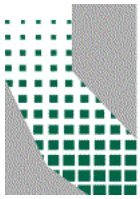

California Integrated Waste Management Board

May 2009

Contractor's Report

To The Board

California Scrap Tire Market Report: 2008

Produced Under Contract by:

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DK Enterprises

California Environmental Protection Agency

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Introduction

Under the California Tire Recycling Act of 1989 and subsequent amendments, the California Integrated Waste Management Board (Board) has adopted an overall tire management strategy focusing on two interrelated fronts: 1) A strong and fair regulatory framework to protect public health and safety and the environment while not stifling scrap tire flow and processing; and 2) Supporting expansion of the business and government market infrastructure for producing and using tire-derived products. The Board's Five-Year Plan for the Waste Tire Recycling Management Program guides efforts to reach the Board's goal of achieving a 90 percent tire diversion rate by 2015. The Board adopted a newly revised Plan in May 2009.

This report supports the Board's efforts by providing information on scrap tire[1] diversion rates and market trends based on research conducted from November 2008 through March 2009. It is intended to provide a new template for annual updates, building on the "California Waste Tire Generation, Markets and Disposal" reports prepared annually by Board staff through 2006. The report was prepared under Board contract by R.W. Beck, Inc. with research assistance by D.K. Enterprises.

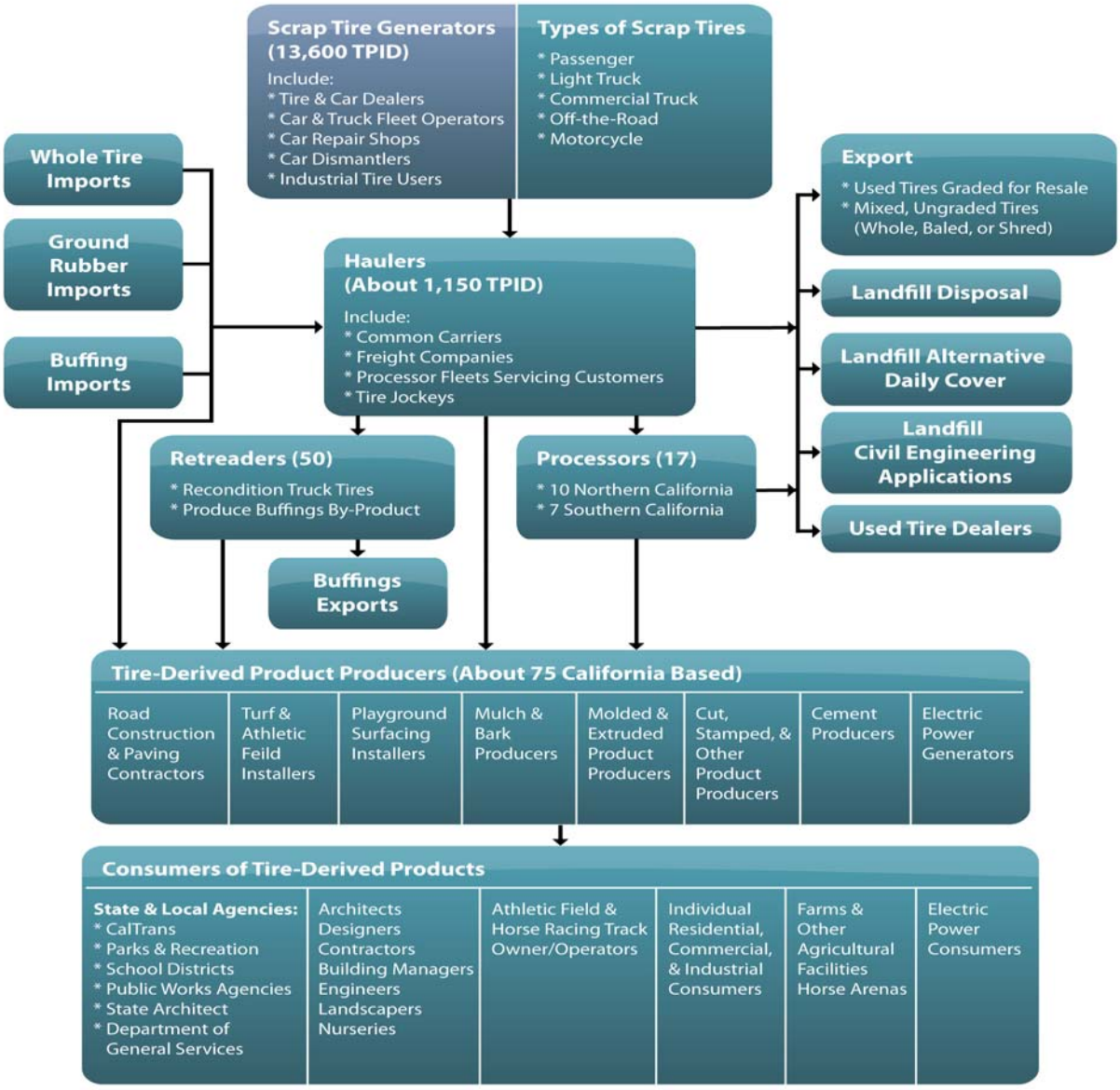
Following this introduction, Section 2 provides a snapshot of markets for California scrap tires with estimated scrap tire uses for 2007 and 2008 and a discussion of the outlook for increased diversion. Section 3 then describes trends under each market category in more detail. Section 4 provides some brief conclusions and Appendix A summarizes the methodology, data limitations, and differences between this report and previous Board staff reports.

Figure 1 below provides a flow chart identifying the number and types of firms involved in California scrap tire management. Additional background information compiled during preparation of this report will be available on the Board's website in fall 2009 including:

- An industry overview with maps and descriptions of the categories of scrap tire management firms identified in Figure 2;
- A California Rubber Feedstock Suppliers List;

[1] For purposes of this report only, "scrap tire" refers to both waste tires and used tires. Note that this is different than definitions in statute and those used in other Board reports and should be considered when comparing information in this report with other sources. The definition in statute for "waste tire" (Public Resources Code [PRC] Section 42807) includes both "scrap tires" (PRC Section 42805.6) and "used tires" (PRC Section 42806.5), both of which are separately defined in statute.

Figure 1
California Scrap Tire Management Flow Chart[2]



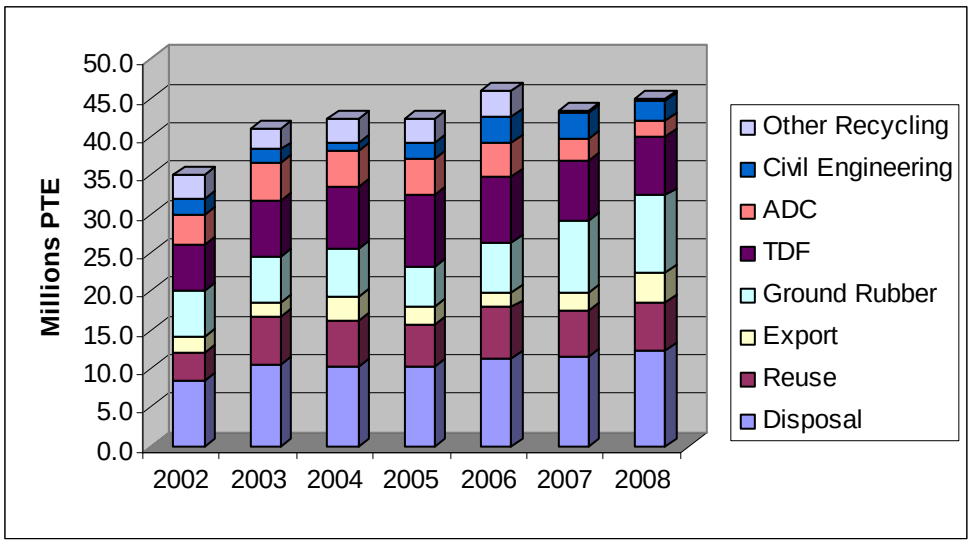
[2] Estimates of the number of California facilities are provided where they are available. TPID stands for tire program identification number, assigned to regulated entities under the Board's Waste Tire Manifest System.

Market Snapshot

Current Diversion Rate and Key Trends

This section provides a snapshot of California scrap tire markets as of December 2008. Figure 2 shows graphically the trends by broad market category since 2002, and Table 1 (on the following page) presents newly derived estimated uses for California-generated scrap tires in 2007 and 2008, along with data from 2006 for comparison. Compared with earlier Board reports, the statistics for 2007 and 2008 are based on a refined methodology using slightly adjusted categories. Because of inherent data limitations these scrap tire use estimates are thought to be accurate to within about +/- 10 percent. Appendix A describes the methodology, data limitations, and differences with prior Board studies in more detail.

Figure 2
Seven-Year Trend for California Scrap Tire End-Uses[3]



Following are some key trends:

The amount of scrap tires diverted from landfill disposal declined slightly, with the diversion rate falling from 74.5 percent in 2006 to 72.4 percent in 2008. The diversion rate may drop further in 2009 depending on whether potential increases through ground rubber and exports can offset expected declines in civil engineering and tire-derived fuel (TDF).

