State of California

TIRE PRODUCT STEWARDSHIP

DRAFT

ACTION PLAN

July 2004

DRAFT – FOR DISCUSSION PURPOSES ONLY

University of Massachusetts/Lowell • Kitson Hall, Room 200 • One University Avenue • Lowell, MA 01854
Telephone: (978) 934-4862 • Fax: (978) 934-3037 • www.productstewardship.us

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I. PURPOSE OF DRAFT ACTION PLAN

The intent of this *Draft Action Plan* is to prepare participants for the dialogue phase of the Product Stewardship Institute's (PSI's) Tire Stewardship Initiative.[1] It includes a proposed problem statement, proposed project goals, dialogue process, and other information that has been discussed extensively with the 22 people PSI interviewed to gain a greater understanding of tire management issues and potential solutions. The contents of the *Draft Action Plan* reflect varying perspectives on waste tire management and not a unanimous approach.

II. PROBLEM STATEMENT

California is faced with the challenge of diverting or safely managing more than 33 million reusable and waste tires[2] generated in the state each year. More than one-third of these tires are disposed of in landfills. Though California has more registered vehicles than any state, concern over tires is not unique to the west coast. Across the country, the growth in markets for waste tires are still not sufficient to keep pace with the annual generation rate. Stockpiles of tires create fire hazards, environmental threats, and serious health nuisances. Owing to these concerns, state and local government agencies often rank tires as one of their top waste management priorities.

III. PROPOSED PROJECT GOALS

Primary Goal: To reach an agreement among government officials, manufacturers, retailers, environmental groups, tire recyclers, and other participants that will result in fewer waste tires; the efficient collection, reuse, and recycling of waste tires; and increased and sustained waste tire markets.

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[1] Funding for this project has been provided by the California Integrated Waste Management Board.

[2] According to California statute 42807, *Waste Tires* are defined as "…a tire that is no longer mounted on a vehicle and is no longer suitable for use as a vehicle tire due to wear, damage, or deviation from the manufacturer's original specifications. A waste tire includes a repairable tire, scrap tire, and altered waste tire, but does not include a tire derived product, crumb rubber, or a used tire that is organized for inspection and resale by size in a rack or a stack in accordance with Section 42806.5." Waste tires are also called *scrap tires* by some organizations.

Supporting Goals

- Increase tire life to reduce generation rates.
- Reduce the illegal dumping of wastes.
- Attain the highest value possible for waste tires, according to the following management options:
    - Reduce
    - Reuse
    - Retread (large, commercial truck tires only)
    - Recycling into other products
    - Tire derived fuel and chipped tire fuel (energy value from combustion)
    - Proper disposal
- Improve collection and recycling practices.

IV. THE PSI DIALOGUE PROCESS

The Product Stewardship Institute's (PSI's) Tire Stewardship Initiative is devoted to bringing together key parties to jointly solve problems related to the management of post-consumer waste tires. PSI will convene a tire stewardship meeting among representatives involved in the manufacture, distribution, sale, use, processing/recycling, and disposal of waste tires. Following the meeting, PSI will develop a final *Tire Stewardship Action Plan* that includes a problem statement, dialogue goals, a prioritized list of issues and strategies, any participant agreements, and potential stakeholder interest in additional meetings. The *Final Action Plan* will lay the groundwork for future meetings pertaining to the management of waste tires.

Phase I (Research and Outreach)

This *Tire Product Stewardship Draft Action Plan* is the culmination of the first phase of the project. It highlights research conducted by PSI, and outlines key issues and potential solutions to the problems associated with managing waste tires in California. The issues and solutions were identified from 22 interviews with potential dialogue participants. (See Appendix A for a list of stakeholder groups that PSI interviewed.) The solutions presented here are for the sole purpose of promoting thought and discussion at the forum and subsequent meetings, and are not intended to define or limit discussion.

Phase II (Initial Dialogue)

The *Draft Action Plan* provides information that will lay the foundation for a one-day Tire Stewardship Forum on July 28. Stakeholders will be expected to discuss priority issues, potential solutions, and goals outlined in the *Draft Action Plan*. PSI will coordinate and facilitate this meeting, develop the meeting agenda and summary, and maintain a web site with project information. Current funding limits this project phase to one meeting. This constraint will require stakeholders to select priority areas for discussion prior to the meeting.

Following the forum, PSI will develop a *Final Action Plan* that will prioritize issues and strategies included in the draft. It will also document the results of the meeting, including

agreements reached among the participants, as well as any agreed upon next steps. The interest of stakeholders to participate in additional meetings will be assessed. The California Integrated Waste Management Board (CIWMB) intends to implement key strategies outlined in the *Final Action Plan* and discuss them in future stakeholder meetings.

V. PROJECT TIMELINE

January – February 2004	Developed Workplan/Conducted Research
February – March	Conducted Stakeholder Interviews
April – July	Developed Tire Stewardship Draft Action Plan
July 28	Conduct Stakeholder Meeting in Sacramento, CA
September	Develop Tire Stewardship Final Action Plan
Post-September	Additional CIWMB Stakeholder Meetings

VI. CURRENT TIRE MANAGEMENT

California is faced with the challenge of managing 33.5 million waste tires generated in the state each year, of which about 75 percent are diverted from stockpiles or disposal (see Table 1 below). In addition, while California has made great progress in cleaning up tire dumps, an estimated 2 million tires remain in stockpiles or illegal dumps, increasing the risk of fires. In fact, in the last five years, California has experienced two devastating waste tire fires – in the cities of Westley and Tracy.

TABLE 1

TIRE MANAGEMENT IN CALIFORNIA (2003)[3]

Application	Tires (in millions)	Percentage
Reused	1.5	.06%
Crumb rubber	5.8	23%
Civil engineering applications	3.0	12%
Other recycling uses	5.9	24%
Retread (light and heavy)	2.3	.09%
Tire derived fuel	6.1	24%
Exported	2.0	.02%
Imported	1.5	
Total Tires Diverted[4]	**25.1**	
Tires Disposed	**8.4**	
Total Tires Generated in CA	**33.5**	**100%**

[3] *California Waste Tire Generation, Market & Disposal – 2002 Staff Report.* California Integrated Waste Management Board. October 2003. http://www.ciwmb.ca.gov/Publications/default.asp?pubid=1047.

[4] Includes 0.5 million net exported tires.

Landfilling

Currently, 25 percent of waste tires generated in California are landfilled, even though state solid waste regulations require that only shredded tires be legally accepted at landfills. The cost of landfilling shredded tires in the state (an average of $2.61 per tire, or $102.70 per ton in 2000[5]) makes this method the least expensive of all management options. Landfilling is also a convenient disposal option, as there are 152 solid waste landfills spread throughout the state, most of which accept shredded tires for disposal. In addition, some tire haulers own and operate landfills, further reducing their business costs in comparison to other options. While landfills serve as the option of last resort for waste tires, it will take greater market development for fewer tires to be landfilled.

Tire Collection

Tires are typically collected by retailers, tire dealers (including those that deal exclusively in used tires), the waste management industry, public and private fleets, and municipal and county governments. In California, as in most locations across the country, waste tires collected by government agencies often occur through tire "Amnesty Days" or at one-day special collection events (such as in conjunction with household hazardous waste).

One challenge faced by those collecting tires is the need to contract with a hauler who can meet all state and federal environmental laws. In California, anyone who collects, hauls, stores, or processes tires must be registered with the state. In addition, any person transporting 10 or more waste tires at a given time must be a registered hauler. In California, there are 16,000 state registered tire generators.

In 1995, California instituted a tire manifest system that was designed to provide oversight of tire haulers and processors to reduce non-compliance with California's laws. In 2001, California revised its law (SB876) to provide even more oversight. Under the new law, the requirements for tire haulers and processors did not change dramatically, although enforcement increased. In addition, the new law included tire generators in the manifest system, so generators now have to submit paperwork to the state. The goal of the revision was to increase oversight and tracking to ensure that tires are being managed properly. While this law was successful in reducing non-compliance, the manifest and reporting system became burdensome for smaller retailers and haulers whom, in many cases, were not properly tracking materials as was required in the past.

Today, only two of the state's large haulers are capable of submitting the proper manifest paperwork electronically, saving them reporting costs, while others must submit by mail. Retailers find that this factor contributes toward reduced competition and high hauler costs. The lack of competition for who can meet the new manifest requirements also means that collectors have little leverage in specifying more environmentally sound management methods. The state has offered technical assistance to companies interested in submitting

[5] Solid Waste Facility Tipping Fees: 1998 to 2000 Summaries of Special Waste Tipping Fee Surveys. January 5, 2004. California Integrated Waste Management Board. http://www.ciwmb.ca.gov/landfills/tipfees/SumSW.htm

forms electronically although, to date, none of the companies that expressed interest followed through and used the resource.

Other collection concerns have come from retailers. When a person purchases a new tire, they usually leave their old tire behind for proper management. While this system offers a convenient collection point for consumers, it also creates challenges for the retailer. In most cases, retailers have limited space to store waste tires. In addition, many local governments will not allow retailers to store used tires outdoors. Therefore, retailers struggle with locating space within their facility to store tires until a hauler can pick them up for proper management in a timely manner so that the number of tires do not become unmanageable or unsafe. To accomplish this, smaller tire retailers often become part of a "milk run" operation, whereby a hauler comes by at a regularly scheduled pick-up time (such as weekly or monthly) to collect the tires.

Reuse/Retread

Reuse refers to when a tire has been used once but still has useful life and could be used again.[6] Tires are most often reused and resold by retailers or dealers changing tires on a vehicle. Reuse also occurs by haulers who segregate and sell used tires to some tire dealers. According to California's 2001 report,[7] 1.5 million tires were reused that year. One stakeholder estimated that approximately 10 percent of all tires disposed of at retail could be reused, while another noted that 2 to 5 percent of all incoming tires are currently segregated for reuse**.** While there are more opportunities for reuse than are being taken today, used tires must often compete with inexpensive new tires, so consumer prices for used tires must remain low. It was also noted by one stakeholder that there could be significant market potential for used tires in Mexican tire markets.

In addition, tires can be retread, in which the tire casings have been recapped. Approximately 1,060 retreading plants in North America are owned and operated by independent small businesses, new tire manufacturers, and a major tread rubber supplier. Nationally, retread businesses sold about 20 million retreaded tires in North America in 2003, with sales totaling more than $2 billion. The majority of these sales were of medium truck tires. In California, there are 59 companies and retailers that sell retread tires for light and large commercial trucks, industrial and farm vehicles, and passenger vehicles. The Tire Retread Information Bureau estimates that 737,500 retread tires are sold in California each year.[8] Retreading is most cost-effective and viable for large commercial truck tires.

