California Tire Market Report: 2009

CalRecycle

California Department of Resources Recycling and Recovery

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Introduction

Background

Under the California Tire Recycling Act of 1989 and subsequent amendments, the Department of Resources Recovery and Recycling (CalRecycle[1]) has adopted an overall tire management strategy focusing on two interrelated fronts: 1) Providing a strong and fair regulatory framework to protect public health and safety and the environment while not stifling waste tire flow and processing; and 2) Supporting expansion of the business and government market infrastructure for producing and using tire-derived products. CalRecycle's Five-Year Plan for the Waste Tire Recycling Management Program, which is required to be revised every two years, guides efforts to reach a 90 percent diversion goal by 2015. The current plan was adopted in May 2009, and the next plan will be considered in spring 2011.

This report supports CalRecycle's efforts by providing information on the waste tire diversion rate, market trends and supply/demand balance based on research conducted from January 2010 through June 2010. The report was prepared under CalRecycle 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 waste tires with estimated waste tire uses for 2009, a look at key trends, with a discussion of the outlook for increased diversion. Section 3 then begins with a discussion of the current balance between supply and demand, and then describes trends under each market category in more detail. Section 4 provides conclusions.

Interpreting and Using Report Findings

Appendix A provides a detailed summary of the methodology, sources of uncertainty and adjustments to report methodology over time. Following are a few key points to remember when interpreting and using data presented in this report:

- **Significant Uncertainty but Reasonable Trend Information—**As described in Appendix A there are several important sources of uncertainty associated with the estimated market flows. For most market segments, the estimates are thought to be accurate to about +/- 10 percent and can reasonable be used to evaluate trends over time. However, the retread market segment estimate has been held steady since 2003. For the 2010 market analysis a new approach to this segment combining expanded surveys and economic activity data will be piloted.
- **Many Sources Combined and Cross-Checked—**The estimates are generally derived from primary data gathered from processors, landfills, tire-derived fuel users, CalRecycle's Waste Tire Manifest System and Disposal Reporting System, and CalRecycle staff, as well as discussions with a range of TDP producers and others with a stake in California waste tire management. Data from these sources is combined and analyzed to remove double-counting, cross-check data where possible and to derive the most accurate estimates possible given the information available.
- **Estimates Are For Use of California-Generated Tires, Not Total Market Size—**The 2009 estimates presented in the report indicate the approximate number of California waste tires flowing into each market segment. They do not "count" imported ground rubber or finished

[1] The department, known as CalRecycle, includes programs from the former California Integrated Waste Management Board. In this report "CalRecycle" is used to refer to the organization, both in relation to current and past activities.

products; nor do they "count" buffing derived from retread operations. Consequently, the estimates do not indicate the entire size of the California market.

- **Waste Tire Generation Based on Documented Flows—**The total estimate of waste tire generation is based on the sum of all documented flows derived from the sources listed above, after adjusting for double counting. Generation estimates are not based on sales data or estimated time between purchase and tire discard.

- **Tire Diversion Rate Not Adjusted for Residuals—**As with many other state and national tire recycling market studies, in this report the tire diversion rate is not adjusted for steel and fiber residuals that occur as a result of producing ground rubber. While these materials are often recycled, to date the project team has chosen not to comprehensively gather this data in order to simplify the survey process. This will be revisited for the 2010 analysis, and stakeholder input is welcome.

  Concurrent with research for this report, CalRecycle has been conducting a detailed review of its waste tire market development program. The following related reports provide additional information on California waste tire markets and state market development efforts:

  - "California Waste Tire Market Development Program Evaluation" evaluates state programs and policy options, and makes recommendations for targeting top priority opportunities and barriers, and for increasing program effectiveness;

  - "Work Paper #1: Market Penetration Report" was prepared to support the program evaluation and provides estimates the potential size of each tire market segment, current penetration rates and potential penetration in 2015, based on current trends and opportunities to enhance current programs;

  - "Tire-Derived Aggregate Market Assessment and Strategy" analyzes markets for use of tire-derived aggregate in civil engineering applications, and recommends to CalRecycle strategies and tactics they can implement to expand this market segment; and