The overall decline in diversion is the result of a combined 23 percent decline since 2006 in diversion through civil engineering, Alternative Daily Cover (ADC) and TDF, which as a group declined from a total of 16.1 million PTE in 2006 to a total of 12.35 million PTE in 2008. Further declines are anticipated in civil engineering and tire-derived fuel based on discussions with facility representatives about their expected usage in 2009. Tire-derived fuel is declining

[3] Data for 2002 – 2006 are from the Board's annual "California Waste Tire Generation, Markets and Disposal" reports. Methodological differences complicate direct comparisons between 2002-2006 and later statistics. "Retread" and "reused tires" from previous reports are regrouped here as "reuse." "Ground rubber" includes RAC but excludes some other ground rubber uses that were previously grouped as "other recycling."

Table 1
Estimated End-Uses for California Generated Scrap Tires, 2006 – 2008[4]

Category	Sub-Category	2006		2007		2008	
		Million PTE	Percent of Total	Million PTE	Percent of Total	Million PTE	Percent of Total
Export	Waste Tires			0.65	1.5%	2.19	4.9%
	Used Tires (Exported)			1.60	3.7%	1.51	3.4%
	Subtotal	**1.90**	**4.3%**	**2.25**	**5.2%**	**3.69**	**8.2%**
Reuse	Retread	4.40	9.9%	4.40	10.2%	4.42	9.9%
	Used Tires (Domestic)	2.10	4.7%	1.78	4.1%	1.85	4.1%
	Subtotal	**6.50**	**14.6%**	**6.18**	**14.3%**	**6.27**	**14.0%**
Ground Rubber	RAC & Other Paving	3.90	8.8%	3.92	9.1%	4.32	9.7%
	Turf & Athletic Fields			2.49	5.8%	2.44	5.5%
	Loose-Fill Playground			0.56	1.3%	0.78	1.7%
	Pour-in-Place Playground			0.26	0.6%	0.45	1.0%
	Mulch/Bark	2.70	6.1%	0.39	0.9%	0.37	0.8%
	Horse Arena Materials			0.12	0.3%	0.08	0.2%
	Molded & Extruded			1.02	2.3%	1.15	2.6%
	Other			0.45	1.0%	0.46	1.0%
	Subtotal	**6.60**	**14.9%**	**9.21**	**21.3%**	**10.05**	**22.4%**
Civil Engineer-ing	Landfill Applications			2.55	5.9%	2.06	4.6%
	Non-Landfill Applications			0.98	2.3%	0.73	1.6%
	Subtotal	**3.30**	**7.4%**	**3.53**	**8.2%**	**2.79**	**6.2%**
Alternative Daily Cover (ADC)		**4.50**	**10.1%**	**2.82**	**6.5%**	**2.06**	**4.6%**
Other Recycling		**3.30**	**7.4%**	**0.10**	**0.2%**	**0.08**	**0.2%**
Tire-Derived Fuel (TDF)	Cement	7.00	15.8%	6.62	15.3%	6.67	14.9%
	Co-Generation	1.30	2.9%	1.10	2.5%	0.83	1.9%
	Subtotal	**8.30**	**18.7%**	**7.72**	**17.8%**	**7.50**	**16.7%**
Landfill Disposal		**11.40**	**25.7%**	**11.45**	**26.5%**	**12.35**	**27.6%**
Total Generated		**44.40**	**100.0%**	**43.26**	**100.0%**	**44.79**	**100.0%**
Total Diverted from Landfill		33.10	74.5%	31.81	73.5%	32.44	72.4%
Imports		1.38	3.1%	0.51	1.2%	1.38	3.1%

[4] Data for 2006 are from the Board's annual "California Waste Tire Generation, Markets and Disposal" reports. Data for 2007 and 2008 are new estimates developed by R.W. Beck. See Appendix A for a discussion of differences in methodology and market categories between the two sources.

largely because of declining demand for cement due to the recession. Landfill civil engineering applications for scrap tires are expected to decline because one landfill that had used large quantities ceased its use in early 2009. ADC is expected to hold steady in 2009; however, because ADC and landfill civil engineering uses involve a small number of facilities, they are subject to abrupt increases or decreases in demand as landfills expand, adjust operations or close that can have a significant impact on the overall diversion rate.

Diversion to ground rubber markets continued to increase steadily as it has over the past several years, to over 10 million PTE in 2008, up from 9.21 million PTE in 2007. Several projects to expand California ground rubber production capacity are planned or under way, indicating continued growth in this category over the short term. However, while strong demand for ground rubber products has driven growth in recent years, the current economic downturn could result in declines for certain products. Another threat to ground rubber markets is media coverage of health and environmental concerns associated primarily with synthetic turf and, to a lesser degree, rubber bark/mulch. Several studies have addressed these concerns and the Board is sponsoring an ongoing study by the Office of Environmental Health Hazard Assessment, due for completion in 2010.

Diversion to reuse, estimated at 6.3 million PTE in 2008, is strong but essentially flat. Historically strong and consistent markets indicate reuse will likely remain a significant, stable value-added market for the foreseeable future.

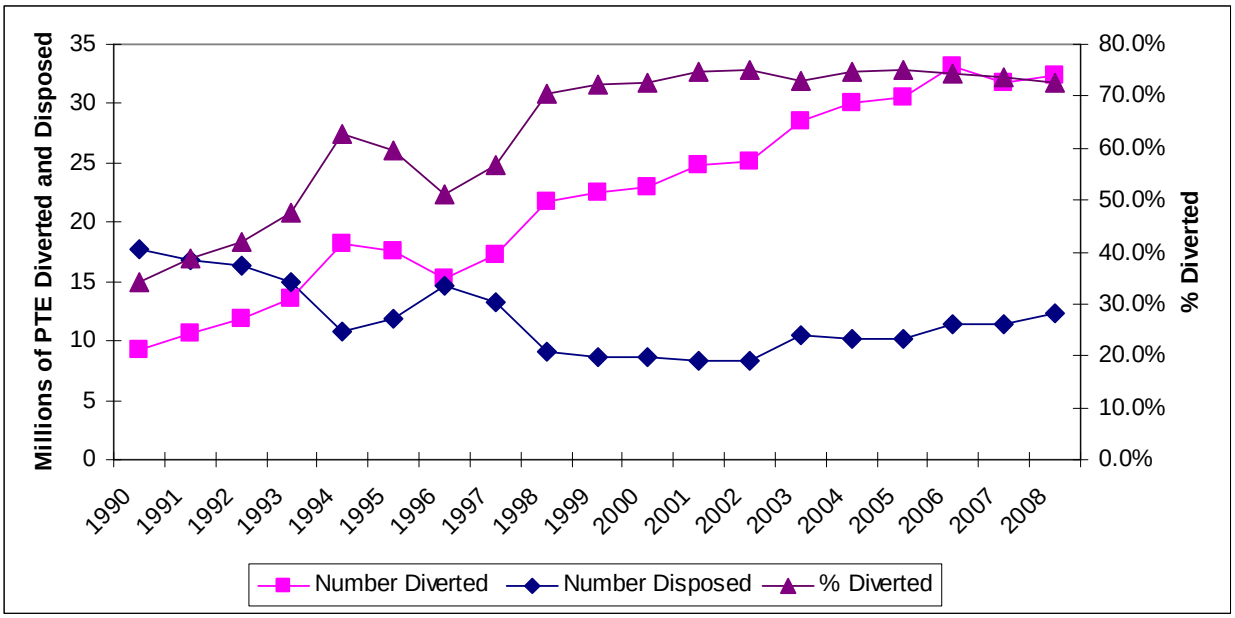
Diversion through export, especially waste tire exports to Asia, is increasing and reached an estimated 3.7 million PTE in 2008. Exports are likely to remain high and could increase further in 2009 as agents representing buyers in several Asian countries are making an increasing number of inquiries. To date, most waste tire exports have reportedly gone to China, apparently driven by rapid development of industries that use scrap tires, including ground rubber production, cement kiln, and other industrial tire-derived fuel users as well as pyrolysis and other emerging technologies. Because China is rapidly expanding its scrap tire processing and end-use manufacture simultaneously with its scrap tire collection infrastructure, it is possible that over time its demand for imported tires may peak and then decline as more Chinese scrap tires become available.

Waste tire export is controversial, and some have questioned whether the Board should allow it. Issues raised include questions over verifying how scrap tires are used, the level of environmental controls at tire-derived fuel and other facilities, and concerns that exporting scrap tires could potentially stymie development of in-state diversion. To date, it appears that increasing exports have not steered scrap tires away from high value diversion markets such as reuse and ground rubber. It does appear, however, that some scrap tires previously sent to landfill civil engineering or alternative daily cover uses are now being sent to the export market. As discussed above, demand for scrap tires in these uses was declining anyway, and it is likely that a good portion of the exported tires in 2008 would have been disposed had they not been exported.

Outlook for Increasing the Scrap Tire Diversion Rate

The Board has adopted a goal of increasing the diversion rate to 90 percent by 2015. As shown in Figure 3, California scrap tire diversion steadily increased from about 31 percent in 1990 to about 75 percent in 2001, and has ranged between 75 and 72.4 percent since.

