirements for the manufacturer to manage the product at the end of its useful life, including recycling or responsible disposal of the consumer product.

(8) Imposing a requirement to fund green chemistry challenge grants where no feasible safer alternative exists.

(9) Any other outcome the department determines accomplishes the requirements of this article.

(c) The department, in developing the processes and regulations pursuant to this section, shall ensure that the tools available are in a form that allows for ease of use and transparency of application. The department shall also make every feasible effort to devise simplified and accessible tools that consumer product manufacturers, consumer product distributors, product retailers and consumers can use to make consumer product manufacturing, sales, and purchase decisions.

SEC. 4. Section 25254 is added to the Health and Safety Code, to read:

25254. (a) In implementing this article, the department shall establish a Green Ribbon Science Panel. The panel shall be composed of members whose expertise shall encompass all of the following disciplines:

(1) Chemistry.

(2) Chemical engineering.

(3) Environmental law.

(4) Toxicology.

(5) Public policy.

(6) Pollution prevention.

(7) Cleaner production methods.

(8) Environmental health.

(9) Public health.

(10) Risk analysis.

(11) Materials science.

(12) Nanotechnology.

(13) Chemical synthesis.

(14) Research.

(15) Maternal and child health.

(b) The department shall appoint all members to the panel on or before July 1, 2009. The department shall appoint the members for staggered three-year terms, and may reappoint a member for additional terms, without limitation.

(c) The panel shall meet as often as the department deems necessary, with consideration of available resources, but not less than twice each year. The department shall provide for staff and administrative support to the panel.

(d) The panel meetings shall be open to the public and are subject to the Bagley-Keene Open Meeting Act (Article 9 (commencing with Section 11120) of Chapter 1 of Part 1 of Division 3 of Title 2 of the Government Code).

SEC. 5. Section 25255 is added to the Health and Safety Code, to read:

25255. The panel may take any of the following actions:

(a) Advise the department and the council on scientific and technical matters in support of the goals of this article of significantly reducing adverse health and environmental impacts of chemicals used in commerce, as well as the overall costs of those impacts to the state's society, by encouraging the redesign of consumer products, manufacturing processes, and approaches.

(b) Assist the department in developing green chemistry and chemicals policy recommendations and implementation strategies and details, and ensure these recommendations are based on a strong scientific foundation.

(c) Advise the department and make recommendations for chemicals the panel views as priorities for which hazard traits and toxicological end-point data should be collected.

(d) Advise the department in the adoption of regulations required by this article.

(e) Advise the department on any other pertinent matter in implementing this article, as determined by the department.

SEC. 6. Section 25257 is added to the Health and Safety Code, to read:

25257. (a) A person providing information pursuant to this article may, at the time of submission, identify a portion of the information submitted to the department as a trade secret and, upon the written request of the department, shall provide support for the claim that the information is a trade secret. Except as provided in subdivision (d), a state agency shall not release to the public, subject information supplied pursuant to this article that is a trade secret, and that is so identified at the time of submission, in accordance with Section 6254.7 of the Government Code and Section 1060 of the Evidence Code.

(b) This section does not prohibit the exchange of a properly designated trade secret between public agencies, if the trade secret is relevant and necessary to the exercise of the agency's jurisdiction and the public agency exchanging the trade secrets complies with this section. An employee of the department that has access to a properly designated trade secret shall maintain the confidentiality of that trade secret by complying with this section.

(c) Information not identified as a trade secret pursuant to subdivision (a) shall be available to the public unless exempted from disclosure by other provisions of law. The fact that information is claimed to be a trade secret is public information.

(d) (1) Upon receipt of a request for the release of information that has been claimed to be a trade secret, the department shall immediately notify the person who submitted the information. Based on the request, the department shall determine whether or not the information claimed to be a trade secret is to be released to the public.

(2) The department shall make the determination specified in paragraph (1), no later than 60 days after the date the department receives the request for disclosure, but not before 30 days following the notification of the person who submitted the information.

(3) If the department decides that the information requested pursuant to this subdivision should be made public, the department shall provide the person who submitted the information 30 days' notice prior to public disclosure of the information, unless, prior to the expiration of the 30-day period, the person who submitted the information obtains an action in an

appropriate court for a declaratory judgment that the information is subject to protection under this section or for a preliminary injunction prohibiting disclosure of the information to the public and promptly notifies the department of that action.

(e) This section does not authorize a person to refuse to disclose to the department information required to be submitted to the department pursuant to this article.

(f) This section does not apply to hazardous trait submissions for chemicals and chemical ingredients pursuant to this article.

SEC. 7. This act shall become effective only if Senate Bill 509 of the 2007–08 Regular Session is enacted on or before January 1, 2009.

SEC. 8. No reimbursement is required by this act pursuant to Section 6 of Article XIII B of the California Constitution because the only costs that may be incurred by a local agency or school district will be incurred because this act creates a new crime or infraction, eliminates a crime or infraction, or changes the penalty for a crime or infraction, within the meaning of Section 17556 of the Government Code, or changes the definition of a crime within the meaning of Section 6 of Article XIII B of the California Constitution.

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