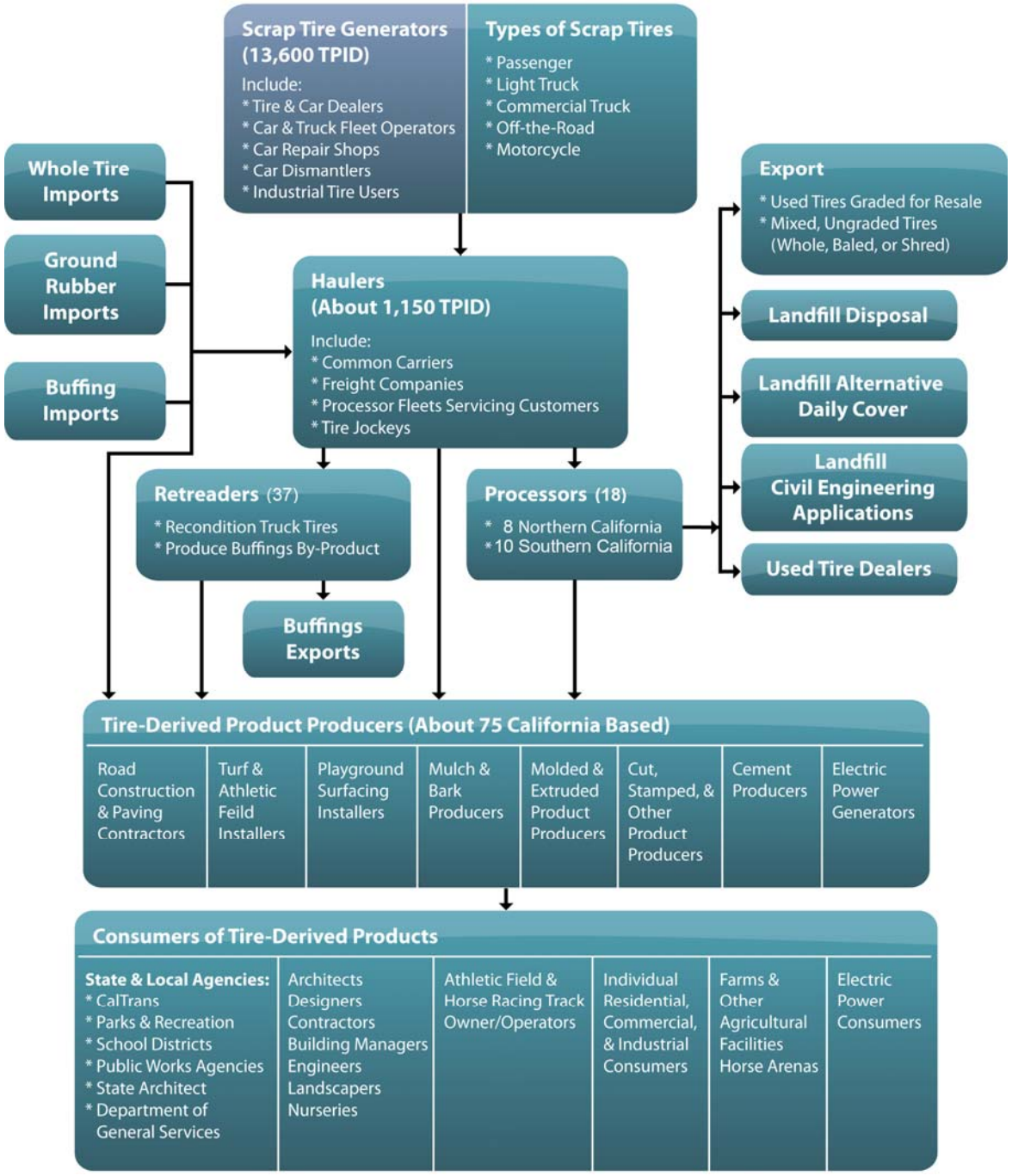
  - The California Rubber Feedstock Suppliers List identifies suppliers of processed waste tires in California.

  Select findings from these sources are included in this report; but the above sources provide additional details related to current trends, opportunities and market expansion barriers.

Industry Overview

Figure 1 below provides a flow chart identifying the number and types of firms involved in California waste tire management. Note that the 18 "processors" indicated in the figure refers to the active facilities surveyed for this report that handle the vast majority of tires generated in California. There are also additional, permitted facilities such as cement kilns using whole tires and landfills accepting whole tires.

Figure 1
California Waste 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 CalRecycle's Waste Tire Manifest System.

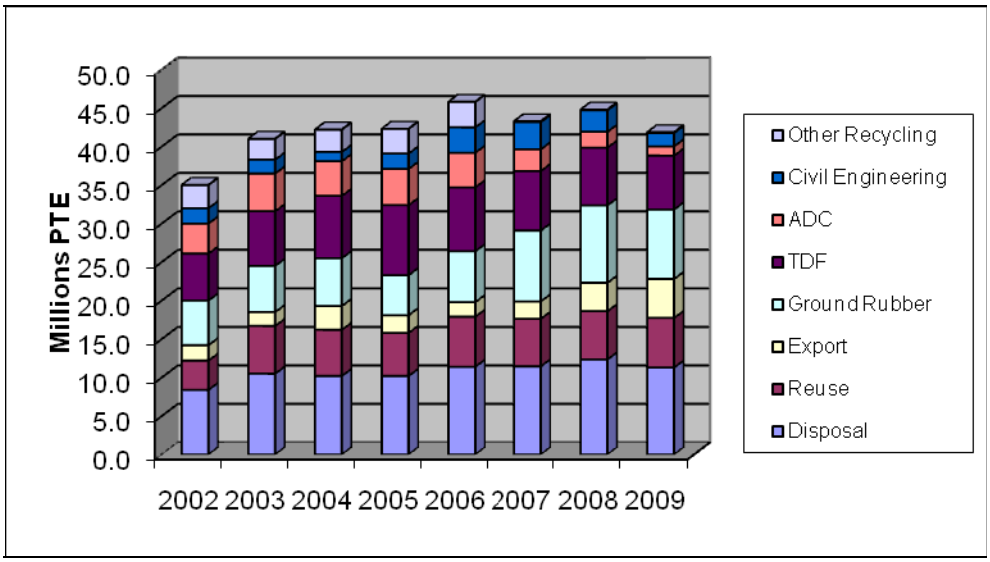
Market Snapshot

Current Diversion Rate and Key Trends

This section provides a snapshot of California waste tire markets as of December 2009, and discusses key trends through mid 2010. More detailed trends for each market segment are covered in the next section.