Figure 3
Scrap Tire Diversion and Disposal Trends



There is a high probability that the diversion rate will fall further in 2009, as summarized in Table 2. Specific reductions in demand in 2009 for landfill civil engineering applications and TDF are estimated at more than 2 million PTE, compared to 2008, based on statements from specific facilities about their expected usage. However, Board staff is developing a proposal for a grant program that would promote TDA in landfills, and this could potentially spur increased use. Ground rubber has the potential to increase, but based on processor interviews and the timing of new production capacity, R.W. Beck estimates that growth in 2009 would likely not exceed an additional 1 million PTE (representing 10 percent growth over 2008). Diversion through ground rubber could continue this high, steady growth rate in 2010; however, on the other hand, recession-induced reductions in demand are a real possibility, especially as government and school district budgets come under increasing pressure. The "worst-case scenario" for ground rubber would see a return in coming years to an oversupply of ground rubber as experienced earlier in this decade, resulting in decreasing prices and possible plant closures. The "wild cards" in predicting scrap tire diversion in 2009 are non-landfill civil engineering applications and the export market. Non-landfill civil engineering applications, while apparently not poised for major growth in the coming year, continues to hold the promise of being a large-scale market if constraints can be overcome. Export holds the potential to absorb any loss of demand in tire-derived fuel, landfill civil engineering or ADC, though this is not a certainty and its benefits are controversial.

Table 2
Short-Term (Two Year) Diversion Outlook, Drivers and Threats

Category	2008 Diversion		Two-Year Diversion Outlook	Drivers	Threats
	Million PTE	Percent			
Reuse	6.3	14.0%	Flat	▪ Favorable economics	None in short term
Ground Rubber	10.0	22.4%	Increase Unless Threats Materialize	▪ Board support ▪ Current strong demand ▪ Green building & sustainability Initiatives ▪ Stimulus/government purchasing ▪ Expanded ground rubber production	▪ Recession-driven reduced demand and government budgets ▪ Health concerns could reduce turf & mulch demand ▪ Possible glut if demand decreases while production expands
Civil Engineering	2.8	6.2%	Large Decrease Likely	▪ Landfill construction activity ▪ Favorable economics at landfills where tire-derived aggregate is used ▪ Potential new grant program to be proposed	▪ One large landfill stopped use of >1 million PTE in Early 2009 ▪ Possible reduction in quantity available locally ▪ Recession-driven reduced demand
ADC	2.1	4.6%	Flat	▪ Favorable economics at landfills where used	▪ Possible reduction in quantity available;
Other Recycling	0.1	0.2%	Flat	None in short term	None in short term
TDF	7.5	16.7%	Decrease – Potentially Large	▪ Favorable economics and production benefits at select plants vs. other fuels ▪ Reduces air emissions relative to coal or petroleum coke	▪ Recession-driven reduced demand of >1 million PTE at cement ▪ Reduced use of 330,000 PTE at cogen facility ▪ Growing interest in biofuels
Export	3.7	8.2%	Large Increase Possible	▪ Strong and growing demand ▪ Favorable economics to processors	▪ Unpredictable swings in demand ▪ Reduced availability of containers or low-cost back-haul rates; ▪ Complex regulations & language challenges
Total Diversion	32.4	72.4%	Net Reduction in Diversion Very Possible	▪ Ground rubber and export likely to increase by uncertain amount	▪ Overall likely reduction of > 2 million PTE in tire-derived fuel and civil engineering uses

Following is a list of some long-term threats that could potentially result in declining diversion levels over the next three years or more. Inclusion here does not necessarily imply these are likely to occur. While some of these have already been mentioned as short-term threats, they are highlighted again here because of the important need to monitor and consider them during planning.

Potential long-term threats to scrap tire diversion include:

- A significant reduction in Board tire program funding could reduce grants, other financial assistance, technical assistance and promotional efforts, potentially triggering a reduction in demand and/or production capacity;
- Perceived health concerns and sustained media coverage could reduce demand for ground rubber products and/or spur installers and distributors to pursue alternatives to tire rubber, especially turf products and potentially bark/mulch and loose-fill playground surfacing products;
- Landfill civil engineering and ADC uses will remain subject to abrupt, large increases or decreases in demand, as landfills adjust operations, expand or close;
- Contraction of the cement industry combined with a shift to renewable power sources triggered by California's Climate Change Act could further reduce demand for TDF;
- Compliance challenges may constrain some firms within the California scrap tire collection and processing industry to thrive and grow, potentially reducing their ability to move materials to diversion markets;
- Strong demand for scrap tires by Asian nations, especially China, could grow and then stall as scrap tire collection volumes grow in China, potentially causing a sudden glut of scrap tires in California;
- Some developing countries could impose bans or duties on the importation of used tires and/or waste tires;
- A significant increase in ground rubber production capacity combined with the possibility of significant reduced demand could potentially result in a glut of ground rubber, with price reductions, reduced profitability and possibly plant closures; and
- Low-cost ground rubber could out-compete California-produced ground rubber in some markets.

Market Trends by Category

This section describes key trends in each segment of the California scrap tire market, starting with the supply infrastructure for collecting and processing scrap tires. This is followed by a brief description of each of the market categories in which processed scrap tires are used.

Supply Infrastructure

California has a large, dynamic infrastructure for collecting and processing scrap tires, including about 1,150 registered haulers and 32 facilities with an active major or minor waste tire facility permit. More than 13,000 registered California facilities, such as tire dealers and auto repair shops, generate scrap tires, with a large percentage flowing to one or more of 17 processor facilities analyzed in this report, and the remainder hauled directly to disposal or end-uses such as cement kilns burning tire-derived fuel (TDF). Although whole tires and processed product are sometimes shipped between Northern and Southern California, to a large degree the industry is divided into two separate regions, each with somewhat different market dynamics.

Processors and haulers earn revenue through collection fees paid by generators. Processors also earn revenue (and incur a processing cost for preparing materials) when they ship value-added products such as used tires, ground rubber or 2-inch chips used for TDF. When processors or haulers ship whole or size-reduced tires to markets such as landfill civil engineering, alternative daily cover, export and cement kilns using whole tires, they typically incur a cost. However, this cost is normally less than the generator fee, providing positive net revenue.

Following are some key trends and issues identified in the California scrap tire supply infrastructure:

Reduced Availability of Scrap Tires

Many processors report that scrap tire generation is down noticeably, apparently the result of consumers delaying purchase of new vehicles and replacement tires due to the current economic downturn. This is supported by statistics by the Rubber Manufacturing Association showing that new tire shipments in the U.S. declined by 9 percent in 2008 to 261 million units (the same level as in 1993) and are projected to decline another 9 percent in 2009. The decline is largest in tires sold to auto and light truck manufacturers as original equipment (19 percent for passenger tires and 34.5 percent for light truck tires) but is also apparent for replacement tires (5 percent for passenger and 14 percent for light truck tires). While newly sold tires do not enter the waste stream for some time, they are a proxy for current scrap tire generation because widespread delays in purchasing new tires affect generation of scrap tires immediately.

Processing Expansions, Contractions and Partnerships

California scrap tire processing is experiencing a very dynamic period involving processor expansions, contractions, and partnerships. This activity is fueled largely by the market trends described in the remainder of this section, including sustained strong demand for ground rubber, the newly expanding waste tire exports to Asia, and the loss of significant demand in Northern California for Alternative Daily Cover and civil engineering applications at landfills.

In 2008, one new processing facility started up, another one (which plans to begin producing ground rubber in 2009) began receiving tires and yet another shut down, all in Northern California. One Northern California facility expanded ground rubber production capacity. One new ground rubber producer in Southern California is prepared to start operating in 2009, and at

least five additional ground rubber facilities are in various stages of planning or investigation, including two in the U.S.-Mexico border region. Some processors are forming partnerships with tire-derived product producers to help both parties secure their niche in a changing marketplace. While it is impossible to predict which of these projects will be successful and what the actual increase in processing capacity and throughput will be, there is certainly the potential for California ground rubber production capacity to increase substantially. This holds the potential to increase diversion through relatively high-value recycling markets, but it also would open the possibility of an over-supply situation if market demand were to drop significantly.

Increased Competition Driving Down Collection Revenue in Some Areas

In some locations, especially areas within Northern California, increased competition among processors for collection accounts with scrap tire generators has led to processors reducing collection fees (a source of revenue to processors) by significant amounts. Some processors stated that certain competitors had driven collection fees so low that in some cases that they are not sustainable because they do not provide sufficient operating revenue. The increased competition was sparked as processors jockeyed to fill the void left when one processor shut down, and also by the favorable economics of the newly expanding export market that allowed certain processors to drop the fees they charge to generators while remaining profitable. For a time, the export market reportedly was paying for scrap tires and covering transportation, and processors who were already active in the export market were ideally positioned to take advantage of this short-term situation. While export terms have moderated, they remain favorable relative to other end-use options. The large number of proposed processing facilities in the planning stages could intensify such competition in the future.