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[6] According to California statute 42806.5, *Used Tire* is defined as "…a tire that meets all of the following requirements: (a) The tire is no longer mounted on a vehicle but is still suitable for use as a vehicle tire. (b) The tire meets the applicable requirements of the Vehicle Code and Title 13 of the California Code of Regulations. (c) (1) The used tire is ready for resale, is stored by size in a rack or a stack not more than two rows wide, but not in a pile, and is stored in accordance with local fire and vector control requirements and with state minimum standards. (2) A used tire stored pursuant to this section shall be stored in a manner to allow the inspection of each individual tire."

[7] California Waste Tire Generation, Market & Disposal – 2002 Staff Report. California Integrated Waste Management Board. October 2003.

[8] Telephone conversation with Harvey Brodsky. Estimated by taking the weekly average of 250 tires x 59 companies x 50 weeks. There are more large retread plants in California than other states. California likely sells more retread tires annually than this figure represents.

Waste tires with casing integrity can be retread after passing company inspection for flaws and other concerns. Unfortunately, retreads have a bad reputation among those who mistakenly assume that tire pieces on the side of the road are derived from retreads and believe them to be inferior to new tires. The fact is that retreading a tire *extends* the tire casing life and gives that tire another life equal to its original. Tire pieces along the road are most often a result of a failure to maintain sufficient air pressure, which causes tire casings to become extremely hot and eventually come apart. A retread is no more likely to come apart than a new tire. While California state government and the private sector recognize the benefits of retread tires, there is a tremendous opportunity to increase retread use in local government fleets.

In addition, a July 2003 draft report from the California Integrated Waste Management Board[9] notes that increasing retreads could have a positive impact on the ability of tire manufacturers to acquire high-quality, pure rubber feedstock. Since high-quality buffings, used in new tires, are a byproduct of the retread process, increasing retread use in passenger and light truck tires would increase the supply of buffings and make recycled content in new tires more feasible. Countering this, however, the Tire Retread Information Bureau contends that there is only a small market for retreads in passenger and light truck tires since there are no cost savings by using retreads over new tires. When consumers are given the choice, they will always choose a new tire.

Crumb Rubber

The use of crumb rubber[10] as a product or as a feedstock raw material in new product manufacturing is considered one of the highest value end uses for waste tires and, therefore, the most desirable for most stakeholders. Over the years, crumb rubber production has become more efficient and cost-effective, as technologies have evolved to manufacturer a greater amount of tire material into crumb rubber products. These markets, however, have been slow to develop, and crumb rubber product is costly to manufacture. While the potential exists for greater crumb rubber use, the Rubber Manufacturer Association[11] has reported that crumb rubber markets have actually decreased in California from 6 million tires in 2002 to 5.8 million in 2003. Nationally, markets have also decreased, from 34 million in 2001 to 28 million in 2003.

In California, four tire processors manufacture a crumb rubber product, using approximately 5.8 million waste tires per year. Some of these processors are targeting specific markets, such as molded products, while others are manufacturing their own end products. Within California, markets have not matured to the point of being able to absorb all the tires produced in the state. To date, it is estimated that 18 percent of the state's waste tires go to crumb rubber applications. Tire processors are diversifying their markets to avoid economic

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[9] California Integrated Waste Management Board. *Increasing the Recycled Content in New Tires* (draft). July 2003.

[10] According to California statute 42801.7, *"Crumb rubber"* is defined as "…rubber granules derived from a waste tire that are less than or equal to one-quarter inch or six millimeters in size." Crumb rubber is also sometimes called *ground rubber* by other organizations.

[11] E-mail from Michael Blumenthal, RMA, to Julie Rhodes. June 27, 2004.

collapse if any one market drops significantly. The hope is that diverse and sustainable markets will strengthen the tire recycling infrastructure over time and enable more waste tires to be turned into crumb rubber products.

One barrier to wider use of crumb rubber is a lack of awareness of existing specifications for the material. The American Society for Testing and Materials (ASTM) has already developed crumb rubber specifications, and the Institute of Scrap Recycling Industries (ISRI) is also in the early phases of establishing its own specifications, both of which could have the potential to enhance waste tire recycling markets. For example, when a potential end user of crumb rubber requests a specific size of rubber, they expect to receive pure rubber powder. Without these standards, however, buyer and seller can still determine the specifications that will set up mutual expectations as to how fine the powder must be ground or how pure the material must be.

Another barrier to increased crumb rubber use pertains to the chemical make-up of tires. Currently, each tire manufacturer has its own manufacturing recipe. As a result, waste tires sent to recycling facilities do not have the exact same chemical properties, making it impossible to remanufacture a truly homogenous product. When molding rubber, chemical makeup is important, as it will dictate material performance during manufacture, its melt threshold, binders or chemical additives needed, and end product performance. While it is not realistic that manufacturers will share a uniform recipe, it may be possible to add a raw material to all tires that would provide more consistency in the crumb rubber product. If this occurs, there will be greater market opportunities for waste tires, as recycled content in tires and for other molded products. Doing so, however, would have to be deemed viable within the confines of anti-trust legislation.

Finally, a third barrier is the cost to produce recycled crumb rubber as compared to virgin rubber. The grinders, hammermills, and other equipment needed for waste tire recycling are expensive to purchase and maintain. In addition, there is an overcapacity of crumb rubber production in California. While tires diverted to crumb rubber processors avoid landfills, there are few markets for the crumb rubber, resulting in the stockpiling of processed material. As a result, it has been difficult for tire processors and recyclers to manufacture a quality crumb rubber product that can compete with virgin material at an equal or lower cost. Tire manufacturers and molded product manufacturers would use greater quantities of recycled rubber in their products if the cost were more competitive with virgin supply.

Crumb Rubber Markets

Recycled Content in Tires

As revealed in CIWMB's 2003 draft report, *Increasing the Recycled Content in New Tires*, new passenger tires contain up to 3-5 percent of the rubber component as recycled content, at a ground rubber size of 80 – 400 mesh. The report also showed that manufacturers could add as much as 10 to 15 percent recycled content, although there is a debate as to the impact that adding any amount of recycled content has on tire longevity and performance.

As mentioned above, one of the greatest challenges to increasing the amount of crumb rubber is that each tire manufacturer has its own recipe for tire rubber. Mixed rubber from a variety of tire brands is challenging to turn into a recycled content tire. For this reason, manufacturers are often more willing to use waste rubber that is internal to the plant instead of post-consumer tire waste. In addition, adding post-consumer recycled crumb rubber can reduce the physical properties of tires, therefore reducing the life of a tire and resulting in *more* tires being landfilled, not fewer.

It was also mentioned that, in today's marketplace, recycled rubber is more expensive and less predictable than virgin rubber. This creates a major barrier to the use of recycled content in new tire manufacture. To illustrate this point, tires that have been cryogenically processed (instead of ambient grinding) are more suited for use in new tires because they are typically of higher quality (without metal or fluff) and can be more easily made into smaller mesh sizes. However, this process for tire recycling is more expensive than ambient processing and, therefore, more costly for tire manufacturers to purchase as an industrial feedstock. One stakeholder commented that the percent of recycled content used in a tire could only be increased through solutions such as advances in devulcanization technology or a lower cost of recycled crumb rubber.

Loose Fill Crumb Rubber Products

Owing to the increased cost of waste tire material over gravel, wood mulch, or other materials, recyclers that manufacture rubber recreational products today rely on government subsidies. To encourage the use of waste tires in recreational applications, California offers the Waste Tire Track and other Recreational Surfacing Grants and Waste Tire Playground Cover Grants. One such grant was provided to Eastgate Park in Garden Grove, which used 21,800 pounds of California ground tire rubber in its playground. California has allocated $800,000 per year to assist in further developing these markets. In 2003, California gave out grants for playground projects totaling $470,304 and grants for running tracks totaling $1.4 million.

The potential exists to increase the use of crumb rubber in loose fill material for playgrounds, and even horse arenas. Crumb rubber, compared to pea gravel or mulch, has been proven to be safer than traditional materials when children fall.[12] Crumb rubber, at one-half inch to one inch in size, can also provide improved drainage and absorb impact. In addition, crumb rubber can be poured in place (much like RAC) for playing surfaces.

Even so, some people are concerned that the material can be dirty, can leave black marks or smudges on clothes or shoes, can have a strong rubber smell, and that there could be steel fragments left in the tire that could cause harm. In addition, there is some concern over crumb rubber burning should someone put out a cigarette or otherwise ignite the surface.

[12] Rubber Manufacturers Association website link.
http://www.rma.org/scrap_tires/scrap_tire_markets/playgrounduse.cfm

Molded Products from Crumb Rubber

Crumb rubber, ground to between 4 and 100 mesh in size, can be used as a raw material in the manufacture of a variety of rubber products, from mats, hoses, and truck bed liners to flower pots and more. Market acceptance of these products has been slow, although some products are starting to find greater recognition. As mentioned previously in relation to other uses of crumb rubber, a significant barrier is the inconsistency of the chemical makeup of tires. This difference in chemical composition can affect the manufacturing process of the product, as well as its performance. Another major challenge is developing a ready market for the tire-derived products that are manufactured. Government agencies, tire retailers, and others (including some tire manufacturers) do not have purchasing policies that favor tire-derived products. This is especially true of companies that sell large quantities of tire-derived products to consumers, and which also sell a significant quantity of waste tires, such as large discount retailers. Probably the largest single barrier to market acceptance, however, is a lack of knowledge about which products are available and where to buy them.

Rubberized Asphalt Concrete

Crumb rubber is also used in the asphalt surface layer of road paving to make Rubberized Asphalt Concrete (or RAC). Thirty-eight states have some roads made with RAC, although Florida and Arizona are the only two states that have used RAC in any widespread manner. The Arizona and Florida Departments of Transportation now use RAC in the majority of their road paving projects. Arizona has used rubberized asphalt since 1970, and began common use of the material in 1988. Arizona has been able to reduce cost and build quieter-riding roads as a result of adding crumb rubber to its asphalt design mix.