Figure 2 graphically shows trends by broad market category since 2002, and Table 1 (on the following page) presents estimated uses for California-generated waste tires in 2009 along with data from 2008 and 2007 for comparison. Compared with earlier CalRecycle reports, the statistics beginning in 2007 are based on adjusted categories and data-gathering methodology. Appendix A describes the methodology, data limitations and differences with prior CalRecycle studies in more detail.

Figure 2
Eight-Year Trend for California Waste Tire End-Uses[3]



The U.S. economy began 2009 mired in a deep recession and reeling from a crisis in the financial system, and this had a profound influence on tire recycling markets (though less than for many other recycling markets). Most directly impacted were waste tire generation and segments tied to construction (such as use of tire-derived fuel by cement plants and certain molded products). Some segments like rubberized asphalt concrete continued to grow, as a result of continued market acceptance and, reportedly, American Reinvestment and Recovery Act funding. Waste tire generation is estimated to have decreased by about 8 percent in 2009 compared to 2008, although some processors stated that volumes were down by as much as 15 percent. Anecdotally, this downward trend intensified in 2010, although the Rubber Manufacturing Association reports

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

that new tire sales are rebounding, indicating that future waste tire generation is likely to rebound as well. The quantity of tires diverted was down by a little more than 7 percent in 2009, but with disposal down by more than 8 percent, the diversion rate held essentially steady at about 73 percent.

Table 1
Estimated End-Uses for California Generated Waste Tires, 2007–2009[4]

Category	Sub-Category	2007		2008		2009		Percent change 08-09
		Million PTE	Percent of Total	Million PTE	Percent of Total	Million PTE	Percent of Total	
Export	Waste Tires	0.7	1.5%	2.2	4.9%	3.3	8.0%	50.5%
	Used Tires (Exported)	1.6	3.7%	1.5	3.4%	1.8	4.3%	18.0%
	Subtotal	**2.3**	**5.2%**	**3.7**	**8.2%**	**5.1**	**12.3%**	37.2%
Reuse	Retread	4.4	10.2%	4.4	9.9%	4.4	10.6%	-0.3%
	Used Tires (Domestic)	1.8	4.1%	1.9	4.1%	2.0	4.9%	9.6%
	Subtotal	**6.2**	**14.3%**	**6.3**	**14.0%**	**6.4**	**15.6%**	2.6%
Ground Rubber	RAC & Other Paving	3.9	9.1%	4.3	9.7%	4.6	11.2%	7.3%
	Turf & Athletic Fields	2.5	5.8%	2.4	5.5%	1.3	3.2%	-45.0%
	Pour-in-Place Playground	0.3	0.6%	0.4	1.0%	0.3	0.7%	-33.1%
	Loose-Fill Play/ Bark/Mulch	1.0	2.2%	1.1	2.6%	1.3	3.1%	12.2%
	Molded & Extruded	1.0	2.3%	1.2	2.6%	0.8	2.0%	-29.2%
	Other	0.6	1.3%	0.5	1.2%	0.1	0.3%	-76.4%
	Subtotal	**9.2**	**21.3%**	**10.1**	**22.4%**	**8.5**	**20.6%**	-15.3%
Civil Engineer-ing	Landfill Applications	2.6	5.9%	2.1	4.6%	1.4	3.4%	-32.1%
	Non-Landfill Applications	1.0	2.3%	0.7	1.6%	0.4	0.9%	-51.6%
	Subtotal	**3.5**	**8.2%**	**2.8**	**6.2%**	**1.8**	**4.2%**	-37.2%
Alternative Daily Cover		**2.8**	**6.5%**	**2.1**	**4.6%**	**1.2**	**2.9%**	-41.5%
Other Recycling		**0.1**	**0.2%**	**0.1**	**0.2%**	**0.1**	**0.2%**	-9.7%
Tire-Derived Fuel	Cement	6.6	15.3%	6.7	14.9%	6.4	15.5%	-3.8%
	Co-Generation	1.1	2.5%	0.8	1.9%	0.6	1.4%	-30.5%
	Subtotal	**7.7**	**17.8%**	**7.5**	**16.7%**	**7.0**	**16.9%**	-6.8%
Landfill Disposal		**11.5**	**26.5%**	**12.3**	**27.6%**	**11.3**	**27.3%**	-8.5%
Total Generated		**43.3**	**100.0%**	**44.8**	**100.0%**	**41.3**	**100.0%**	-7.7%
Total Diverted from Landfill		**31.8**	**73.5%**	**32.4**	**72.4%**	**30.0**	**72.7%**	-7.4%
Imports		1.2	2.7%	0.5	1.1%	**1.5**	3.6%	188.4%

[4] Data for 2007 and 2008 are from the "California Scrap Tire Market Report: 2008." See Appendix A for a discussion of differences in methodology and market categories between the two sources.

Despite a stagnant diversion rate, the California waste tire management industry remained highly dynamic with several changes in processing facilities and clear shifts in certain markets. Following are some of the key trends currently shaping the market:

- **Infrastructure—**The waste tire "supply" infrastructure initially contracted somewhat in 2009, with two Northern California processors discontinuing operations, spurring increased competition for collection accounts and aggressive pricing terms. Competition for waste tires has further intensified in 2010 as three new ground rubber production facilities have started operations (two in the south and one in the north). Currently, 18 processors handle the vast majority of tires generated in the state.