Compliance Challenges

The Board's renewed push to increase and enhance enforcement activities over the past 18 months is increasing compliance with permitting, manifesting, and operational regulations, but also is causing some processors to incur fines or make significant adjustments that may curtail their previous level of business. In one case, enforcement action contributed to a facility's decision to shut down. Some processors have raised concerns about the Board's approach and negative impacts on recycling market development objectives, including issues related to: storage limitations and PTE measurement; permit approval processes; and fairness and equity across firms. Compliance issues are complex and evaluation is dependent on the specific details of each case.

From Board staff's perspective regarding these concerns, they are seeking to enhance compliance in an efficient, fair, and equitable way to create a level playing field, and are committed to increasing communication and dialog with the industry to overcome challenges in a manner that both satisfies environmental health and safety regulations and market development objectives. Furthermore, increased compliance and enforcement against those who do not comply has been a consistent request from tire industry representatives over the past several years; recent actions are removing unauthorized individuals and firms from the market place that compete unfairly, and in some instances have caused environmental damage; and, in one instance the result of increased enforcement led to business practice changes that conformed to the regulations and resulted in greatly reducing the potential impacts of a tire fire at a major processing facility.

Need for Improved Standards and Specifications to Enhance Quality

Some processors (as well as some tire-derived product producers) expressed concern over the need for widely accepted material and product standards that would define grades and quality parameters of ground rubber and other processed tire rubber products in order to assure high quality and consistency across the industry. The American Society for Testing and Materials (ASTM) does have some standards in place for sizes and uses of ground rubber, and several active committees are exploring the possible expansion and/or refinement of these standards, with involvement from several trade associations and California firms. However, sales of ground rubber and other processed tire products are still typically conducted informally, without reference to specific detailed specifications, thresholds for contaminants, etc.

Fairness and Appropriate Use of Board Assistance Resources

Some processors expressed concern about the appropriate role and priorities for the Board in scrap tire market development and specifically programs that may support some processors or markets while not others. One tire-derived fuel user expressed concern that the Board's recycling market development efforts were raising the cost and reducing the availability of TDF.

Competition from Out-of-State Subsidized Ground Rubber Imports

Two processors expressed concern that imported ground rubber from Canada where processors receive cost subsidies may be unfairly reducing sales of California rubber in some markets. This issue is addressed under Imports and Exports below.

Reuse

Reuse, including retreading and sale of partially worn used tires, is strong and stable, with about 6.27 million PTE being reused in 2008.

Retread Tires

California retread levels are estimated to have held essentially flat between 2006 and 2008, at about 4.4 million PTE. California is home to about 50 retread facilities that remanufacture used truck tire casings into retread tires for reuse. Although they receive some casings from haulers and processors, retreaders most often provide services directly to their customers, mainly trucking companies and other trucking fleet managers.

Truck tire retreading is highly economical and considered mainstream by many trucking companies and other fleet managers. Anecdotally, some cite growing demand for retreads driven in part by cost concerns associated with the recent economic downturn. Unfortunately, the downturn is also responsible for reduced trucking miles driven, moderating any overall increase in retread demand. The main barriers to increased retreading is the already high market saturation and the concern of some fleet managers regarding relative safety and performance compared to new truck tires. However, industry representatives argue that retreads perform as well or better than new truck tires.[5]

[5] Tire Retread Information Bureau.

Used Tires

Shipments of used tires to dealers within California were estimated at 1.78 million PTE in 2007 and 1.9 million PTE in 2008. Additionally, as discussed under "Imports and Exports" later in this report section, an estimated 1.6 million PTE in 2007 and 1.5 million PTE in 2008 of used tires were exported from California. An unknown percentage of the used tire (domestic) category sold to California dealers was likely sold to distributors, who in turn exported a portion of the used tires they handle, but due to a lack of data no estimate for these additional used tire exports is available. Therefore, the data pertaining to exports likely understates the actual quantity of tires exported.

Used tires are partially worn tires suitable for continued use as vehicle tires that have been culled and graded by haulers or processors for resale. Most processors view used tires as an attractive market because of the relatively low cost to prepare them and the relatively consistent price and demand for them. A large network of dealers purchase used tires for wholesale distribution to tire outlets, for direct resale to consumers, and/or for export.

As with retreads, some processors report that the current economic downturn is resulting in increased demand for used tires both domestically and internationally. Simultaneously, the downturn may also be resulting in fewer tires being suitable for reuse as consumers choose to delay purchase of new tires. The main constraint to increasing used tire shipments is the limited number of scrap tires that are suitable for reuse. Additionally, some ground rubber producers may limit culling used tires because of the need for feedstock to produce relatively high value ground rubber.

Ground Rubber

California is home to six producers of ground rubber plus one firm that produces buffings from truck tires (but not other types of ground rubber). These firms used approximately 9.21 million PTE in 2007 and 10.05 million PTE in 2008, corresponding to production of about 119.7 million pounds in 2007 and 130.7 million pounds in 2008.[5] This includes coarse ground rubber of one-quarter to three-quarter inch (generally used for loose-fill playground, mulch, and horse arenas), finer ground rubber of 4 to 30 mesh (used in rubberized asphalt concrete, turf ground rubber, and molded products) and buffings produced from truck tires by processors (used mainly in pour-in-place playground surfacing). Table 3 provides a summary of California ground rubber markets for 2007 and 2008.

Table 3
Estimated Ground Rubber Shipments by Market Category

Category	2007		2008	
	Pounds[6]	Percent of Total	Pounds	Percent of Total
RAC & Other Paving	50,922,824	43%	56,204,040	43%
Turf & Athletic Fields	32,394,927	27%	31,742,828	24%

[6] These production volumes assume an average yield of 65 percent ground rubber per ton whole tires. Specific company yields vary based on the mix of tires and processing technologies.

Loose-Fill Playground	7,330,652	6%	10,102,434	8%
Pour-in-Place Playground	3,432,920	3%	5,803,831	4%
Mulch/Bark	5,019,868	4%	4,839,672	4%
Horse Arena Materials	1,570,160	1%	1,056,600	1%
Molded & Extruded	13,213,736	11%	14,992,707	11%
Other	5,885,320	5%	5,925,098	5%
Total	119,770,407	100%	130,667,209	100%

Factors driving demand for all ground rubber products include: Board grant programs and other financial/technical/promotional support efforts; growing interest in green building and sustainability; the federal stimulus package; and government purchasing programs. Some common constraints include: Recession-driven declines in demand, especially in the construction industry; declining government budgets; and perceived environmental and health concerns and corresponding media attention.

Following is a brief description of each ground rubber sub-market.

Rubberized Asphalt Concrete and Other Paving

In 2008, about 56.2 million pounds of ground rubber, derived from approximately 4.32 million PTE of scrap tires, were used in rubberized asphalt concrete, chip seals, and other paving applications. This was up about 10 percent from the levels in 2007 and 2006. In these paving applications, processors sell ground rubber to a small number of asphalt paving firms that have invested in the equipment required to produce rubberized asphalt concrete, who in turn are often subcontractors on Caltrans or local government paving contracts.

The main consumer is Caltrans, and their usage has increased markedly in recent years, as shown in Table 4. Caltrans is required by statute to increase the percentage of all flexible pavements that use rubberized asphalt concrete to 25 percent by 2010 and 35 percent by 2013. In 2007, the actual rate of use was 29 percent. With substantial support from the Board augmenting a strong legislative mandate, Caltrans' use of this asphalt alternative is becoming quite common. Caltrans has made rubberized asphalt concrete the strategy of choice when evaluating flexible pavement alternatives for Caltrans projects. Caltrans requires that all rubber used in rubberized asphalt projects be derived from U.S.-generated tires (not just California-generated tires), so imported ground rubber is not allowed. Rubberized asphalt concrete also is used by local governments, sometimes with financial grant support and technical assistance provided by the Board.

Table 4
Caltrans' Estimated Use of Scrap Tires in Rubberized Asphalt Concrete[7] (PTE)

Year	RAC	Chip Seal and Other Applications
2004	1,788,945	100,997

[7] Caltrans has adopted the term rubberized hot mix asphalt (RHMA) instead of rubberized asphalt concrete as commonly used by the Board.

Year	RAC	Chip Seal and Other Applications
2005	2,387,356	190,714
2006	3,343,533	105,339
2007	3,140,808	86,699
2008	3,500,000	81,512
Total	14,160,642	565,261

Source: Caltrans. May include some ground rubber imported from other states.

Most processors and others involved in rubberized asphalt concrete say that future demand will likely remain strong, with its use now an accepted and demonstrated practice within State paving contracts and a growing practice in local paving. A further inducement currently is the high price of conventional hot mix asphalt, which could provide an additional cost advantage in some circumstances for rubberized asphalt concrete. The price of hot mix asphalt spiked in 2008 as a result of high oil prices, and it has sustained at a high level due to changes in asphalt industry production practices, even as oil prices have dropped.

The main determining factor for future use may be State and local paving budgets. Caltrans' use of rubberized asphalt concrete is highly dependent on funding available in the State Highway Operational Protection Plan (SHOPP) for pavement projects. Funding projections for 2009 are not available, although anecdotally several individuals involved said they expect 2009 use to at least match 2008. According to one processor, federal stimulus funds could also bode well for rubberized asphalt concrete usage in coming years, although the "shovel ready" requirement may limit projects to resurfacing.