The Arizona Department of Transportation reports that it saves money by laying a thinner layer of road using rubberized asphalt as compared to using traditional asphalt. Instead of laying a 4 – 6 inch overlay of traditional asphalt over a cracked road surface, they only have to lay ¾ to 1 ½ inches of rubberized material. Roads laid this way have lasted 40 percent longer before cracking occurs. Arizona uses rubberized asphalt as standard operating procedure in the majority of its pavement projects. As a result, both material and lifecycle costs can actually be reduced with the use of RAC.[13]

There are opportunities with the California Department of Transportation (CalTrans), local highway departments in California, and construction contractors to use more RAC. However, budget constraints have resulted in fewer roads being paved, translating into fewer opportunities for the use of RAC. Even so, several stakeholders mentioned that some highway officials around the country are reluctant to use RAC because they are more accustomed to handling traditional aggregate and asphalt materials and have performance concerns related to past projects and pilots using RAC. Other typical concerns mentioned that RAC is not readily available in the quantities needed at road construction jobsites, where time is of the essence. Further concerns centered on the issue of cost. However, even though RAC

[13] Standard mix design guidelines can be found on the Rubberized Asphalt Technology Center website at: http://www.rubberizedasphalt.org/ar_design_guide/index.htm. Examples of the cost differential between RAC and traditional pavement are outlined at the Rubberized Asphalt Concrete Technology Center website at: http://www.rubberizedasphalt.org/cost.htm.

is more expensive per unit of material compared to traditional asphalt, Arizona found that its overall road budget did not increase owing to its technique for laying thinner layers of rubberized asphalt.

Each year, CalTrans reports to the California State Legislature on progress made towards increasing RAC use. In 2001, CalTrans reported using 1.1 million tires in road construction, compared to 2.7 million in 2000, and 0.8 million in 1999.[14] California passed legislation in 2002 to encourage greater use of RAC in public works projects. This program allows the CIWMB to award grants to local governments for the funding of RAC projects. In addition, in 2004, Californians Against Waste sponsored a bill, which would require CalTrans to include RAC in 15 percent of its road projects.

Civil Engineering Applications

Shredded waste tires have been substituted for commonly used materials, such as aggregate, stone, and sand in a variety of civil engineering applications. Many stakeholders believe these applications hold the greatest promise for waste tire market opportunities, particularly because of the large numbers of tires that are needed for each job. To date, CalTrans has conducted one test project with shredded tires as lightweight fill, using 660,000 tires on an embankment project on the Dixon Landing in Santa Clara County in 2001.[15]

Nationally, since 1988, more than 70 projects have been constructed using shredded tires with a thickness of 1 meter or less , and an additional 10 fills were constructed with a thickness of less than 4 meters. In 1995, three tire shred fills with a thickness greater than 8 meters experienced a catastrophic internal heating reaction, resulting in a fire. This unfavorable experience has curtailed the use of all tire shred fills on highway projects.

Possible causes of the 1995 incident are oxidation of the exposed steel belts and rubber. Microbes may also have played a role in the internal combustion reaction. Although details of the reaction are being studied, the following factors are thought to create conditions favorable for oxidation of exposed steel and/or rubber: access to air or water; retention of heat caused by the high insulating value of tire shreds in combination with a large fill thickness; large amounts of exposed steel belts; smaller tire shred sizes and excessive amounts of granulated rubber particles; and the presence of inorganic and organic nutrients that would enhance microbial action.

The Rubber Manufacturers Association (RMA) has developed design guidelines to minimize the potential for heating of tire shred fills by minimizing the conditions favorable for this reaction. As more is learned about the causes of the reaction, it may be possible to ease some of the guidelines, which are divided into two classes: Class I Fills with tire shred layers less than 1 meter thick, and Class II Fills with tire shred layers in the range of 1 meter to 3 meters thick. Although no projects using less than 4 meters of tire shred fill have experienced a catastrophic heating reaction, to be conservative, tire shred layers greater than 3

[14] Annual Report to the Legislature and the California Integrated Waste Management Board, Senate Bill 876, Waste and Used Tires. 2001. http://www.dot.ca.gov/hq/oppd/rescons/sb876/2001-SB876-annual-rpt.pdf#xml.
[15] Annual Report to the Legislature and the California Integrated Waste Management Board, Senate Bill 876, Waste and Used Tires. 2001.

meters thick are not recommended.[16] These guidelines considered the insulating effect caused by increasing fill thickness and the favorable performance of projects with tire shred fills less than 4 meters thick. Thus, design guidelines are less stringent for projects with thinner tire shred layers.

The following sections outline the most common civil engineering applications using shredded tires between 2 and 12 inches in size that serve as a lightweight fill or aggregate. According to RMA, tires in civil engineering applications show 10 times better drainage properties than soil and 8 times better insulation properties than gravel.[17]

Landfill Applications

Shredded tires can be used for several landfill applications – as daily cover, in the landfill drainage layer, as part of a landfill cap, and to assist landfill gas venting. Shredded tires have been used in the required daily cover layer at landfills, replacing dirt, sand, or other cover material. Chipped tires have also been used during new landfill construction in the bottom layer to provide drainage in the leachate collection system. While use of waste tires for landfilling applications provides benefits that disposal does not, many environmentalists do not support these applications because they believe that there are higher-value end uses that have not been fully explored. In addition, there are risks of fire if shredded tires are not installed properly, although the risks of spontaneous combustion are very low when tires are laid as a landfill drainage layer less than 3 feet thick. However, a recent tire fire at an Indiana landfill has raised new questions about using tires in the liner layer of landfill construction (Monroe County Landfill, January 10, 2004).

Lightweight Fill

Chipped tires can be used as a lightweight fill substitute, especially on top of weak soils, as subgrade fill and in the construction of bridge embankments, retaining wall reinforcements, and other projects. In these applications, tires are substituted for other raw materials, such as gravel or sand. ASTM standards have been developed for testing the physical properties of chipped tires and provide data for assessing the leachate generation potential of processed or whole waste tires. The ASTM website[18] outlines typical construction practices to demonstrate use. One challenge that must be overcome, however, is that is has been difficult to get large quantities of shredded tires to a jobsite when needed. Since civil engineering projects are under construction for only a limited period of time, there

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[16] RMA website. Design Guidelines to Minimize Internal Heating of Tire Shred Fills. July 7, 2004. https://www.rma.org/scrap_tires/scrap_tire_markets/tireshredfills.cfm.

[17] RMA. U.S. Scrap Tire Markets 2001. December 2002. https://www.rma.org/publications/scrap_tires/index.cfm?PublicationID=11106

[18] ASTM website. (D6270-98 (2004)) Standard Practice for Use of Scrap Tires in Civil Engineering Applications. July 7, 2004. http://www.astm.org/cgi-bin/SoftCart.exe/DATABASE.CART/REDLINE_PAGES/D6270.htm?L+mystore+pgzs0386+1066851199

are logistical challenges to transporting the tires, finding temporary storage, and managing waste tires at the job site.

Septic Field Drainage

Chipped tires can also be used as a backfill around effluent leach field piping in septic systems. While in some areas of the country, such as South Carolina, chipped tires in septic fields have gained acceptance, this is not true for all communities across the country.

Road Base

Shredded tires can be used in the base layer of a road construction project in place of aggregate or stone. However, while tires have been used successfully in such applications for years, many still recall the state of Washington road fires, which were caused by using chipped tires at too great a thickness level. New standards have significantly reduced the risk of spontaneous combustion of tires used as an aggregate substitute in road base. Unfortunately, a negative perception still remains among many transportation officials. In addition, since road construction occurs over a limited period of time, the logistical challenges mentioned above for lightweight fill apply here as well.

Tire Derived Fuel and Tire Chip Fuel

In 2002, it was estimated that 6.1 million tires per year were combusted in California cement kilns and co-generation plants for energy recovery. Waste tires can be used whole or chipped, depending on the facility, and fed into industrial boilers, electric arc furnaces, cement kilns, pulp and paper mills, and co-generation plants to serve as an energy substitute for coke or coal. Tires provide a good energy source as they generate 14,000 BTUs of energy per pound, compared to coal, which generates 12,500 BTUs of energy per pound. In addition, in some instances, such as in cement kilns and in electric arc steel furnaces, the iron/steel contained within a waste tire is converted into raw material for the manufacture of end products. Additionally, tire-derived fuel markets are typically more economically viable, and allow for a greater degree of minor contaminants than tire processing markets.

Those in favor of using waste tires for energy production point to a fuel that is cleaner, more efficient, and more environmentally-friendly than the mining, transportation, and use of coal that is typically supplied to California from Utah, Montana, and other western states. Again, however, environmental groups are concerned that promoting tire-derived fuel decreases the potential to use waste tires in higher-value applications. In addition, they argue, burning a tire loses the long-term value of the initial resource. As a result of these different perspectives, as well as the high cost of transporting tires, two of eight cement kilns that have been permitted in California to use TDF are not burning the tires. An additional nine cement kilns could potentially be permitted to accept waste tires should TDF become a more acceptable solution.[19]

[19] There are nine companies operating 17 cement kilns in California.

Although there are air emission concerns with the burning of waste tires as TDF, both the California Air Resources Board and the U.S. Environmental Protection agency have approved waste tires as a fuel substitute. In fact, sulfur dioxide (SOx) and nitrogen oxide (NOx) emissions can be substantially reduced when substituting tires for coal in cement kilns in the preheating phase of the kiln.

Other barriers to the widespread use of TDF relate to regulatory and facility retrofit costs, as well as tire transportation costs. A significant cost is the "test burn" that is required to ensure that the facility can meet air quality standards. These tests are currently not eligible for state grant funding. In addition, equipment installation and conversion costs that enable a facility to process waste tires for fuel can be high. (Industrial boilers may or may not require significant adaptation to burn tires as an energy source, while electric arc furnaces do not require significant conversion costs.) For example, the cost for a cement kiln to drill a hole in the shaft/tube and install a conveyance or feed system to bring the tires from the ground level into the kiln is approximately $1.5 million per kiln. Further, costs are often significant to transport waste tires to facilities that can burn them.

Tires can also be burned for energy in co-generation plants, or facilities specifically built for energy recovery. In the case of chipped tire fuel for co-generation plants, while the product has value, there is also a cost to process the waste tires prior to sending them to co-generation plants. There could be additional co-generation markets developed if proven economical.