- **Exports—**Driven mainly by strong demand for TDF in China, Japan, and other Asian countries, exports of waste tires are continuing to rapidly increase, with a 50 percent estimated increase in 2009 compared to 2008, and a five-fold increase compared to 2006. Anecdotally, waste tire exports are continuing to grow rapidly in 2010, buoyed by sustained strong demand and favorable pricing.

- **Reuse—**Reuse, including retreading and the culling of used tires for sale domestically, continues to hold essentially steady at just over 6 million PTEs, with an additional 1.8 million PTEs in used tires sold internationally, a slight increase from the estimated 2008 level.

- **Ground Rubber—**After several years of consistent, sharp growth, the volume of ground rubber produced from California waste tires decreased by about 15 percent: from 10.1 million PTEs in 2008 to 8.5 million PTEs in 2009. However, the number of tires used to produce ground rubber sold into RAC and other paving applications increased by 7 percent from 4.3 million PTEs in 2008 to 4.6 million PTEs in 2009. And, the volume of California ground rubber sold into the loose-fill playground/bark/mulch market segment increased by about 12 percent to about 3.1 million PTE. Ground rubber production is poised to grow significantly in 2010 with three new producers having entered the market, assuming strong demand for RAC, turf, and bark holds and that no major threats materialize. In this year's report, loose-fill playground and bark/mulch are combined for the first time. See Appendix A for an explanation.

- **Civil Engineering—**The estimated use of California waste tires in civil engineering applications declined in 2009. Estimated landfill civil engineering applications declined from 2.1 million PTEs to 1.4 million PTEs; however, some of the activity reported by landfills and/or processors for previous estimates could not be validated and may not constitute "civil engineering" according to CalRecycle staff. Reporting definitions and procedures will be refined for the 2011 market analysis. Non-landfill civil engineering applications fell from 0.7 to 0.4 million PTEs in 2009, although CalRecycle appears to be poised to catalyze some uses, such as local agency use of tire-derived aggregate in landslide repair and regional Caltrans use of TDA as lightweight fill in certain retaining wall projects.

- **Alternative Daily Cover—**Use of waste tires as alternative daily cover also decreased markedly, from about 2.1 million PTE in 2008 to 1.2 million PTEs in 2009, due to reductions in the estimated amount used at two landfills that have used large quantities in the past, which is in part likely due to large recession-induced decline in municipal solid waste disposal.

- **Tire-Derived Fuel—**The estimated use of California waste tires as tire-derived fuel declined slightly in 2009, a surprisingly positive level given that cement production is down markedly

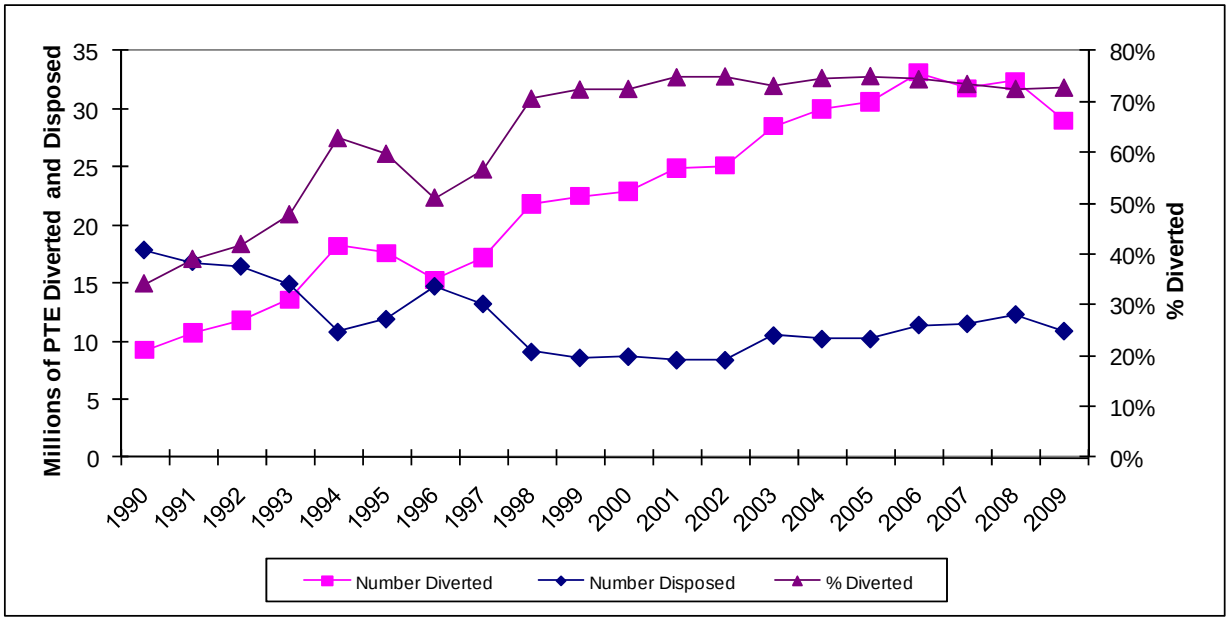
due to the continuing weak economy and one major plant has now closed. Use of TDF by cement plants declined from 6.7 to 6.4 million PTEs. However, , for the first time the market estimates have estimated the flow of imported waste tires to different market segments, including 0.35 million PTEs flowing to cement plants, which accounts for the apparent decline since 2008. Use of waste tires in California cogeneration plants continued to show a steady decline, from 0.8 to 0.6 million PTEs in 2009, led by a switch to biofuels spurred by AB 32 greenhouse gas emission rules and renewable portfolio standard rules.