The main constraint to further increases in the product at this time appear to be State and local budgeting and overall paving levels, although some knowledgeable about rubberized asphalt concrete trends acknowledge a need for continued education, especially regarding its relative engineering benefits compared to other paving alternatives (for example, in relation to reduced noise and crack resistance). One ground rubber producer cited a concern that some Caltrans projects may be using ground rubber imported from Canada despite State policy.

Turf and Athletic Fields

In 2008, about 31.7 million pounds of ground rubber, derived from approximately 2.4 million PTE of scrap tires, were used in synthetic turf and athletic field applications, a slight decrease compared to the amount used in 2007.

Ground rubber in the 10-20 mesh range is used as dressing in synthetic turf athletic fields and in a variety of running track, horse racing track, and other applications. While dominated nationally by one large firm, a large number of companies are in the business of marketing and installing these products nationally, with several California-based firms and out-of-state firms installing product in California.

Demand in turf and athletic field applications have grown steadily in recent years, and many in the industry expect growth to continue through 2009. According to the Synthetic Turf Council, more than 1,000 synthetic turf fields were installed nationally in 2008, a 20 percent increase from 2007. This sales pace is expected to continue in 2009. Although initial costs are much higher than for grass fields, advantages include longer life, and reduced maintenance and watering costs.

Although most expect demand to remain strong in 2009, some market players are concerned that the market may decline in coming years due to several inter-related factors. The main factor is the media coverage related to a perception promoted by certain environmental advocacy organizations that artificial turf may pose certain health and safety risks. Several studies and literature reviews have addressed these concerns, and the Board has commissioned a study by the Office of Environmental Health Hazard Assessment that is due for completion in 2010. Reportedly, these health concerns may be contributing to another potential threat to the use of ground rubber in synthetic fields—the potential for installers to identify alternative infill materials that may have lower costs, improved performance, or other advantages. Anecdotally, some market players have mentioned that the search is on for such substitutes.

Loose-Fill Playground Surfacing

In 2008, about 10.1 million pounds of ground rubber, derived from approximately 780,000 PTE of scrap tires, were used in loose-fill playground surfacing applications, a 38 percent increase from the amount used in 2007. In this application, ground rubber generally of one-quarter to three-quarter-inch size is colorized and used to replace wood bark and other playground surfacing materials. This is the same specification as bark/mulch discussed below, although the market dynamics are different.

Loose-fill playground surfaces are marketed and installed in California by several firms based both in-state and out-of-state firms with an operating presence in the state. Customers are largely local school districts and parks but also include other government agencies and architects, contractors, and designers responsible for new and renovated building construction projects.

Key sales drivers include enhanced fall safety, longer life, and lower maintenance costs as compared to wood bark and many other alternative surfacing products. Satisfactory standardized safety test results are required by many customers, and many producers have received certification through the International Playground Equipment Manufacturers Association (IPEMA). Another driver is the potential for credit in green building programs such as the Leadership in Energy and Environmental Design (LEED) program administered through the U.S. Green Building Council.

One possible constraint to future sales is the need for all playground-surfacing products to demonstrate satisfaction of the Americans with Disabilities Act (ADA) requirements for access by wheelchairs. Some producers have expressed concern about the ability of most loose-fill playground material to satisfy this requirement, although some producers have received successful test results.

Another constraint is the relatively high up-front cost of rubber playground materials compared to wood, though this is moderated by claims of longer life and reduced maintenance, in addition to added safety. Finally, the media coverage of perceived environmental health and safety concerns related to turf products (discussed above) sometimes are addressed toward rubber bark, mulch, and loose-fill playground surfacing as well, indicating this issue could potentially constrain sales in coming years.

Pour-in-Place/Other Playground Surfacing

In 2008, about 5.8 million pounds of buffings, derived from about 450,000 PTE of truck tires, were used in pour-in-place playground surfacing applications, a 70 percent increase from the amount in 2007. This is in addition to buffings produced as a by-product of retreading that were sold to multiple markets, including pour-in-place playground surfacing. (While buffings

production from California retreaders were not part of this study, the amount generated in California may be in the range of 30 million pounds.[8]) In this application, buffings are combined with urethane binder and generally a virgin ethylene propylene dimonomer (EPDM) rubber surface layer to produce a bound surface.

Many of the same playground surfacing installers described above also install pour-in-place surfacing products. Many of the advantages and constraints are the same. One additional constraint is the shortage and relatively high price of California-generated buffings, which has motivated three processors to begin production of buffings in the last two years, and at least two installers to develop new product recipes that use ground rubber instead of buffings.

Pour-in-place markets benefit from the general tire-derived product benefits described above, although they do not qualify for Board grants unless they are made with buffings derived from passenger tires. Pour-in-place surfacing may be less vulnerable to concerns about human and environmental health and safety, since there is much less loose material that can potentially be ingested, inhaled, or blown/washed into the environment. Pour-in-place surfacing generally satisfies ADA requirements for wheelchair accessibility. Partly for this reason, there are anecdotal suggestions that the overall market for pour-in-place playground surfacing may far exceed loose-fill playground surfacing. Otherwise, drivers and constraints are very similar to those discussed for loose-fill playground material above.

Mulch/Bark Landscaping Materials

In 2008, about 4.8 million pounds of ground rubber, derived from about 370,000 PTE, were used in mulch and bark applications, a slight decrease from 2007. This is the same material described for loose-fill playground surfacing above, but it is sold to landscapers, designers, architects, building managers, and others for a wide variety of landscaping and mulch applications. Rubber bark is one of the very few tire-derived products to be sold in national "big box" retail outlets such as Wal-Mart, and this has contributed to significant market growth in recent years, especially on the East Coast.

Rubber bark and mulch benefits from the general tire-derived product drivers and constraints described above as well as those listed for loose-fill playground surfacing. Some are attracted to its lower maintenance costs and convenient performance characteristics such as long life, lack of deterioration, and choice of colors.

Rubber bark and mulch may be vulnerable to some of the environmental, health, and safety concerns raised about ground rubber used in sports turf applications, although to date they have not received nearly the level of scrutiny or media coverage. One barrier to increased sales in retail outlets is the challenge of producing the quality and quantity required at an acceptable price point. Some have indicated that this is more challenging in California because of the relatively strong markets and Board policies requiring that California rubber be used whenever State funds are involved, which has generally resulted in higher ground rubber prices.

Molded and Extruded Products

In 2008, about 14.9 million pounds of ground rubber, derived from about 1.15 million PTE, were used to produce molded and extruded products, a 12 percent increase from the amount in 2007.

[8] Based on multiplying the Rubber Manufacturer Association's estimate of 250 million pounds retreader buffings produced nationally by 12 percent, approximately California's share of national population.

In this application, ground rubber generally in the 10- to 30-mesh range is combined with urethane and other materials, including recycling plastics in some applications. A very wide range of products are produced in California, including flooring, mats, wheelchair transition ramps, drainage channels, erosion control devices, wheel stops, and others.

There is also growing interest, and some success, nationwide in developing new applications and in promoting the use of ground rubber by established manufacturers through feedstock conversion initiatives. Feedstock conversion applications are limited only by the current rubber and plastics industry and by innovation. For many established manufacturing operations, fine ground rubber of at least 80-mesh and often 200- to 300-mesh is required, a specification that no current California producer offers on a regular basis. Nationwide several new producers of "very fine" ground rubber have emerged, though none to date in the West. Product applications include industrial machine parts such as gaskets, hoses, and insulation; reflective paints; and potentially use in the production of new tires.

Opportunities for expansion of this market category are largely in the feedstock conversion and new product development category, and may likely involve incremental increases of relatively high value products that fetch a higher price in the market (as opposed to high volume, low value opportunities such as civil engineering applications). Generally, depending on the product, technology and other factors, manufacturers may benefit from one of three potential drivers:

- Potentially reduced raw material costs by substituting ground rubber for higher priced oil, plastic, or other raw materials;
- Enhanced product performance due to the beneficial qualities of rubber in some product applications; and/or
- Enhanced marketing opportunities leveraging green marketing opportunities, for example in the green building arena.

Constraints to expanding this market involve, among others, institutional resistance to replacing established and proven raw materials, concern over customer reactions, the need for product testing and performance documentation, and the need to develop new product recipes and processes.

Horse Arena Materials

In 2008, about 1.0 million pounds of ground rubber were derived from about 80,000 PTE, were used to produce horse arena material – a 33 percent decline from 2007. This material is similar to loose-fill playground and rubber bark, although the product specification can sometimes be more forgiving. Material is usually colorized.

Horse arena material is often sold directly from processors to horse arena owners. While somewhat variable, the market appears likely to provide an outlet for small quantities of material in future years.

Other Ground Rubber Applications

In 2008 about 5.9 million pounds of ground rubber was derived from about 460,000 PTE and used to make a variety of products, about the same amount classified in the "other" category for 2007. Examples of products in this category include very coarse 1-inch "ground rubber" used in ballistics applications, production of buffings from truck tires sent to products other than pour-in-place, and miscellaneous other applications that were not specified by processors in surveys.

Civil Engineering

Civil engineering applications used about 2.79 million PTE in 2008, a 21 percent decline from 2007. In California, civil engineering applications in landfills have dominated this category in the past, with a relatively small amount going to non-landfill applications as described below.