VII. EXISTING TIRE RELATED PROJECTS IN CALIFORNIA

California is one of the most aggressive states regarding the management of waste tires, combining legislative and regulatory solutions with research and grant funding to encourage new waste tire markets. There are five principle areas in which California has taken action:

- Laws and regulations
- Tire Management Fee
- Extending the Lifespan of Tires
- Increasing the Recycled Content in Tires
- Tire Grant Program

Laws and Regulations

California has instituted numerous laws and regulations related to waste tire management from 1989 through 2003, with the intent of diverting an increasing number of waste tires to recycling and providing safer tire management. The following laws and regulations have been the most significant in relation to waste tire management:

- a waste tire fee to fund state programs;
- safe collection, storage, transportation, and handling requirements for waste tires;
- a grants and loans program for tire research and recycling activities;
- a program to remediate illegal tire piles;
- tire law enforcement program; and

- programs to encourage the use of rubberized asphalt concrete in public works projects and to increase state procurement of tire-derived products.

Tire Management Fee

In 1989, California passed the California Tire Recycling Act that originally placed a $0.25 per tire visible fee on all passenger and truck tires sold in the state. This fee was raised to $1.00 per tire in 2000, but is scheduled to be scaled back to $0.75 per tire on December 31, 2006. The fee is collected from consumers at the retail level and deposited into a state-managed fund, which is used to pay for market development research and projects, stockpiled tire abatement, and tire regulation and enforcement. Each year, the fee brings in approximately $31 million. Retailers add an additional charge onto this fee to cover their administrative costs, including contracting with a tire hauler to properly dispose of the tires. The cost of this service was reported to be, on average, $0.75 per tire. Retail charges are not set by regulation, and are based on what the market will bear. Therefore, the actual cost to consumers is between $2.00 and $4.00 per tire, with the retailer generating approximately $1.00 to $2.00 in profit from each transaction.

Extending the Lifespan of Tires

In July 2003, Symplectic Engineering Corporation and the University of California at Berkeley's Institute for Transportation Studies completed a report entitled, *Extending the Lifespan of Tires*, which concluded that improving tire maintenance can extend the life of about 60 percent of all light-duty tires. Researchers used data from Michelin to conclude that 50 percent of all light-duty tires entered the waste stream with abnormal wear owing to poor tire maintenance. Another 10 percent of tires entered the waste stream owing to oxidation and separation, both of which are also linked to poor tire maintenance, primarily low air pressure.

Studies conducted by the National Highway and Traffic Safety Administration (NHTSA) also concluded that inadequate passenger vehicle tire pressure leads to a shortened lifespan for tires. The NHTSA study cited Goodyear, which reported that an improperly pressurized tire loses 17.8 percent of its life. On a typical tire expected to run for 80,000 miles, tire life would thus be reduced to 65,760 miles, causing that tire to enter the waste stream much sooner than necessary. The study suggests that "smart tire systems" that continuously maintain air pressure can deliver a significant jump in the average tire life.

The report concludes with four broad strategies to extend the lifespan of tires:

- Advancing auto-inflate systems where tire pressure is automatically maintained through voluntary or mandatory efforts;
- Educating the public to better maintain their tires, such as by adjusting air pressure, rotating tires, and keeping proper tire alignment;
- Mandating that producers that sell tires in California meet an overall average standard tire life within the mix of light-duty tires they sell, much like the national standards set on automotive manufacturers for fuel efficiency. For example, an average standard tire life might be based on existing industry standards, such as the tread wear rating component of the uniform tire quality grading, as well as the weight of the tires; and

- Employing a combination of taxes and rebates to replace the uniform $1 tire disposal fee with an *ad-valorem* tax, which would require those who purchase heavier weight tires to pay a larger fee than those purchasing lighter weight tires. Oklahoma and Arkansas currently charge a lower fee for passenger tires than for truck tires.

Increasing the Recycled Content in New Tires

In May 2004, work was completed on a report entitled, *Increasing the Recycled Content in New Tires*, which was produced by the Nevada Automotive Test Center (NATC), along with the California Integrated Waste Management Board. In this report, researchers evaluated how recycled content in new tire manufacturing can affect tire rolling resistance and tire lifespan. As a result, an integrated approach was recommended that balanced inherent tradeoffs between higher recycled content and reduced tire life.

According to the NATC report, ground rubber that is recycled into new tires represents 12.5 percent of all material going into recycled rubber products. The NATC concluded that this represents approximately 4.2 million tires a year that are recycled into new tires, although it is not clear how much of this material is generated from internal factory waste as compared to post-consumer waste tires.

Based on the NATC findings, over the past 10 years, the recycled content in new passenger and light-truck tires has increased from 0.5 percent to 5.0 percent by weight. In some cases, incorporating recycled content of up to 10 to 15 percent in new tires is reported as technically feasible, without adversely affecting the performance characteristics of tires. However, tire manufacturers limit the recycled content to under 5 percent due to several factors, including concern over performance and durability, economic considerations (e.g., transportation, energy cost, and low price of virgin rubber), supply and quality of crumb rubber, and the perception that tires with recycled content are inferior.

According to the NATC report, the recycled content in new tires could be increased if one or more of the conditions or actions listed below are implemented, although NATC recommends a detailed economic feasibility analysis before taking any action.

- Provide grants to ensure that a reliable supply of high-quality crumb rubber is available.
- Conduct pilot projects using government fleets to demonstrate safety and performance effectiveness of tires with recycled content.
- Encourage vehicle manufacturers to develop recycled content requirements and standards for new tires.
- Provide government incentives, including tax exemptions, and grants for equipment and land.
- Identify large sources of waste tires in densely populated northern and southern areas of the state to attract processors.
- Increase retreading, which can generate a greater quantity of high-quality buffings, which may be more readily accepted as a feedstock in new tire manufacturing. (The process used to generate buffings is less capital intensive than the process used to develop crumb rubber from whole tires.)

- Educate consumers through comparative testing of tires with recycled content as compared to similar tires using virgin components.
- Locate tire processing facilities in areas in need of economic revitalization.
- In conjunction with the above-listed conditions or actions, NATC found that the following factors and recommendations are also important:
- The automotive industry is the most significant influence in redirecting the recycling of waste tires from landfilling to use in new tire manufacturing. In addition, the automotive industry is targeting a 25 percent increase in recycled content of their products and encouraging supplies to provide components with such recycled content.
- Increasing the use of retreaded passenger car and light-truck tires can complement efforts to use crumb rubber in new tire manufacture.
- For consumers to be more receptive to purchasing recycled-content tires, testing and demonstration projects will need to change their perception about these tires so they have a more positive image.
- Compounds should be developed that have higher resilience characteristics to reduce excessive temperature rise, while maintaining desired performance characteristics such as resistance to cutting, chipping, cracking, and abrasion.
- The availability of more dependable casings can expand retreading, increasing the use of buffings as recycled content in tires.
- More research is required to understand how recycled crumb rubber behaves in rubber compounds. Resources should be allocated for research and development to understand the effect of increased recycled tire content on the dynamic properties of tires in the end-user environment. This can be accomplished at academic institutions or independent organizations that can provide the necessary technical expertise.

Tire Grant Programs

The California Integrated Waste Management Board's tire grant programs encourage activities that promote the reduction of waste tires disposed of in landfills and the elimination of waste tire piles. Funded activities include tire pile cleanup and enforcement, waste tire market development, product procurement, and demonstration projects. Eligible projects have included individuals, businesses, local governments, universities, school districts, park districts, and qualified California Indian tribes. Revenue for the grants is generated from the $1.00 fee on each new tire sold.

California's current tire grant programs include the following[20]:

- Local Government Waste Tire Cleanup Grants – funds local tire clean-up projects, involving law enforcement agencies, county and city departments, fire districts, code enforcement agencies, and qualifying California Indian organizations.

- Local Government Public Education and Amnesty Day Grants – competitive grants used to develop educational programs on the requirements for proper tire disposal and on ways to properly care for tires. The program also includes amnesty events aimed at the

[20] A recent bill that was passed does not currently allow state funding to be used for energy recovery, although such grants were provided in the past.

consumer to deal with nuisance tires and small tire pile clean-ups.

- Waste Tire Track and other Recreational Surfacing Grants – competitive grants used for the purchase and installation of recreational surfaces made from California waste tires.

- Waste Tire Playground Cover Grants – grants to cover expenses related to playground surfaces that are manufactured using California-derived waste tire rubber.

- Tire Product Commercialization and Research Grants –competitive grants available to research institutions, individuals, businesses, and qualifying Indian tribes to assist with development of commercial processes and technologies using waste tires.

- Waste Tire Enforcement Grants – competitive grants available to local enforcement agencies and cities and counties with regulatory authority for inspection, compliance, and surveillance activities.

VIII. TIRE STEWARDSHIP PROJECTS OVERVIEW

This section provides an overview of tire stewardship activities in the United States and abroad. Each stewardship effort operates on the principle of shared responsibility between manufacturers, retailers, government agencies, tire haulers, tire recyclers, and consumers, although there is a wide range of perspectives as to how this responsibility should be distributed. The exact nature of this "shared" aspect of responsibility is at the heart of product stewardship negotiations.

The responsibilities to be shared are generally divided into two basic categories – *physical responsibility* to manage the waste tire from generation through its end-of-life management, and *financial responsibility* involving who pays the management cost, how it is collected, what it is used to fund, and how it is disbursed. There is also a program management responsibility as well, which involves setting goals, evaluating performance, planning, and providing overall leadership.

The existence of a financing system that can sustain the management of waste tires is a critical component of a successful program, and financing fuels all current efforts to manage waste tires. The ultimate goal of managing tires, however, is to reduce waste and find value-added markets for waste tires with economic value so that no extra funds are needed to manage the product. Currently, though, the management costs exceed the inherent value in the waste material, and funding has been required to properly manage waste tires, prime the market for recycled tire products, and conduct demonstration projects and technical research on longer-lasting tires. This section describes efforts in the United States, Canada, and Europe where systems have been put in place to manage waste tires and move towards a sustainable economic scenario.

Tire Product Stewardship in the United States

Currently, 35 states across the country have enacted a waste tire fee (or advanced recycling fee, ARF) on new tires, which is usually understood as a visible fee paid by a consumer at retail to pay for the costs of tire management programs.[21] These legislatively mandated fees are assessed based on the costs associated with the product's end-of-life management costs. These fees are quite variable among the different states, ranging from $0.25 to $5.00 per tire, with the most common fee being $1.00 per tire (as is the case in California). In addition, nine states have sunset tire fees previously in place, and two additional states are scheduled to sunset fees in 2010. North Carolina is the only state that does not charge a flat fee, but instead charges 2 percent of the cost of the tire.