- **Disposal—**Disposal declined by 8.5 percent, from 12.3 to 11.3 million PTEs, although the aforementioned adjustment for imported waste tires accounted for 0.5 million PTEs of this reported reduction. The expanding export market appears, in at least some cases and especially in Southern California, to be diverting tires directly away from California disposal facilities, a trend which could bode well for future diversion rates, although the desirability of waste tire exports remains controversial.

Outlook for Increasing the Waste Tire Diversion Rate

CalRecycle has adopted a goal of increasing the diversion rate to 90 percent by 2015. As shown in Figure 3, California waste tire diversion steadily increased from about 31 percent in 1990 to about 75 percent in 2001, and has hovered between 75 and 72.4 percent since. However, while the diversion rate has been stagnant, the volume of waste tires diverted increased every year between 1996 and 2006, more than doubling during that period. This is because, until 2009, the quantity of tires generated had been steadily increasing. Between 2008 and 2009, the volume diverted decreased by over seven percent; however, the quantity of tires generated declined by almost 9 percent, resulting in the diversion rate essentially holding steady at about 73 percent in 2009. While California tire markets may continue to grow and diversify, a separate CalRecycle analysis has indicated that it is not likely the 2015 90 percent diversion goal will be met. (See the Waste Tire Program Evaluation Final Report.)

Figure 3
Waste Tire Diversion and Disposal Trends



As summarized in Table 2, there is a good chance that both waste tire diversion volumes and the diversion rate may increase in the next two years, assuming that key threats identified do not materialize.

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

Category	2009 Diversion		Two-Year Diversion Outlook	Drivers	Barriers/Threats
	Million PTE	Percent			
Reuse	6.4	15.6%	Flat	▪ Favorable economics	None in short term
Ground Rubber	8.5	20.6%	Increase possible due to capacity increases if threats do not materialize	▪ CalRecycle support ▪ Strong demand, especially for RAC ▪ Stimulus funding/ government purchase ▪ Expanded ground rubber production capacity	▪ Recession-driven reduced demand and government budgets ▪ Health concerns may reduce turf demand ▪ Possible glut if demand decreases significantly
Civil Engineering	1.8	4.2%	Flat or Modest Growth	▪ Expanding CalRecycle focus and support ▪ Favorable economics at certain landfills ▪ ARRA funding	▪ Tight government agency budgets ▪ Lack of awareness/ experience ▪ Supply challenges
ADC	1.2	2.9%	Flat	▪ Favorable economics at landfills where used	▪ Possible reduction in quantity available due to expanding export, ground rubber;
Other Recycling	0.1	0.2%	Flat	None in short term	None in short term
TDF	7.0	16.9%	Decline in early 2010 has now apparently stabilized	▪ Favorable economics and production benefits at cement plants vs. other fuels ▪ Reduces emissions relative to coal or petroleum coke	▪ Reduced demand in 2010 due to one plant closure and reduced production at one other plant ▪ Proposed EPA rule on TDF could greatly reduce future demand
Export	5.1	12.3%	Sustained at High Level & Continuing Increases Possible	▪ Strong and growing demand by Asian countries ▪ Favorable economics to processors	▪ Unpredictable swings in demand ▪ Complex regulations & language challenges
Total Diversion	30.0	72.7%	Modest diversion increase	▪ Ground rubber, export and possibly TDA likely to increase	▪ Declining segments may have hit bottom; future TDF threat

Following are the key diversion rate projection trends for each market segment:

Ground Rubber—Ground rubber may be poised for yet another growth spurt, due to recent production capacity expansions, steady increases in demand for RAC and bark/mulch, and continuing strong demand for synthetic turf. However, RAC, and to a degree synthetic turf, have reportedly been buoyed by American Recovery and Reinvestment Act (ARRA) support, implying that as ARRA funds are depleted sustained demand for these products may be dependent on sustained government stimulus and/or a strong rebound in the economy, neither of which is certain. The economy has had a particularly negative impact on molded/extruded products and playground surfacing products, although no ground rubber markets have been devastated and these segments could rebound well if the economy improves. Some new projects in the molded/extruded category may begin this year and next, and bark/mulch is increasingly being sold through retail outlets, in part due to CalRecycle support. It is as yet unclear whether media attention to claims of health risks associated with synthetic turf, and to a lesser extent bark, will decline or grow. While some projects have been cancelled, this threat does not appear to have had a hugely negative impact on the market.

Civil Engineering—Civil engineering may also be poised for a growth spurt, although in 2010 use levels may remain flat or only slightly higher. While volumes declined between 2008 and 2009, CalRecycle is making civil engineering a top priority and will likely be expanding funding, technical assistance, education, and outreach targeting this segment. Regarding the landfill market, one large landfill that consistently uses TDA in a range of activities reports this use may decline somewhat until 2012 when new projects again boost demand. Another landfill reports that it intends to begin shredding on site for use of TDA in civil engineering applications. CalRecycle plans to clarify the types of projects that may qualify as civil engineering, and this could potentially further reduce reported usage in 2010.