Tires are used in civil engineering applications in the form of tire-derived aggregate (TDA), which competes with rock aggregate and/or a range of aggregate or lightweight fill materials. Generally, potential benefits include:

- It is lighter than soil and most aggregate materials, providing performance advantages in some situations and resulting in less tonnage required compared to heavier materials;
- It is has desirable performance characteristics: for example, it is relatively durable, compressible, a good insulator, and has good hydraulic conductivity; and
- In many circumstances it is less costly to use than traditional lightweight fill and aggregate materials.

Although rough tire shreds are sometimes used as TDA without a formal specification (especially in landfill applications), two types of tire-derived aggregate are widely recognized. Type A is 3- to 4-inch material and is typically used in drainage, insulation, and vibration dampening applications. Type B is 12- to 18-inch material and is typically used as lightweight fill.

Landfill Civil Engineering Applications

In 2008 about 2.06 million PTE were used as TDA in civil engineering applications at landfills, a 20 percent decrease from the amount in 2007. Civil engineering applications at landfills include use in leachate collection and redistribution layers, gas collection layers, and in landfill road construction, generally replacing rock aggregate materials. The specification of its used in these applications varies, and can sometimes be allowed as a rough shred with a forgiving specification. Landfill tire-derived aggregate is a low- or no- value adding market. Processors delivering tire-derived aggregate to landfills may receive a small amount of revenue (e.g., $2 – $4 per ton), may still need to pay a discounted tip fee or may be permitted to drop materials free of charge.

Only two California landfills reported its use in civil engineering applications in 2007 and 2008. Use at a single landfill may vary tremendously, but can exceed 1.5 million PTE depending on cell construction and other aspects of a landfill's design, size, and stage of life. Because of the small number of facilities using tire-derived aggregate, its use can increase as facilities expand or decrease abruptly as they adjust operations and/or close. One of the two landfills stopped its use in late 2008, indicating that this category will drop substantially in 2009.

However, as aggregate prices increase as a result of the shortage of new aggregate supplies, the market for tire-derived aggregate use in landfill applications could increase in coming years. Landfills can benefit from its use by reducing their costs for aggregate and by taking advantage of the availability of scrap tires and the need for beneficial use opportunities. In some cases, landfill engineers without experience with tire-derived aggregate may be reluctant to use it, and there may be some situations when it is not appropriate or is prohibitively expensive due to long haul distances from processors. However, generally, if a landfill is located near a processor there are few constraints to this use.

Non-Landfill Civil Engineering Applications

In 2008 about 730,000 PTE were used in non-landfill civil engineering applications, down from about 980,000 PTE in 2007. As with landfill civil engineering, non-landfill applications may involve a small number of relatively large projects. Especially as the Board's efforts to boost Caltrans and other use of tire-derived aggregate picks up, abrupt increases or decreases in use are likely to occur. Non-landfill applications include lightweight fill for embankments, landslide stabilization, retaining wall backfill and vibration dampening for light rail trains. In situations where the material qualities of tire-derived aggregate are needed, it can offer a low-cost alternative to traditional materials. In some states such as Maine, these applications have become quite common. Moreover, in some states such as South Carolina and other Southern states, use of tire-derived aggregate in residential and commercial septic systems is widespread. (This use has suffered in recent years however, because of very strong demand and pricing for tire-derived fuel in the Southeast.) In contrast to landfill applications, tire-derived aggregate used in non-landfill applications, depending on a range of factors, may provide positive revenue to processors in the range of $10 to $20 per ton.

In California, non-landfill civil engineering applications have been limited to state-sponsored projects conducted by Caltrans contractors with considerable financial and technical support provided by the Board, as well as a small number of other projects at the local level, which were not analyzed in this study. As shown in Table 5, Board-sponsored tire-derived aggregate projects over the last 11 years used a total of 1.65 million PTE.

Table 5
Board Sponsored Non-Landfill Civil Engineering Projects

Year	Item	Cost	Number of Tires Used
1997	Levee reinforcement project	$660,000	45,000
1998	Research of tire shreds in septic leach fields	$169,400	20,000
2001	Lightweight fill for the Dixon Landing Interchange	$350,000	600,000
2001	Sound and Vibration Attenuation for Light Rail System	$0*	100,000
2003	Lightweight fill for the Route 91 Retaining Wall	$100,000	84,000
2006	Lightweight fill for the Highway 215 Retaining Wall	$190,000	150,000
2007	Lightweight fill for Marina Drive Landslide Repair	$740,000	133,000
2007	Badlands Landfill Gas Collection System	$25,000**	16,000
2008	Lightweight fill for Geyser Road Landslide Repair	$350,000	150,000
2008/09	Lightweight fill for Highway 101 Realignment	$0**	350,000
	Totals	**$2,584,400**	**1,648,000**

Source: California Integrated Waste Management Board

**After an initial consultation with CIWMB staff and consultants, Valley Transportation Authority paid the cost for the material and construction for this project.*

***Ongoing projects scheduled to be completed in 2009*

Despite the relatively small amounts used to date and some important constraints, TDA civil engineering applications have the potential to be a very large volume market in California.

According to the California Department of Conservation, aggregate needs are greatest in urban areas where construction activity is highest, with billions of tons needed through 2055.

Although tire-derived aggregate can offer clear price and performance benefits in some situations, some challenging barriers are constraining its large-scale use. These include:

- Storage—Most large-scale construction projects require that large quantities of aggregate be available at a particular location at a particular time. State and local storage regulations limit the amount of material that can be stored at a given site and strictly regulate how it can be stored to reduce fire risk and other threats.
- Institutional—Since it is not widely used in California, some decision makers and engineers may be reluctant to use tire-derived aggregate.
- Price—It does not always provide the lowest cost solution to aggregate needs, for example in situations where low-cost rock aggregate is suitable, as opposed to situations where the material's light weight and structural properties are required.
- TDA Suppliers—A few processors have stated they are interested in being a large-scale supplier. Some others, however, have voiced reluctance because of skepticism that a stable, large market will emerge and that the price will merit their investment in equipment and the opportunity cost of not sending material to current market outlets.

Notwithstanding these constraints, the Board is making a significant investment in tire-derived aggregate through technical and financial assistance and promotion to local government and State agencies like Caltrans. While use in the short-term is not expected to increase substantially, the market could grow in coming years to be a major use of California scrap tires.

Alternative Daily Cover

In 2008, approximately 2.06 million PTE were shred and used as alternative daily cover (ADC) in landfills, a 27 percent decline from the amount in 2007. Tire shreds used as alternative daily cover to replace dirt and other materials such as green waste or wood waste, and can provide landfills with a cost advantage if they would be required to purchase other materials for use as cover. Processors typically must pay a tip fee or at best may be provided with a zero cost for delivering tire shreds to landfills for use as Alternative Daily Cover.

Only three landfills reported using tire shreds as ADC in 2008, down from four in 2007, with the amount at each landfill varying from 220,000 PTE to over 1.5 million PTE. Another similarity with landfill civil engineering is the potential for abrupt, relatively large increase or decreases in demand. For example, the loss of a single landfill using ADC in 2008 reduced demand by about 580,000 PTE.

Other Recycling Uses

In 2008 about 80,000 PTE were used in a variety of applications classified in this report as "other recycling," a small decrease from the amount in 2007. Products in this category include rings cut from truck tires used to weigh down agricultural film, and cut and stamped products such as dock bumpers. This category is likely to remain a small but stable use of California tires in future years.

Tire-Derived Fuel

In California, scrap tires are used as tire-derived fuel (TDF) in two applications: cement kilns that often burn coal or coke and co-generation facilities producing electric power generally from biomass. At the national level, use of tire-deriver fuel in pulp and paper mills has increased significantly in recent years, but California has no pulp and paper mills permitted to use tire-derived fuel. In 2008, about 7.5 million PTE went to tire-derived fuel facilities, a slight decrease from the amount in 2007 but a nearly 10 percent decrease from the amount in 2006.

Cement Plants

In 2008, about 6.67 million PTE were used as tire-derived fuel in California cement plants as a fuel source, a slight increase over the amount in 2007 but a 5 percent decline from the amount in 2006. Most cement plants use whole tires, which they may receive with no revenue or cost, or for a small tip fee. One California plant uses processed scrap tires for which they must pay.

As of 2006, there were seven cement kilns in California that were permitted by the California Air Resources Board to use TDF or whole scrap tires. Of these, four were using 1.4 million PTE or more of TDF in 2006, one used about 100,000 PTE, and one has now reportedly closed. One cement plant indicates they are not likely to use TDF in the future. The largest plant used 2.4 million PTE in 2006, but was down to 1.5 million PTE in 2008 due to slumping sales. A representative of another plant that used 1.7 million PTE in 2006 has decreased its use also due to reduced demand, but said that they plan to increase the percentage in their fuel mix in the future. If this plant were operating at full capacity, it could use up to 4.0 million PTE, indicating the industry has high growth potential but is highly dependant on the economy. Other sources state that there are also an additional four cement plants that are not currently permitted to accept scrap tires or tire-derived fuel as a fuel source.