A few states, like Maryland and South Carolina, collect fees and allow the retailer to keep a portion of the fee to cover administrative costs. In states where this does not occur, the retailer typically charges an additional fee on top of the state fee to cover its actual disposal or recycling costs. The funds are paid to the state and cover a variety of activities, including tire abatement, enforcement, market development, demonstration projects, loans, grants, and educational programs. In some cases, state tire funds have been raided to fund general fund activities unrelated to tire activities.[22] This was particularly prevalent in 2003 when many states experienced budget shortfalls and searched for supplemental funding.

There are numerous other tire program requirements that vary by state. For example, 37 states ban whole tires from landfills. Of those, 28 states require tires to be quartered or shredded before landfilling may legally occur. Nine of those states have banned shredded tires from landfills as well. Related to market development, 14 states provide incentives for the purchase of tire-derived products by state government agencies, most of which allow a 5 to 10 percent price preference for state purchases of tire-derived products over virgin material counterparts. California's law provides a 5 percent price preference for tire-derived products.

ARFs in the United States have also been enacted on a state level to manage motor oil and lead-acid vehicle batteries, with the fees being paid into a government fund. These fees, which are authorized by legislation, serve to educate a consumer about the reason for the product price increase, but are viewed more as a way to cover costs and develop markets than as a means to provide a financial incentive for manufacturers to redesign their products to produce fewer environmental impacts, one of the tenets of product stewardship.

Each stakeholder in the tire stewardship initiative has a role to play in managing waste tires. Consumers, for example, pay a fee to fund end-of-life management costs. They also have the responsibility to bring their waste tires to an appropriate collection point and not dump it illegally. State government plays a key planning and enforcement role to level the playing field, whereas local governments often provide a part of the collection infrastructure, and may enforce against tire dumping and educate residents about recycling opportunities. Retailers also provide collection and consumer education, as well as fee collection. In this

[21] For a state-by-state breakdown of state legislation related to scrap tire disposal, see RMA website at: https://www.rma.org/publications/scrap_tires/index.cfm?PublicationID=11121.

[22] Rubber Manufacturers Association, State Legislation – Scrap Tire Disposal Report – September 2003.

vein of responsibility, on the national level, manufacturers, through the Rubber Manufacturers Association and the Tire Industry Association, typically provide support to state and federal tire management programs through information, workshops, and other educational activities.

While waste tire management in California is not faced with a lack of funding, there are a significant number of programs with little agreement among stakeholders about how the funding should be distributed. There may be opportunities in the current system for greater efficiencies through increased stakeholder cooperation in system management.

Tire Product Stewardship in Canada

Each of the Canadian provinces has developed similar tire product stewardship programs, although there are regional variations. Each program includes a mandatory fee on new tires purchased between $2 per tire (passenger tires in Prince Edwards Islands) and $35 per tire (truck or agricultural tires in Saskatchewan). Some provinces require that consumers pay the fee to retailers, while others require retailers to pay the fee. However, in all cases, the fee is passed on to the consumer. The fees are assessed by non-profit entities with independent boards usually consisting of industry and government representatives. These boards manage the funds and allocate payments for the collection, transportation, processing, and recycling of waste tires, as well as the clean up of tire stockpiles. In most cases, government is responsible for ensuring that all manufacturers and retailers comply with the law.

Tire Product Stewardship in Europe

In Europe, 372 million tires are generated annually with about 252 million tires (or 68 percent) reused, recycled, or otherwise recovered for value. According to the Bureau de Liaison des Industries du Caoutchouc (BLIC), throughout the European Union, each country has its own organization dedicated to managing waste tires. In many countries, these organizations are legislatively required. These organizations assist companies in meeting their responsibilities under the law.

While Europe has enacted an "End-of-Life Vehicle Directive," it only requires that tires be removed from the vehicles. In addition, whole tires were banned from landfills in July 2003, and shredded tires will be banned as of mid-year 2006. These two regulations create the need for tire management systems. A number of countries have enacted laws requiring the producer or importer to take responsibility for tire management, including Belgium, the Czech Republic, Finland, France, the Netherlands, Norway, Poland, Portugal, and Sweden, with legislation pending in Greece and Hungary. There may be a consumer contribution to the financing of this system but it is invisible, not a distinctive visible line-item fee on their bill. Other countries in the European Union work on a free market system, requiring that the last holder of a tire have responsibility for handling it.

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[23] For a state-by-state breakdown of state legislation related to scrap tire disposal, see RMA website at: https://www.rma.org/publications/scrap_tires/index.cfm?PublicationID=11121.

[24] Rubber Manufacturers Association, State Legislation – Scrap Tire Disposal Report – September 2003.

According to information from the Rubber Manufacturers Association (United States), European countries follow three basic systems.[25]

Free Market System: The distributor deals directly with the recycler of his choice on a free market basis. Free market systems are active in Ireland, United Kingdom, Spain, France, Italy, Austria, Germany and Greece.

Take Back/Fund System: Take back/fund systems mandate individual producer responsibility. Producers contribute to a collective fund that finances the recycling organization. Take back systems are active in Norway, Sweden, Finland, Denmark, Poland, Portugal and the Czech Republic

Tax System: Under this system, producers pay a tax to the government, and the state is responsible for the overall organization and pays recyclers. A tax system is active in Denmark, Slovakia and Hungary

Tire markets in Europe are similar to those in the United States. Europe has increased the amount of tires recycled from approximately 8 percent to over 20 percent in the past several years. (See Table 2 for a breakdown of waste tire markets in Europe.)

Table 2

Breakdown of European Waste Tire Markets

Market	Landfill	Energy Recovery	Recycling	Retread	Export	Misc.
Percentage	31%	22%	21%	14%	8%	4%

The main market for recycled tires in Europe is crumb rubber, which is converted into products such as tiles, horse arenas (a very popular use in the United Kingdom), and minor uses in road applications. The use of rubberized asphalt has been hindered by political and economic factors, as road construction is a government responsibility. Energy recovery is a large market for waste tires, and electric generation plants that use tires are working especially well in Southern Italy. There are also pilot projects currently underway in France (with one about to start in Spain) where carbon from the tires is extracted for use in making steel. As in the United States, Europe has a healthy retread market for truck tires, but not for car tires.

Table 3 below outlines the various markets for European waste tires. The table also provides information on tire disposition in Europe for 2001 and 2002:

Table 3

[25] Rubber Manufacturers Association, European End of Life Tyres (ELT) by Dan Pyanowski, presentation to the RMA Rubber Recycling Conference in Montreal, Quebec, October 2002.

[26] Rubber Manufacturers Association, European End of Life Tyres (ELT) by Dan Pyanowski, presentation to the RMA Rubber Recycling Conference in Montreal, Quebec, October 2002

Used Tires analysis in 2002 in Europe

	Tire Generation (000 tonnes)	Reuse (%)	Export (%)	Retreading (%)	Material recycling (%)	Energy recovery (%)	Landfill & unidentified (%)	Used Tire recovery rate (%)
Austria	55	0	0	0	46	54	0	**100**
Belgium	75	2	3	4	23	31	37	**63**
Denmark	43,5	0	0	9	76	15	0	**100**
Finland	37	0	0	3	97	0	0	**100**
France	390	0	10	14	33	19	24	**76**
Germany	578	4	8	10	18	52	8	**92**
Greece	50	4	2	3	14	3	74	**26**
Hungary	43	0	8	0	4	23	65	**35**
Italy	360	5	2	14	14	33	32	**68**
NL (pc tires only)	35	0	85	0	15	0	0	**100**
Poland	101	0	0	15	8	27	50	**50**
Portugal	50	0	0	30	40	16	14	**86**
Spain	263	0	4	14	8	10	64	**36**
Sweden	76	1	15	4	35	45	0	**100**
Switzerland	53	0	40	2	30	28	0	**100**
UK (estimates)	485	16	2	10	32	10	30	**70**
EU average 02	**2695**	**5**	**7**	**11**	**24**	**27**	**27**	**73**
EU average 01	**2617**	**6**	**6**	**13**	**19**	**21**	**35**	**65**

Source: Bureau de Liaison des Industries du Caoutchouc, November 2003.

In December 2000, the European Commission passed the Directive on Incineration of Waste, which fixed emission limits for all new cement kilns after December 28, 2002. Beginning in December 2005, new provisions will apply to existing plants that are co-incinerating waste, including cement kilns burning waste tires. Most or all existing cement kilns will be unable to meet the new air, more stringent quality standards set by the commission. Existing cement kilns are not likely to be able to burn tires at all once the 2008 standards come into effect. This measure will reduce the overall capacity for tires used to produce energy by approximately 10 percent.

Product Stewardship Models

Two United States product stewardship initiatives may be instructive in the development of a tire product stewardship dialogue in the United States – the National Carpet Dialogue, an example of how performance standards were set to drive market development efforts, and the Rechargeable Battery Recycling Corporation, an industry-run third party organization that internalizes the costs of collecting and recycling rechargeable batteries.

Performance Goals – National Carpet Dialogue

Setting product performance goals is one means to strategically drive market development efforts. In the National Carpet Dialogue, carpet manufacturers helped set goals for reuse, recycling, energy recovery, and landfill diversion, as well as to set up a non-profit

organization to meet the goals. This approach is expected to reduce the environmental impacts of carpet throughout its life cycle – from design to end-of-life management.

As a result of mounting quantities of discarded carpet in the waste stream, members of the carpet industry, government officials, and non-governmental organizations met beginning in 2000 to develop a strategy for diverting carpet from disposal. At that time, total carpet discards reached 4.7 billion pounds per year, with only a small percentage of the material being reused or recycled. National concerns about disposal capacity, combined with the carpet's bulk (which makes it difficult and expensive to handle), contributed to the search for increased recycling and reuse opportunities.

In January 2002, stakeholders signed a joint Memorandum of Understanding (MOU) for Carpet Stewardship. This agreement established an ambitious ten-year schedule to increase the amount of recycling and reuse of post-consumer carpet and reduce the amount of waste carpet going to landfills. The MOU set forth national goals over a ten-year timeframe to significantly increase the amount of recycling and reuse of post-consumer carpet. By 2012, the parties plan to achieve a landfill diversion goal of 40 percent. These goals are intended as steps toward fulfilling a long-term commitment to eliminate the disposal (including energy recovery) of waste carpet. The parties will resume negotiations in 2010 to set new goals that go beyond the 2012 timeframe.

The carpet industry created the Carpet America Recovery Effort (CARE) to meet the goals of the agreement (see Table 4 below). The multi-stakeholder group includes members from the carpet industry and government, and is responsible for monitoring, evaluating, and assessing progress toward meeting the goals. CARE is funded and administered by the carpet industry.