Export—Export of waste tires has grown at a very fast pace over the past two years. Anecdotally, it appears that in 2010 export demand remains strong and may even be intensifying. Growth is likely in 2010, and continued strong demand by Asian countries means there is the possibility of another substantial uptick in exports. But, as with all export markets, there is also the possibility of an unexpected, abrupt decline in demand due to a range of potential factors that are out of the control of California tire recyclers.

Reuse and Alternative Daily Cover—As with ADC and the "other" category, use of tires in reuse segments appears to be flat and stable, although expanding export and ground rubber markets have the potential to draw some tires away from ADC in Northern California. On the other hand, ADC demand in Northern California could potentially increase if the economy does, as landfill volumes tend to closely track economic activity.

Tire-Derived Fuel—The modest decline in TDF use in 2009 may intensify in 2010 due to the shutdown of one plant that used 1.2 million PTE in 2009. While some of this demand may have shifted to other plants, the slowdown in the cement industry has continued and is strongly dependent on construction industry activity. A pending U.S. EPA rule would redefine the regulatory status of TDF and holds the potential to substantially reduce demand for TDF by cement plants, even as California cement plants express a desire to increase waste tire use as the economy rebounds. The proposed U.S. EPA rule holds the potential to reduce a large portion of current demand because it would require cement plants that historically used whole tires to either begin paying for processed feedstock (rather than receiving a tip fee) or to secure complex new permits beginning in 2012. Currently, four California plants that used more than 5.2 million PTE in 2009 consume whole tires, with only one cement plant using processed TDF as fuel. However,

this threat does not appear likely to impact demand in the immediate future as the regulatory process plays out.

A broad threat to California waste tire markets is the ongoing state fiscal crisis. While the waste tire management fund has so far proven immune to pressures, the severity of the crisis could potentially result in a cutback of funding. While the exact impacts of a severe cutback are hard to predict, at a minimum it would vastly reduce the potential for expansion in segments that are currently most dependent on CalRecycle support, such as civil engineering and some ground rubber segments.

Market Trends by Category

This section describes in more detail the current balance between supply and demand in the California waste tire market, and key market trends affecting each market segment.

Overall Supply and Demand Balance

As in any commodity market, the balance between the supply of waste tires and processed tire feedstock, and demand for these materials is constantly shifting in response to market trends, changes in processor and TDP producer capacity and government support/regulation.

Following is a brief update on supply infrastructure trends, concluding in a synopsis of the current balance between supply and demand for different market segments, and implications for potential expansion projects.

Processing Expansions, Contractions and Partnerships

More than 13,000 registered California facilities, such as tire dealers and auto repair shops, generate waste tires. California has a large, dynamic infrastructure for collecting and processing waste tires, including about 1,150 registered haulers and 32 facilities with an active major or minor waste tire facility permit. The vast majority of tires generated flow to one or more of 18 processor facilities analyzed in this report, with the remainder hauled directly to disposal or end-uses such as reuse or cement kilns burning tire-derived fuel (TDF) which were also surveyed. 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.

California waste tire processing continues to experience a very dynamic period involving processor expansions, contractions and partnerships. This activity is fueled largely by the market trends described throughout this report.

In 2009, two Northern California processors with a combined total throughput of about 1.7 million PTEs in 2008 ceased operations. By the end of the year, three new ground rubber operators (one in Northern California and two in Southern California) had started up new facilities or were about to. In addition, as in past years, a variety of additional projects, especially for new ground rubber production, in both California and in the border region were being discussed. Interest in partnerships by and between processors and tire-derived product producers continued, in some cases with the goal of helping 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. The three new ground rubber producers each received low-interest loans through CalRecycle and reported a combined production capacity of 3.5 million PTEs per year, equivalent to 39 percent of the estimated 2009 California ground rubber production. One additional firm has increased capacity to produce buffings from waste tires, although soft demand may delay launching the operation.

Reduced Availability of, and Increased Competition for, Waste Tires

Overall waste tire generation was estimated to be down by almost 8 percent between 2008 and 2009, and anecdotal evidence suggests this trend may have continued and even intensified during the first half of 2010. (CalRecycle reports that MSW disposal declined even more sharply in the same period.) Some processors reported even higher reductions in waste tire availability, as high

as 15 percent in some cases. This is apparently a result of consumers delaying the purchase of new tires, and reduced auto sales caused by the weakened economy. In Southern California, truck tires in particular are currently in very short supply. Truck tires are valued by some ground rubber producers because they have more rubber and can be processed more efficiently than passenger tires, and because the all-black rubber is required by some TDP manufacturers. Tip fees for truck tires have reportedly declined markedly due to the competition, with some historically unusual shipments from Northern California to Southern California.

Competition for waste tires has greatly increased as a result of the strong export market and the changes in processor capacity discussed above. In both Northern and Southern California, there are anecdotal reports of aggressive competition for collection accounts, which is driving down collection fees and, therefore, processor revenue.

According to Tirebusiness.com, U.S. tire production fell 14.6 percent in 2009, and this trend was mirrored by a roughly equal decline in new tire imports. Overall, U.S. tire shipments dropped 8 percent in 2009, with the greatest drop seen in truck and bus tires. According to the Rubber Manufacturers Association, however, nationally new tire sales are rebounding in 2010 and may increase by up to 8 percent, which would bring them up roughly to the number sold in 2008. This indicates that waste tire generation may rebound as well in coming months. While newly sold tires do not enter the waste stream for some time, they are a proxy for current waste tire generation to a degree because widespread delays in purchasing new tires affects current generation of waste tires.