Tire-derived fuel and whole scrap tires can be an attractive fuel for cement plants depending on their proximity and access to suppliers and their production equipment, as well as their technology. TDF burns hotter than coal and is less expensive. Also, it can improve air emissions relative to petroleum coke or coal. One plant stated that using tire-derived fuel allowed them to use more high-sulfur petroleum coke (which is less expensive) because it is low in sulfur.

The current economic downturn and the especially hard-hit construction industry are having a strong negative impact on the cement industry, and use of tire-derived fuel/scrap tires in California cement plants is expected to decline in 2009 by at least 1 million PTE, based on statements from representatives of specific plants regarding their expected TDF use. California is the largest cement-producing state in the U.S., accounting for between 10 to 15 percent of production.[9] By the end of 2007, U.S. cement consumption had dropped 9.7 percent relative to 2006 although the slowdown in California was more pronounced at 14 percent. According to the Portland Cement Association (PCA), cement consumption in North America is forecast to decline 12 percent in 2009 and an additional 5 percent in 2010, with no recovery forecasted until 2011. Moreover, with capacity utilization at about 75 percent, this situation could potentially lead to plant closures.

Even in good economic times, cement plants typically close once per year for two or more weeks for maintenance. However, currently plants are taking extended down time of as much as six

[9] Statistics in this paragraph are from Ed Sullivan, Chief Economist, Portland Cement Association, presentation at Cemtech Americas meeting. Available at www.cemnet.com.

weeks according to one processor. Use of tire-derived fuel is constrained by cement production levels, by permit restrictions and in-place equipment.

Co-Generation

In 2008, about 830,000 PTE were used as tire-derived fuel by one California co-generation facility, a 24 percent decline from 2007 and a 36 percent decline over 2006. Since 2006, one co-generation facility stopped using tire-derived fuel and is due to shut down in 2009. The remaining plant blames its reduced use on increased pricing caused by its suppliers choosing to use material to produce higher-value products for other markets. Of the remaining four co-generation facilities that were permitted to use tire-derived fuel in 2006, one has now closed and two indicate they do not currently use the material and would not likely become permitted to do so in 2009, but they do intend to review that decision in the near future. Use of tire-derived fuel at co-generation facilities is expected to decline by about 330,000 PTE to 500,000 in 2009.

Disposal

In 2008 about 12.35 million PTE were disposed in landfills, an 8 percent increase from 2007 levels. While small quantities of tires are disposed in many California landfills, these estimates are based on an analysis of 13 landfills identified as accepting tires through the Waste Tire Manifest System. Of these, one large Southern California landfill received approximately 7.7 million PTE, two facilities received more than 1 million PTE, four facilities received more than 250,000 PTE and six received less than 250,000 PTE. In addition, five facilities in 2008 and six in 2007 received tire shreds for use as Alternative Daily Cover or tire-derived aggregate in civil engineering applications.

Landfills remain the ubiquitous “market” of last resort, and continue to consume more California scrap tires than any other end-use. Disposal in 2009 was more than 950,000 PTE higher than in 2006, apparently largely due to a decline in ADC, civil engineering and tire-derived fuel markets of over 4 million PTE in the same period. The balance of this lost demand was covered by increases in ground rubber and exports.

Also, the new methodology employed this year relative to previous years may have analyzed a larger number of landfills, as described in Appendix A.

Factors that tend to drive the disposal of scrap tires include: favorable economics due to proximity or in some cases preferred tipping rates; insufficient demand for tire shreds at diversion facilities at an acceptable price; lack of processing capability to produce higher value diversion products and the inertia of established relationships and business practices.

Imports and Exports

To varying degrees, used tires, processed waste tires (e.g., bales or shreds), ground rubber and buffings are all imported to and exported from California. Trends in each of these areas are described below.

Used Tire Imports and Exports

Used tires that have been culled and graded depending on their type and quality (as opposed to waste tires) have long been a staple export from California and other U.S. states. Though most

California used tires are shipped to Mexico,[10] they also are shipped to many different parts of the world including India, Latin America, and Asia. No estimate of the number of used tires imported into California is available, although relatively small quantities are likely shipped from neighboring states.

In 2008 used tire exports from California were estimated to be 1.51 million PTE, a slight decline from 2007. However, this estimate understates actual used tire exports because it is based only on shipments that were reported as directly exported. An unknown percentage of the used tire (domestic) category that was described above under reuse were likely sold to distributors who in turn exported a portion of the used tires they handle. Also, additional quantities of used tires were likely exported to Mexico through informal means that were not tracked or reported by generators and/or haulers.

The main drivers and constraints for used tire exports are the same as for used tires (domestic) described above under reuse. In short, exporting used tires is highly economical because of the low cost to cull and grade them, combined with their relatively high value (about $6 to $8 wholesale). Because a high percentage of consumers in Baja Mexico opt to purchase used tires rather than new tires, there is a strong demand for them across the border. One export-specific constraint to used tires over the long-term is interest by some in certain developing countries to curtail used tire imports in an effort to safeguard their domestic tire industries or over other concerns. For example, a recent report under the International Basel Convention seeks to define used tires as hazardous, a change that could significantly affect used tire exports if it were to be enacted.

Waste Tire Imports and Exports[11]

Until 2008, export of waste tires (as opposed to used tires, described above) from California had been limited and sporadic, mainly involving small amounts shipped to neighboring processing facilities across the state border in Oregon, Nevada, Arizona, and into Mexico. However, in 2007 bulk export of waste tires to Asia, and in particular to China, increased to approximately 0.65 million PTE and in 2008 the estimated quantity exported increased to about 2.2 million PTE.

Agents representing buyers in several Asian countries are making an increasing number of inquiries regarding export of California waste tires, including buyers from China, Japan, Korea, Vietnam, and other nations. Several factors appear to be driving this demand. First, the availability of containers and excess ocean freight capacity has resulted in very low shipping costs. Second, the spike in energy prices during 2008 may have spurred increased interest in imported tire-derived fuel (to replace coal, oil, or other fuels), and once established this demand appears to be sustained even after fuel prices dipped. Finally, changing infrastructure and policies are apparently driving demand in several countries. In Japan, for example, a renewable portfolio standard for energy product is reportedly spurring interest in tire-derived fuel by pulp and paper mills.

To date, most waste tire exports have reportedly gone to China. For that reason, and also because of China's size, it is covered here in some detail. Demand for waste tires in China is apparently

[10] A Board-funded study by San Diego State University's Institute for Regional Studies of the Californias examines waste and used tire flows between California-Mexico border region in detail.

[11] Research on export markets is still being compiled. A separate memorandum summarizing research results will be posted on the Board's web site in late Spring 2009.

being driven by rapid development of industries that use scrap tires, including ground rubber production, cement kiln and other industrial tire-derived fuel users as well as pyrolysis and other emerging technologies.

China is reportedly the second largest generator of scrap tires in the world (after the United States), with an estimated 112 million scrap tires generated in 2004, projected to exceed 200 million tires by 2010.[12] China is also now the world's largest rubber consumer. However, because it lacks rubber resources, it is making a concerted effort to develop its scrap tire management industry, including explicit goals to rapidly develop ground rubber production and tire-derived product manufacturing capacity, and to develop technologies such as de-vulcanization and pyrolysis with an aim of displacing other natural resources and fuel sources and reducing pollution. China's scrap tire collection and processing infrastructure may be lagging its development of end uses, although considerable resources are apparently being focused on this issue. Because China is rapidly expanding both its scrap tire processing and end-use manufacture simultaneously with its scrap tire collection infrastructure, it is possible that over time its demand for imported tires may decline as Chinese scrap tires become available. In the short-term, however, it is expected that demand for scrap tires in China will remain very strong.

The legalities of exporting waste tires into China and other nations are difficult to confirm. By most accounts Chinese firms are allowed to import scrap tires if they have an appropriate permit. Others have stated that the practice is always illegal, but that certain Chinese importers are engaged in the practice anyway. Reportedly some shipments to Vietnam are actually destined for China, but are not shipped directly in order to by pass regulators. (R.W. Beck is working with state and federal export agencies to confirm this situation prior to finalizing this draft report.)

Processors export waste tires in containers, either baled or shred. Exports are driven mainly by favorable economics, with export firms often handling most logistical details including providing and picking up trucks at processors facilities. Terms have reportedly varied from a small positive to a low or no tip fee. In some cases, as discussed above under supply infrastructure, the economics of exporting have been highly advantageous, with some processors expressing concerns that some of their competitors were using the opportunity to undercut prices and disrupt the market by establishing an unsustainable floor price that generators will then expect to continue.

Exporting does have some risks. For example, export markets have a tendency to be unpredictable. Some processors have confirmed that demand can suddenly increase or decrease significantly, and that sales terms can sometimes change abruptly. The economics of exporting could potentially be altered if a shortage of containers or shipping space developed, since the low shipping costs are highly dependent on these favorable conditions. And, regulations governing the import of other waste materials such as electronics scrap in some countries including China have sometimes been abruptly changed, sometimes in a manner that makes it difficult for foreigners to confirm current regulations and requirements.