Table 4

Summary of the national goals for carpet recovery

Figures rounded to millions of pounds. Data on carpet discards provided by the Carpet and Rug Institute.

	2002	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Total Discards	4,678	4,828	4,537	5,038	5,261	5,590	5,642	5,887	6,020	6,605	6,772
Reuse	0			25			113		211		203-339
Recycling	180			353			620		903		1,354 -1,693
Waste-to-Energy (WTE)	-	48	45	50	53	56	56	59	60	66	68
Cement Kilns	-			100			300		200		200
Landfill	4,498			4,510			4,552		4,646		4,812
Recycling Rate	3.8%			7%			11%		15%		20-25%
Landfill Diversion Rate	3.8%			10%			19%		23%		27 - 34%

Cost Internalization – Rechargeable Battery Recycling Corporation

Another type of product stewardship model is exemplified by the Rechargeable Battery Recycling Corporation (RBRC), which was established by manufacturers, without legislation (initially), to collect and recycle rechargeable batteries. In this case, the consumer is not aware that the recycling infrastructure was created through funds derived from a charge assessed by RBRC, a "third party organization," on its member manufacturers. Each manufacturer recovers these costs in the course of doing business, and internalizes them into the product purchase price, passing them on invisibly to the consumer in full or in part.

Some stakeholders prefer that end-of-life management costs be internalized into the product price invisibly, believing that such a mechanism gives greater incentive to manufacturers to reduce product impacts, as compared to visible fees. They reason that a manufacturer that reduces its end of life costs should be able to pass on that savings to consumers through a lower product price, thus developing a competitive advantage.

In the RBRC model, rechargeable batteries are collected from consumers by municipalities, retailers, businesses, and public agencies across the United States. The program is free to consumers and municipalities, as RBRC pays the shipping costs to the battery recycler. The fee paid by manufacturers into a fund is determined by a formula set by RBRC based on battery type and market share. The fees pay for collection, shipping, recycling, and program outreach.

IX. ISSUES AND STRATEGIES

This section of the Tire Stewardship Action Plan outlines key issues and potential strategies to address the problems related to waste tire management identified by the Product Stewardship Institute (PSI) from 22 interviews with government officials, tire manufacturers, retailers, recyclers, and other key participants.

Issue 1: Waste Tire Generation
Solution: Increase lifespan of tires

In the state of California, 33.5 million tires are generated as waste each year. The magnitude of this estimate indicates the clear need to reduce the generation of waste tires. The most effective way to reduce the costs and environmental impacts of waste tire management is to avoid the generation of tires in the first place by extending the life of tires so that they last longer. The Rubber Manufacturers Association and the Tire Industry Association both educate consumers on how to properly maintain tires and, therefore, to minimize or delay waste. Expanding the life of tires will reduce the number of tires entering the waste stream.

Potential Strategies

1. **Increase consumer education on tire maintenance at retail and other locations.** Most consumers are unaware that tire maintenance is related to increasing the life of their tires and could save them money. Education on tire maintenance could occur at retailers, municipal locations, auto repair shops, and through the media. Existing materials provided by RMA and TIA could be incorporated.

2. **Provide free and convenient pressure gauges and air for tire maintenance.** Providing easy access to a tire gauge to test pressure, and providing free and convenient air when tires are low could increase consumers' ability to properly maintain their tires. These could be provided at gas stations, service stations, and retailers.

3. **Install "smart tire" systems on new vehicles** (recommended in the report entitled, *Extending the Lifespan of Tires – Final Report*).[27] Smart tire systems do not require a change in consumer behavior, but instead rely on computerized devices to maintain proper tire function. Three examples include: (a) a device that alerts drivers when a tire is low on pressure and should be filled; (b) an auto-inflate system that monitors and maintains tire pressure at optimal levels; and (c) a system that can communicate information from tires to the vehicle suspension and braking system to help reduce breaking distances. This strategy could be implemented either voluntarily by the manufacturing industry or through state or federal legislation.

4. **Manufacture longer lasting tires** (recommended in the report entitled, *Extending the Lifespan of Tires – Final Report*). With so many inexpensive tires on the market, it is difficult to get many consumers to purchase higher-end tires. However, in most cases, cost is directly related to quality and to the mileage one gets from a tire. Manufacturers increased the life of a standard tire from 28,000 miles for a light-duty tire in 1981 to 43,000 miles in 2001, resulting in a 15 percent reduction in waste tires. An even longer lasting tire would further California's effort to reduce waste tires being landfilled. Manufacturers who sell tires in California could agree, or could be required, to meet increased standards for average tire life through similar methods set under the federal Corporate Average Fuel Economy (CAFÉ) standard that requires fuel efficiency in vehicles. This approach would either push low-cost tire manufacturers to improve standards or force them to withdraw from the California market.

5. **Encourage consumers to buy longer life tires.** While longer lasting tires are currently in the marketplace, many consumers are still purchasing low-cost, shorter

[27] Extending the Lifespan of Tires Final Report by Schmuel L. Weissman and Jerome L. Sackman, Symplectic Engineering Corporation and David Gillen and Carl Monismith, Institute for Transportation Studies, University of California at Berkeley, July 2003.

[28] Extending the Lifespan of Tires Final Report by Schmuel L. Weissman and Jerome L. Sackman, Symplectic Engineering Corporation and David Gillen and Carl Monismith, Institute for Transportation Studies, University of California at Berkeley, July 2003.

life tires in an effort to save money. Information about tire lifecycle costs and benefits could help encourage more consumers to invest in better quality, longer-lasting tires.

6. **Develop a unified approach to optimal tire pressure.** Currently, information provided to retailers by automobile manufacturers and/or tire manufacturers is not in agreement with retailer's opinion about the optimal tire pressure. Retailers typically pressurize tires at a higher level than recommended by the automobile manufacturer. Lower pressure often provides the consumer with a smoother ride. However, the tire then is more likely to be low on air and, therefore, have a shorter life. Higher pressure levels increase tire longevity and translates into better fuel efficiency for the vehicle. Conversely, too much air in a tire can mean the vehicle will not handle as well and can cause safety risks. The automobile manufacturer prints the optimal tire pressure on a label placed on the vehicle, usually on the inside panel of a door. Participants could convene a multi-stakeholder workgroup to refine this issue and develop a common strategy.

Issue 2: Waste Tire Markets
Solution: Develop performance metrics for program success

Currently there are no agreed upon goals for the amount of tires that should be diverted from disposal or into different market development efforts. Setting goals for these efforts could help focus priorities, much as it did with the carpet industry. The Environmental Protection Agency's Resource Conservation Challenge Tire Cluster has begun to discuss possible measurable national goals.

Potential Strategies

1. **Set measurable goals for market development and reduced disposal.** Setting long-term goals for reuse, retread, recycling, and reduced disposal of waste tires can draw attention to the need to develop new markets, and to prioritize market development activities. California's tire programs do currently address many of the issues and strategies outlined in this Action Plan. However, these initiatives could be prioritized based on what stakeholders are most interested in working on together. By developing priority programs together, all stakeholders would have a vested interest in the program as a whole, which might provide greater momentum towards resolving priority issues.

Issue 3: Tire Reuse
Solution: Increase Reuse and Retread Markets for Tires

Reuse is second on the waste management hierarchy only to waste prevention. Reuse refers to when a tire has been used once, but still has useful life and could be used again. While reuse of waste tires can be more challenging than reuse of other products, there are some legitimate reuse opportunities that could impact the number of tires being landfilled. A separate market that offers even more opportunities to reduce waste exists for retread tires.

Retreading refers to reusing a tire casing with a new tread applied to the tire surface. Retreads offer performance equal to a new tire at a significantly lower cost. There are more reuse and retread opportunities available today that could be explored to divert tires from disposal to beneficial use, including export markets. However, both practices are hampered by a poor perception among consumers.

Potential Strategies

1. **Promote use of retreads among local government and commercial fleets.** Retreads are most common and practical in commercial fleets for large truck tires. While state government fleets and many private business fleets in California are currently having their tires retread, there is a tremendous opportunity to increase retread use by county and city fleets, as well as commercial fleets. Education could be accomplished through workshops, outreach, and targeted campaigns, including a model local government procurement strategy for retread tires.

2. **Reduce liability concerns over reused tires.** While segregating usable tires for reuse is a common practice, the potential for reuse is not being fully realized. Some people are concerned that their automobile insurance might be voided if used tires are mounted on their vehicle. It was particularly suggested that more reused tires could be sold in Mexico if this insurance barrier could be overcome.

Issue 4: Collection and Transportation
Solution: Reduce regulatory barriers to lower costs of tire collection

A new Waste Tire Hauler and Manifest System went into effect in California on July 1, 2003. The manifest system in California, like most other states, was enacted to discourage the illegal disposal of tires, which would contribute to existing tire pile problems. These regulations have reduced the illegitimate tire hauling businesses in the state. However, recent increased enforcement of the regulations has also resulted in fewer haulers that can meet the burdensome reporting requirements. This loss of competition makes it harder to find a hauler to pick up waste tires, and harder to find a company to buy waste tires from. In addition, collection of waste tires by small retailers poses a particular problem owing to limited space and the need for more frequent pickup. Further, some local governments have passed ordinances that do not allow tires to be stored outdoors because of the possible attraction of mosquitoes and vermin.

Potential Strategies

1. **Streamline tire manifest system.** CIWMB could streamline its existing tire manifest system to reduce regulatory costs without easing up on environmental protection. According to several stakeholders, only two processors are reportedly able to submit manifests electronically, which creates an uneven playing field for tire haulers across the state. While the state has been providing incentives to get other haulers on the Electronic Data Transfer (EDT) program, such as computer consulting assistance, those efforts are yet to be successful. In addition, registration and reporting

requirements have also been described as burdensome. Reviewing and revising the waste tire management rules and regulations to be more conducive to smaller collectors, haulers, and processors could increase competition and decrease costs of tire management in the state.

2. **Develop cooperative collection contracts.** Work with organizations, such as the Chamber of Commerce or CIWMB to develop cooperative contracts with collectors of waste tires. This could reduce costs by bringing smaller businesses under one contract. Cooperative collection and management will make tire markets more efficient no matter what market the waste tires go.

Issue 5: Crumb rubber markets
Solution: Develop sustainable and diversified crumb rubber markets

When tires are processed cryogenically (frozen and broken) or ambiently (ground) to a small particle size, the finished product, crumb rubber, can be used in a variety of applications, from loose fill to molded products to rubberized asphalt. Crumb rubber markets struggle owing to the high cost of producing crumb, along with technological barriers and the lack of use of existing specifications. In order to develop long-term, diversified, and sustainable markets for crumb rubber, there need to be technological advancements, financial assistance, and education to overcome the barriers that exist today.