Other Supply Trends

Additional trends/factors related to waste tire and rubber feedstock supply include:

- **Competition from out-of-state suppliers—**While sales to California customers of ground rubber and TDPs from out-of-state producers has certainly continued, there have not been widespread concerns raised regarding the impact of this competition on California firms. Processors in British Columbia, Alberta, Utah, and Arizona, as well as proposed producers in Baja Mexico, all have expressed enthusiasm for the California market, even as California-based producers increasingly eye market expansion into the national and North American marketplace. As ground rubber production capacity expands across the continent, especially if demand continues to soften, there is a very real potential for increased competition, with producers from states and provinces that subsidize ground rubber at a competitive advantage.

- **Need for adoption of quality standards and practices—**Some TDP industry players have expressed the need for adoption and widespread use of quality standards for ground rubber and other feedstock materials. While certain standards have been established by ASTM and other groups, there are gaps, and the standards are rarely used by buyers and sellers in practice. Some TDP manufacturers/installers have indicated that there is a need to improve overall quality of California ground rubber supplies to meet their production needs.

- **Development of new storage regulations—**CalRecycle continues to develop new storage regulations governing the type, amount and conditions under which waste tires and certain processed materials can be stored. While the new regulations are stricter in some ways to address fire risks and other health and safety considerations, they also provide opportunities to request exemptions to meet market needs.

- **Review of export permitting requirements—**CalRecycle staff is also reviewing the permitting requirements and current activities related to export to ensure that current

regulations are being abided by. Some processors have complained that regulations are being bypassed by haulers shipping whole tires to export destinations through California ports.

- **Stepped up compliance monitoring and enforcement—**CalRecycle expanded and formalized its compliance monitoring and enforcement activities over the past two years, and this effort is continuing. Some haulers and processors have had difficulty complying and this has contributed to the shutdown or restructuring of operations for some firms.

Mixed Demand Trends

As summarized above and described in detail below, in 2009 overall demand for ground rubber decreased, while demand for RAC and bark/mulch continued to increase. Anecdotally, this trend is continuing. Some suggest that turf may be beginning to rebound in 2010, although there is apparently widespread sentiment that this market segment, which has grown substantially in the past several years, may decline rapidly as the industry shifts to other infill materials. Demand for TDF held steady in 2009 but declined in early 2010. Demand for TDA and ADC declined while exports continued to increase. Overall, this mixed demand trend is unexpectedly positive, given the magnitude of the economic downturn. While there is a possibility of sustained growth in demand for certain segments, overall demand remains threatened by a continuing sluggish economy, along with a variety of other threats as described above.

While inventories of processed tires and TDPs have reportedly been much higher than usual, especially in the molded/extruded product segment, and some ground rubber producers have experienced difficulty moving their product to market, the situation has not appeared to threaten the viability of any producers. It is possible that the softening may bottom out in 2010 and that demand could rebound in 2011, assuming the overall economy does. On the other hand, the threats discussed in the previous section hold the potential to further reduce demand for ground rubber, and, given the expansion of production capacity in California and throughout North America, could possibly result in a supply glut that could trigger reduced prices, increased competitive pressures, and ultimately threaten the viability of weaker producers. Similarly, the potential reduction in TDF demand could further exacerbate this situation as a worst-case scenario for 2012 and beyond.

Implications Supply/Demand Balance for Future Market Expansion Projects

Following are some implications of the above analysis for future market expansion projects:

- **Projects to Expand Ground Rubber Production Capacity Should Proceed With Caution**—The issue of supply and demand balance is particularly important for ground rubber, which requires a greater processor investment than other rubber feedstock operations and therefore puts facilities at greater risk during downturns. Two years ago demand for ground rubber was outpacing supply, and there were concerns about potential shortages, with some firms complaining of tight supplies and increased prices. By spring 2009, these concerns had subsided as demand softened due to the recession (especially demand by local government agencies). And as of spring 2010 the shift has continued, with supply beginning to outpace demand for ground rubber. Future market conditions are difficult to predict. However, the recent expansion of California ground rubber capacity by 3.5 million PTE (40 percent of 2008 production) during a period of softening demand in some segments, coupled with supply expansion across North America, holds the potential to trigger a supply glut with the threat of reduced sales, revenues and ultimately a shakeout in producers as has occurred periodically in the past. On the other hand, if the economy rebounds and key threats do not materialize, ground rubber demand could resume its expansion, and the new capacity would

allow the ground rubber markets to reach all-time highs. Given the uncertainty over which scenario will unfold, CalRecycle and project developers should evaluate current market factors carefully prior to investing in additional ground rubber production capacity at this time.