Waste tire export is controversial, and some processors and others have questioned whether the Board should allow it. Issues raised include questions about verifying how scrap tires are used,

[12] Information on trends in China presented in this paragraph is based largely on a PowerPoint presentation presented to an Institute of Scrap Recycling Industries conference in 2008 titled, "Tire Recycling in China: The Current State and Future Development," by Nai-Xiu Ding of Oingdao University of Science and Technology in China.

environmental controls at tire-derived fuel and other facilities, and concerns that exporting scrap tires could potentially stymie development of in-state diversion. The "worst-case scenario" would be that exports grow substantially over several years, causing domestic processing capacity to decline, and then for demand in other countries to abruptly decline as they bring on their own scrap tire supply systems. This is roughly the situation that American plastics reclaimers have found themselves in today.

While difficult to predict in detail, demand for waste tires in the export market is very likely to increase substantially in 2009 and beyond and could comprise a growing share of scrap tires diverted from landfill in coming years. To date, it appears that increasing exports have not steered scrap tires away from higher-value diversion markets such as reuse and ground rubber. It does appear that some scrap tires previously sent to landfill civil engineering or Alternative Daily Cover uses are now being sent to the export market. However, as discussed in the sections above, demand for scrap tires in these uses was declining anyway, and it is likely that at a good portion of the exported tires in 2008 would have been disposed had they not been exported.

In addition to other countries, some California waste tires were also exported and imported to other states. Board staff estimate that scrap tire imports into California in 2008 totaled 1.38 million PTE, up from 0.5 million PTE in 2007. Imports of waste tires into California generally occurs as a result of transactions between affiliated facilities in California and other states, or from generators in neighboring states where California processors are the least-cost option. Anecdotally, some interviewees cited examples of certain processors importing or exporting whole tires to and from other states that could not be documented and were not confirmed by the processors in question.

Ground Rubber Imports and Exports

Ground rubber is reportedly imported into California by producers in British Columbia, Alberta, Utah, and Arizona, although quantities are difficult to estimate or confirm. Two California processors expressed concerns that imported ground rubber from Canada is sometimes sold at a discount because the producers are subsidized through tire stewardship incentive programs. Several years ago this issue was a widespread concern among California ground rubber producers, especially during a period in which there was excess production capacity for ground rubber with declining market demand, causing severe price reductions and contributing to the closure of at least one California ground rubber production facility. Some have argued that the Canadian ground rubber producers were able to weather the downturn because of the financial support provided by their incentive systems.

British Columbia is home to one ground rubber producer of approximately 35 million pounds per year, and one other ground rubber producer operates in Western Canada out of Alberta. Ground rubber is also produced in Ontario, which may be poised to increase production substantially as a result of that province's new tire stewardship policy. However, it is unlikely that significant quantities of ground rubber are being shipped to California from distances as far away as Ontario, Canada. Shipments of ground rubber into California from the two Western Canadian producers, however, have been confirmed, though the quantity is difficult to estimate.

Some examples of very low-priced ground rubber being sold into California were cited by interviewees, mainly involving ground rubber used in agricultural products. Canadian ground rubber is also used in turf and bark/mulch applications, among others. The Board's requirement that tire-derived product and rubberized asphalt concrete grantees use state funds only for products made with California rubber, and that firms receiving State support use only California

ground rubber, helps to ensure a strong market for California scrap tires and tire-derived products, and also contributes to somewhat higher ground rubber pricing which can further increase attractiveness of low-cost imported ground rubber in products not supported by the Board. Caltrans requires the use of ground rubber in rubberized asphalt concrete that was produced from U.S. generated scrap tires, so some portion (though undetermined) of ground rubber used in these applications comes from other U.S. states, including a large ground rubber producer based in Utah. While Board and Caltrans policies restrict the use of ground rubber imported from out of the country in Board-supported products and rubberized asphalt, partnerships reportedly are being developed between Canadian and U.S. producers aimed at tire-derived product markets that are outside of this restriction.

Buffings Imports and Exports

Although estimates are not available, buffings are imported and exported across the California state line, often to and from points on the East Coast. Buffings are produced as a by-product of retreading, and are in high demand for use in pour-in-place playground surfacing products and other tire-derived products.

According to the Rubber Manufacturers Association, approximately 250 million pounds of retreader-generated buffings are produced nationally each year. Multiplying this amount by California's share of the U.S. population (about 12 percent) yields estimated in-state buffings production from retreaders of about 30 million pounds. This is equivalent to about 23 percent of the amount of California-produced ground rubber in 2008, and is about five times the amount of buffings produced from truck tires by processors (outside of retread operations) in 2008.

Some tire-derived product producers have complained about a shortage of buffings which constrains their ability to meet demand and serves to increase pricing, especially within California. As a consequence, the buffings market is highly competitive, with buffings users closely guarding their supply networks and seeking to strengthen them via new partnerships or affiliations. Also, at least three California firms now produce buffings, totaling about 5.8 million pounds in 2008, from truck tires expressly for sale or use in tire-derived product production. At least two California tire-derived product producers are experimenting with new product recipes that replace buffings with lower-priced and more readily available ground rubber.

Conclusions

The California scrap tire industry entered 2009 in a relatively strong position, with good markets, a robust and expanding processing infrastructure, and ample State resources for related programs. On the other hand, the diversion rate decreased in 2008 and there is a strong possibility that it will again in 2009, due to decreased use of tires in landfill civil engineering and tire-derived fuel, and potential reductions in demand spurred by the current severe recession or other threats identified in this report.

As many observers note, scrap tire markets tend to be cyclical, with periods of strong demand followed too often by periods of low demand and industry shake-ups. This report, along with other Board resources, provides a foundation for developing a long-term strategy to help ensure that the California scrap tire recycling industry continues to grow and thrive, with minimal disruptions.

A long-term market development strategy could include:

- Articulating a long-term vision for scrap tire recycling markets and principles to guide decision making;
- Adopting strategies to pursue specific market expansion and strengthening opportunities that address identified barriers, with measurable and time-specific goals;
- Evaluating current Board programs and innovative approaches from other states and countries, including examining the potential for additional partnerships; and
- Identifying the specific programs and activities that would most effectively implement the adopted strategies and achieve the identified goals.

R.W. Beck is currently tasked with updating this report in early 2010. Armed with up-to-date market recognizance and a long-term strategy, the Board would be well prepared for a fresh look at the Five Year Plan when it is next updated in late 2010.

Appendix A
Methodology and Data Limitations

Appendix A

This appendix briefly summarizes the methodology used for this report, the level of accuracy and sources of uncertainty, and differences with previous Board reports.

The market flow estimates presented in Tables 1 and 2 are thought to be accurate to within about +/- 10 percent, which may be an upper bound on the potential accuracy of scrap tire flow studies. The estimates are based on surveys, interviews, analysis of data in the Board's Waste Tire Manifest System (WTMS), and review of written information. Because these sources are generally incomplete and conflicting, the study team evaluated them for accuracy, double counting issues, and overall consistency, and selected the best available estimate for the facilities and market categories analyzed.

Data limitations include:

- Conversion Factors—Firms and the Board typically use a standard conversion factor of 20 pounds per tire, even though scrap tire weights vary significantly. According to the Rubber Manufacturers Association, based on national average statistics: passenger tires weigh 22.5 pounds; commercial/truck tires weigh 110 pounds; mixed loads of passenger and light truck tires average 32.8 pounds per tire; and heavy truck tires and off-the-road tires may weigh hundreds or even thousands of pounds. WTMS data in particular is subject to large errors as data may be entered in tons, number of tires, or cubic yards.
- Data Entry—As one example, the Board estimates that approximately 25 percent of comprehensive trip log (CTL) reports have errors.
- Un-Manifested Flows and Off-the-Books Transactions—Some flows are not manifested, either due to Board-approved exemptions or through failure to submit required trip logs. Some flows, especially of used tires, are sometimes treated as off-the-books transactions and are not reported in surveys or tracked by generators, haulers and/or processors.
- Discrepancies Between Inputs and Outputs—Manifest data provides data on inputs to facilities, while surveys provide data on outputs. Output data is often based on shipping data or facility estimates that do not reflect stored inventories and that may occur in a different study year than when the scrap tire inputs to make them were received.
- Data Gaps—The project team had to confront a number of data gaps in developing this report, including poor data on retreading and certain other market categories or facilities.

The methodology used for this report is generally similar to that used for the previous "California Waste Tire Generation, Markets and Disposal" reports prepared by Board staff. However, there are some key differences that complicate direct comparisons, including:

- Market Category Adjustments. These include separating exports into waste tires and used tires, adding more detailed ground rubber categories and consequently reducing the types of uses included in the "other" category.
- Different Survey Approach. Different surveys were used for processors, tire-derived product producers and retreaders and the amount of data and information gathered through interviews was increased;

- Different Analysis Approach. A new spreadsheet was developed to organize and compare data from different sources, especially to facilitate eliminating double counting and other issues.
- Number of landfills analyzed. Thirteen landfills that received scrap tires for disposal and were logged in manifest forms were analyzed for 2008 in this report, including some that may not have been included in previous Board reports.

Finally, it should be noted that this report does not attempt to explicitly estimate scrap tire generation. Rather, the total generation figure presented in Table 2 represents the total documented flow of scrap tires, which is thought to represent a very high percentage of actual generation in the study years.