Potential Strategies

1. **Promote existing specifications for crumb rubber.** Tire processors often do not produce a product to a standard specification even though there are existing ASTM standards for recycled vulcanizate particulate rubber,[29] and another specification under development by the Institute for Scrap Recycling Industries (ISRI) through its Scrap Tire Workgroup. The lack of awareness of these specifications contributes to a lack of clarity of expectations between those who buy and sell recycled rubber products. Stakeholders could work jointly to promote the existing standards for widespread use in California's tire industry.

2. **Increase government and business purchase of tire-derived products.** While there are a wide variety of tire-derived products available in the marketplace, building market acceptance and sustainability continues to be a challenge. Few government agencies or businesses are purchasing tire-derived products, such as mats, liners (e.g., for truck beds), and rubberized asphalt (such as parking lots). Start-up companies have a difficult time securing customers to purchase their products, and there remains a glut of crumb rubber in the marketplace. The purchase of tire-derived products by government agencies and businesses can be increased by developing model procurement policies, as well as marketing plans that target specific areas that show

[29] ASTM D5603-96 Standard Classification for Rubber Compounding Materials – Recycled Vulcanizate Particulate Rubber

the best potential for increased use. Businesses, such as tire processors, retailers, and manufacturers could particularly benefit from such action.

3. **Overcome perception related to inferior quality of recycled content tires.** As with other types of recycled-content products, consumers must learn that recycled doesn't mean inferior. Overcoming negative perceptions about tire-derived products could open doors for new markets and products. This holds true especially in product categories such as new tires with recycled content. Consumers could be educated on the price, quality, and availability of tire-derived products and how this compares to products containing only virgin materials. Such education could be conducted in conjunction with tire-related associations to make information more readily available for consumers at the point of purchase.

4. **Research and develop strategies to overcome technical barriers to using crumb rubber as a raw material.** Two approaches are included in this strategy: (a) Research on devulcanization technologies, and (b) Material Safety Data Sheets (MSDSs). Today, partial devulcanization exists, which still limits the amount of material that can be incorporated into new product manufacturing. If devulcanization could be accomplished in full to break the sulfur bonds that hold tire rubber together, there could be a much greater potential for using crumb rubber in new tire production. A second approach would involve tire manufacturers providing generic MSDSs on tires so that those manufacturing crumb rubber, or products made from crumb, had a full understanding of the chemical properties with which they were working. Any solution, however, would have to allay any anti-trust concerns.

5. **Equipment grants for crumb rubber manufacture.** Equipment for processing tires is expensive to purchase and maintain. It is estimated that, for every tire a processor recycles annually, they need one dollar in capital investment. Grinders, cutters, slicers and sheers must be sharpened and replaced regularly in order to keep equipment operating. Providing funding for equipment, start-up projects, or expansion projects could help overcome some of the initial economic inequities of recycled rubber over virgin, particularly if the current matching requirements were reduced. In addition, it might level the playing field with Canadian companies that receive subsidies for tire recycling. However, most stakeholders agree that initial funding should not lead to long-term subsidies of the industry. In addition, some stakeholders noted that if CIWMB was going to subsidize the tire infrastructure, they should support the end markets and not the hauler/recycler. Financial assistance could also be directed to the purchase of energy-efficient equipment.

6. **Provide marketing assistance for California tire-derived product manufacturers.** In Georgia, the state assists manufacturers of tire-derived products by providing funding for marketing costs, including the cost of international trade trips to market products abroad. This type of assistance is useful in finding new markets. The tire recycling industry is still in its infancy, and marketing assistance will enable tire-derived product manufacturers to mature as the markets develop.

Issue 6: Recycled Content in New Tires
Solution: Increase the percentage of recycled content in new tire manufacture

Today, the tire industry uses between 3 and 5 percent recycled content in new tire manufacturing. Reports indicate that recycled content could be increased to up to 10 to 15 percent with little degradation of tire performance. The goal would be to increase recycled content in tires without compromising performance and safety, and without causing tires to degrade and enter the waste stream earlier. Through technological advancements and financial assistance, and by overcoming public perception of product inferiority, there could be opportunities for greater recycled content in new tire manufacturing.

Potential Strategies

1. **Increase recycled tire rubber in new tire manufacturing and other molded products.** Today, most tire manufacturers use about 3 to 5 percent recycled rubber in their new tire production. According to the 2003 report commissioned by CIWMB on recycled content, it is technically feasible for manufacturers of tires to use as much as 10 – 15 percent recycled content, although there is a debate as to the impact that adding any amount of recycled content has on tire longevity and performance.[30]

2. **Conduct research on technologies to increase recycled content in tires.** Devulcanization is a technology that holds the greatest potential for enabling tire manufacturers to add higher percentages of recycled content into new tire manufacturing. Increasing research on devulcanization could help reduce costs of using recycled rubber and improve crumb rubber feedstocks. Of all the potential markets for crumb rubber, use in new tire manufacturing would be the highest and best use of the material. Stakeholders could explore the means for overcoming the technological and cost barriers to increasing recycled content in new tire manufacturing.

3. **Provide financial incentives to increase demand for recycled rubber.** Since the cost of recycled rubber is typically higher than virgin rubber, it is difficult for it to compete in the marketplace. Short-term financial incentives, such as procurement grants to test new products or tax credits, could increase demand for recycled rubber and drive down long-term pricing.

4. **Develop recycled-content tire procurement specifications along with a strategy for procurement of recycled-content tires and molded products.** To stimulate demand, state and local government fleets, as well as large private sector procurement entities, could require or encourage the purchase of new tires that contain greater than 5 percent post-consumer recycled content. In addition, California state government could consider changing its price preferential policy to allow purchases on recycled content tires and other specified products that are up to 10 percent higher than virgin counterparts, as many states now do. California could also develop a campaign to increase the amount of tire-derived products purchased, including setting procurement

[30] Increasing the Recycled Content in New Tires, Draft Report, July 2003.

targets, developing an internal marketing campaign, and conducting demonstration projects. Further, the state could set a goal for the increased use of recycled-content incrementally over time. Finally, CIWMB could work with automobile manufacturers to specify and procure recycled content in tires.

Issue 7: Rubberized asphalt concrete markets
Solution: Develop sustainable and diversified rubberized asphalt concrete markets

The states of Arizona and Florida successfully use rubberized asphalt pavement for many road-paving projects. However, RAC use has often faced barriers regarding a perception of higher cost and lower performance. California's Department of Transportation has developed an internal goal of using RAC on 15 percent of all its flexible pavement projects. There is great potential to increase RAC use within CalTrans, county highway departments, and among asphalt contractors through education, financial assistance, use of existing specifications, and technological advancements.

Potential Strategies

1. **Use standardized asphalt mix designs and paving standards for rubberized asphalt concrete (RAC).** Using specifications from the Arizona Department of Transportation and others, California could develop standards for asphalt mix designs in conjunction with CalTrans that could be incorporated into state transportation standard operating procedures for road construction. Standard RAC mix designs and paving standards could be tested and proven to work under California climate conditions. Following successful demonstration projects, the state could promote the use of RAC for other projects.

2. **Train and educate state and local highway engineers, and others on rubberized asphalt use, costs, and benefits.** When evaluating crumb rubber as part of a rubberized asphalt project, it is important to look beyond initial costs and towards long-term benefits. Rubberized asphalt has been proven to improve rolling resistance of vehicles and vehicle traction and, when installed properly, it can increase the useful life of the road and reduce cracking. Most governments look at budget cycles and lowest bid when constructing a road, which makes it difficult for rubberized asphalt to compete. However, when a lifecycle analysis is completed, including the improved safety features, rubberized asphalt can compete well with traditional road construction. CalTrans, county highway departments, and other state and local agencies could be a major consumer of rubberized asphalt if staff are given the technical specifications and education on how and why to do so. Training could also benefit paving contractors for use on private jobs, such as parking lots and private roads. Education is particularly needed to overcome perception issues related to cost and performance, and will be essential to employees understanding technical aspects of the material. Continued state grants are an essential component of this strategy. Currently, CIWMB does offer grants for RAC, although these grants could be marketed more widely and used in more projects by the paving industry. However, as rubberized asphalt gains greater market acceptance and market share, these subsidies could be eliminated.

3. **Require CalTrans and others receiving state funding to purchase California tire-derived tire rubber.** Most of the rubber used in California in rubberized asphalt originates from Canada. To further develop markets for California-made crumb rubber, the state could require that the rubber be supplied by a California manufacturer.

4. **Develop infrastructure and logistics for material delivery at jobsites.** There is a need to further develop the crumb rubber infrastructure so that tire processors can amass enough crumb rubber supply in advance of a road paving project. This could include consolidation areas, storage areas, and cost-effective transport systems. In addition, delivery and storage logistics need to improve for crumb rubber at the jobsite so that material is available at the quantities needed at the time needed. Becoming a more dependable source will enable companies to develop long-term contracts for crumb rubber supply and delivery on a regular basis and develop more secure markets for crumb rubber.

Issue 8: Shredded tire markets
Solution: Increase the civil engineering applications for shredded tires

Shredded tires can be substituted for traditional civil engineering materials, such as aggregate or stone, and as a lightweight fill material. There are existing ASTM standards for the use of shredded tires in many civil engineering applications, including road base, embankments, landfill drainage, and landfill cover. Owing to past problems associated with using waste tires in these applications, there is some reluctance to use shredded tires today. Through local and state government education and use of standard specifications, these barriers may be able to be overcome.

Potential Strategies

1. **Provide education and information on benefits of using waste tire shreds in landfill applications.** Chipped and shredded waste tires have been successfully used to line the bottoms of landfills and to provide drainage in the leachate collection field. In addition, they can be used as daily cover material at landfills as an alternative to dirt, sand, or other cover. Strategies could target landfill operators and solid waste authorities, such as the Solid Waste Association of North America's CA Chapter.

2. **Educate transportation officials about ASTM specifications for tire shreds.** Those using waste tires as an aggregate substitute for bridge embankments, subgrade fill, retaining wall reinforcements, and other civil engineering applications need to understand and follow the ASTM standards for maximum project performance. This can be accomplished by educating transportation officials and writing ASTM standards into state and local contracts.

3. **Allow for, and promote, waste tire use in local septic fields/drainage through local ordinances and state rule.** Regulators and lawmakers, such as state and local

departments of health, could formally accept tire chips as an alternative to aggregate and sand when installing or repairing a septic system. In addition, there would need to be education provided on the proper installation of septic fields using tire chips among residents and those who install septic systems.

4. **Educate about specifications to increase the use of tires in road base.** There are existing specifications that have been widely accepted for the use of tire chips in road base applications. This would lead to reduced risk of problems such as those that occurred in the past. There is also a need to provide education to overcome negative press; success stories and proper technical applications should be shared with both state and county highway engineers.

Issue 9: Recreation markets
Solution: Develop sustainable and diversified recreation markets

Loose fill crumb rubber can be used in a variety of applications for recreation and outdoor use, such as playgrounds, running tracks, sports fields, horse arenas, golf courses, and walking trails. However, crumb rubber is often not chosen as a ground cover or fill owing to cost barriers and a public perception of product inferiority. The CIWMB has implemented a successful grant program to help encourage the use of the crumb rubber in recreation application. Yet, there are still limited markets. Through public education, grants, marketing, and other avenues, stakeholders could build more sustainable markets for recreation use of waste tires.

Potential Strategies

1. **Promote benefits of crumbed and chipped rubber over traditional materials used in sports fields, playgrounds, horse arenas, golf courses, walking trails and as mulch.** In many cases, tire material used for playgrounds, sports fields and other recreational applications can perform better than traditional materials. However, there remain certain negative perceptions about the product that create barriers to its widespread use. Through proper installation techniques and education of parks and recreation officials (public and private), schools, day care providers, and others, these barriers could be overcome. The result could be an increased use of crumbed and chipped rubber in these markets.

2. **Develop a market development plan for recreational uses.** California currently offers grants for the use of crumb rubber in playgrounds. However, to move these products into the mainstream and provide a sustainable market, a focused marketing plan would be needed. This could involve assistance to manufacturers of crumb rubber to market their recreational products to parks departments, schools, and daycare centers. California could use existing demonstration projects, evaluate the applications, and use the demonstration projects as testimonials. Recycled plastic lumber is a good example of a recycled product that overcame the initial difficulty entering the market against wood decking and fencing. Now the material is readily available and, even though recycled plastic lumber is more expensive than wood in

the short term, it is used widely owing to its positive attributes and long-term economic viability. Crumb rubber in recreation applications could follow that lead.

Issue 10: Tire-derived Fuel
Solution: Increase tire-derived fuel markets

Currently, six of eight permitted cement kilns in California are burning tires. Another nine kilns in the state are not currently permitted to burn tires. In addition, there are two co-generation plants in state burning tire-derived fuel. As a result, there is an opportunity to increase waste tire use in these applications and divert more tires from landfills. In addition to cement kilns and co-generation plants, there are other facilities, such as industrial boilers, steel mills, and pulp and paper mills that can also use tires as a fuel source or other beneficial use. While tires are not considered the highest and best use for a waste tire, often it is the only economical market available to divert material from landfills. In addition, the mining and transportation of coal or coke as a fuel source is less efficient and more environmentally damaging than using local tires for energy. Finally, tires can also improve air quality by reducing hazardous air pollutants in coal and coke.

Potential Strategies

1. **Overcome perception related to environmental hazard of burning tires for fuel.** U.S. EPA has recently developed a draft TDF policy that is circulating internally for approval, and has been conducting outreach to gain wider acceptance of the use of TDF. Once the final policy is published, there will be official federal support for TDF, which could be leveraged in California. EPA is also working on a white paper on best management practices for pulp and paper mills and cement kilns using TDF, which will provide further support for the use of TDF for fuel . While TDF may not be considered the highest and best use of the tire resource by many stakeholders, it can be an effective means of reducing tires disposed while other markets are being developed. Education of the fuel alternatives and their environmental impacts, such as the mining and transportation of coal and the reduction in NOx emissions with TDF over coal might help some opponents better understand the potential benefits of TDF markets over landfilling.

2. **Provide financial assistance for facility conversion or other start-up costs**. Currently, California law does not allow any of the waste tire fees collected to be used for tire-derived fuel projects. If operators of boilers, furnaces, and kilns had access to financial assistance to defray start-up capital costs or to assist in overcoming logistical barriers, more tires might be converted from landfills to tire-derived fuel markets. There is agreement among those who use TDF that, while start up financial assistance would help stimulate the TDF market, long-term subsidies would not be required.

Issue 11: Landfill Disposal
Solution: Reduce tire landfilling through incentives and disincentives

The biggest deterrent to diverting more tires from landfilling is that it remains the least expensive management option. In order to overcome this barrier to recycling markets, California could level the playing field and make tire recycling as economical, or more economical, than landfilling. Some participants, however, believe that it is more appropriate to let market forces drive tire management options rather than government intervention.

Potential Strategies

1. **Phase in a landfill ban on tires.** Though California currently does not allow whole tires in landfills, a complete ban on processed tires would provide incentive for materials to move to other markets for recycling. However, any ban would need to be phased-in over time to avoid stockpiled tires without a market destination.

2. **Increase landfill tipping fees.** To provide added incentive to recycle and dissuade landfilling, the CIWMB could add a surcharge on waste tires disposed of at landfills beyond what is currently charged for municipal solid waste. This could be done in the form of a state or local fee placed on tires per by ton, per cubic yard, or per tire, to create a financial disincentive to landfill tires .

3. **Provide recycling incentives for retailers or haulers –** provide a financial incentive to those who seek recycling outlets for waste tires over landfilling. One consideration is to pay a reduced fee, less than the $1.00 per tire currently require to the state, for those tires collected and destined for recycling markets over landfilling.

4. **Require storage and marketing of tires before landfilling.** The State of Illinois requires that all waste tires taken to a landfill must be held for 30 days, with efforts made to find recycling markets for the materials instead of landfilling. Landfills can accept the material following the 30-day period, but must first post the material availability in a materials exchange for possible market placement. This policy could be instituted in California to encourage less landfilling.

Issue 12: Sustainable Financing
Solution: Develop agreement on long-term funding strategy

Today, California has a $1.00 per tire fee that is collected at the point of retail from consumers on each new tire purchased. That fee funds all of the state of California's tire programs. Having a funding source will be critical to the success of any statewide tire collection and processing program. However, the goal of funding should be to provide the market stimulus necessary for waste tires to have value at the end of their life and that tire markets be able to sustain themselves. Some states, such as Oregon, have sunset their tire fees before that sustainable dynamic has occurred and quickly had new illegal tire piles with no funding source for proper management.

Keeping costs low will require the active involvement of all stakeholders, particularly the tire industry, which best understands the market dynamic. Cost-effective system management has often been the trademark of private sector involvement. While government has a key role in tire management, there may be more room for greater efficiencies as stakeholders work more closely together on system management.

Potential Strategies

1. **Develop a third party organization that can provide cost-effective system management.** A third party organization (TPO), comprised primarily of tire industry officials, with a multi-stakeholder advisory panel could manage the tire infrastructure system, market development projects, and other critical initiatives. The TPO could also function as the fund manager, keeping government out of fund collection and distribution. Government could maintain its planning and enforcement role and set overall system goals. Having a third party organization manage the fund could ensure that tire fees are not raided to meet state general fund needs. In other product stewardship initiatives, such as the RBRC, a third party organization oversees all funding and programs. In other instances, like CARE, an industry third party organization helps set, meet, and evaluate goals. Whether led by CIWMB or an independent organization, evaluating the fee on a regular basis and setting and working towards reaching goals will ensure that adequate funding is available and spent to meet predetermined goals for waste tire diversion from landfills.

2. **Distribute funding according to negotiated priorities.** Funds could be distributed based on a negotiated agreement among stakeholders representative of the key interest groups in California. Funding would follow priority strategies agreed to as part of this dialogue process, or another process lead by CIWMB. Such a mechanism could lead to greater commitment from stakeholders to a full package of options rather than staying focused on their own particular interests. The goal of the funding strategies would be to work towards a sustainable tire infrastructure, and fund program priorities set by the CIWMB and other participants in the context of the final Tire Product Stewardship Action Plan. Stakeholders would need to develop a process for updating priorities and evaluating projects and funding allocations. The TPO could play a critical role in this process.

X. PROPOSED PROJECT SUCCESS METRICS

- Fewer tires stockpiled and disposed (reflecting education and other efforts on tire purchase, maintenance, reuse, retreading and recycling)
- Of the waste tires collected, increased levels of tires reused, retreaded, and recycled.
- Increased amount of tire-derived products available on contract and purchased.
- Increased levels of recycled content in new tires.
- Reduced cost of tire management for generators, haulers, and processors.

APPENDIX A: PSI INTERVIEW LIST

Organization	Type	Interviewee(s)
US EPA, Region 5	Government – Federal Agency	Paul Ruesch
US EPA, Region 4	Government – Federal Agency	Pamela Swingle
California Integrated Waste Management Board	Government – State	Michael Paparian
Illinois Environmental Protection Agency	Government – State	Todd Marvel
Georgia Department of Natural Resources	Government – State	Lon Revall
California Department of Transportation (Caltrans)	Government – State	Linda Fong
Arizona Department of Transportation (retired)	Government – State - Recycled Asphalt Concrete	George Way
Rubber Manufacturers Association	Trade Association – Tire Manufacturer	Michael Blumenthal
Rubber Manufacturers Association	Trade Association – Tire Manufacturer	Tracy Norberg
Tire Industry Association	Trade Association – Retailier	Dick Gust
Tire Retread Information Bureau	Trade Association – Retreaders	Harvey Brodsky
BLIC	Trade Association – European Tire Manufacturers	Fazilet Cinaralp
Cooper Tire & Rubber Company	Tire Manufacturer	Tom Wood
Michelin	Tire Manufacturer	Clarence “Red” Hermann
Golden By-Products, Inc.	Manufacturer – Tire Derived Products	Jana Nairn
U.S. Rubber Recycling Inc.	Manufacturer – Tire Derived Products	Rick Snyder
BAS Recycling	Recycler	Murray Quance
Lakin Tire	Recycler	Randy Roth
Big O Tire	Retailer	Jerry Kiefer and Bruce Cherry
California Portland Cement	Tire Derived Fuel User	John Bennett
Californians Against Waste	Environmental Organization	Scott Smithline
Symplectic Engineering Corporation	Consultant	Shmuel Weissman
Waste Tire News	Consultant	Mary Sikora
TL & Associates	Consultant	Terry Leveille