- **Tire-Derived Aggregate Needs Expansion in Both Demand and Supply**—Unlike ground rubber, the tire-derived aggregate market is in its early stages and is in need of expansion for both demand and supply. Because of the much lower investment required to supply TDA compared to ground rubber, there is less risk, and government programs and businesses should focus on identifying viable projects that increase TDA demand in a way that can be feasibly supplied with TDA cost effectively, and in compliance with regulations.
- **Tire-Derived Fuel Supply Exceeding Demand**—Several California processors and haulers have historically relied on the strong TDF market. While the softening of this demand in early 2010 may have reached a short-term low and be poised to recover with the economy, there is a looming threat of a drastic reduction in demand due to the proposed EPA rules to redefine whole tires used as fuel as MSW. However, the supply infrastructure is well established for TDF and the main implication of this trend is the need for processors to ensure a diversity of outlets for their tires. The continuing growth of RAC provides one alternative, as does export growth, although export markets can be subject to sudden declines due to global economic and regulatory factors. .
- **Reuse Supply in Balance With Demand**—While there is some room for growth in retreading, by most accounts the supply of used tires and retreads is more or less in balance with demand, therefore operations are likely to continue at essentially the same level as they currently do.

Market Segment Updates

Reuse

Reuse, including retreading and sale of partially worn used tires, is strong and stable, with about 6.4 million PTE being reused in 2009, essentially equal to the amount in 2008.

RETREAD TIRES

The CalRecycle estimate of California retread levels has been held flat since 2003 at 4.4 million PTEs. However, this is due to challenges in the measurement of retread volumes. For the 2010 market analysis report, CalRecycle will test a new approach combining expanded surveys with other available data to estimate retread volumes and identify broad trends.

California is home to about three dozen retread companies 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 suggest retread volumes may have grown in part to cost saving measures implemented in response to the recent economic downturn. Others suggest the down economy may have resulted in a decline in retreading since the downturn is also responsible for reduced trucking miles driven, moderating any overall increase in retread demand. The main barriers to increased retreading are 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.

USED TIRES

Shipments of used tires to dealers within California were estimated at 2.0 million PTEs in 2009, even with the level in 2008. Additionally, as discussed under "Imports and Exports" later in this section, in 2009 an estimated 1.8 million PTEs of used tires were exported from California, an approximately 20 percent increase over 2008 estimates. An unknown percentage of the used tire (domestic) category was likely sold to California dealers who exported a portion, 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. The main constraint to increasing used tire shipments is the limited number of waste 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 now home to seven producers of ground rubber, three of which started operations at the end of 2009 or the beginning of 2010. Additionally, one facility is currently producing buffings from waste tires and another has established the capacity to do so, but is waiting for demand to rebound. These ground rubber producers used approximately 8.5 million PTEs in 2009 to produce about 110 million pounds of ground rubber, a 15 percent decline over the estimated amount produced in 2008.[5] This includes coarse ground rubber of ¼ to ¾ inch (generally used for loose-fill playground, mulch, and horse arenas), finer ground rubber of 4 to 30 mesh (used in RAC, synthetic turf infill, 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 production by market segment for 2008 and 2009.

Table 3
Estimated Ground Rubber Shipments by Market Category

Category	2008		2009	
	Pounds[5]	Percent of Total	Pounds	Percent of Total
RAC & Other Paving	56,204,044	43%	60,320,000	54%
Turf & Athletic Fields	31,742,828	24%	17,446,000	16%
Pour-in-Place Playground	5,803,837	4%	3,883,100	4%

[5] 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 the equipment and production processes employed.

Category	2008		2009	
	Pounds[5]	Percent of Total	Pounds	Percent of Total
Loose-Fill/Bark/Mulch	14,942,200	11%	16,766,425	15%
Molded & Extruded	14,992,705	11%	10,618,400	10%
Other	6,981,702	5%	1,651,000	1%
Total	130,667,316	100%	110,684,925	100%

Factors driving demand for all ground rubber products include: State RAC use mandates, CalRecycle grant programs, and other financial/technical/promotional support efforts; growing interest in green building and sustainability; and federal ARRA funding. Some common constraints include: Recession-driven declines in demand, especially in the construction industry; declining government budgets; and, perceived environmental and health concerns.

Following is a brief description of each ground rubber submarket:

RUBBERIZED ASPHALT CONCRETE AND OTHER PAVING

California ground rubber producers supplying RAC projects uniformly report that the RAC market has not only maintained its strength, but appears to be growing. In 2009 about 60 million pounds of ground rubber, derived from approximately 4.6 million PTEs of waste tires, were used in rubberized asphalt concrete (RAC), chip seal, and other paving applications. This reflects an increase of about 7 percent from 2008, which in turn was about 10 percent higher than the volume in 2007. 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 RAC. These processors are often subcontractors on Caltrans or local government paving contracts.

The main RAC consumer in California is Caltrans, and the department's usage has increased markedly in recent years. Caltrans is required by statute to increase the percentage of all flexible pavements that use RAC to 25 percent by 2010 and 35 percent by 2013. In 2008, Caltrans used approximately 3 million PTE in RAC projects, down from 3.8 million PTE in 2007, for a reported use rate of use of 27.2 percent, down slightly from the 29 percent rate reported for 2007. With substantial support from CalRecycle augmenting a strong legislative mandate, Caltrans' RAC use is becoming quite common. Caltrans has made RAC the material of choice when considering flexible pavement alternatives. Caltrans requires that all rubber used in RAC projects be derived from U.S.-generated tires (not just California-generated tires), so ground rubber imported into the U.S. is not eligible for use in Caltrans projects. RAC is also used by local governments, sometimes with financial grant support and technical assistance provided by CalRecycle. While firm estimates are not available, there is reportedly growing acceptance of RAC by local agencies, although budget constraints are severely limiting paving activity of any kind currently. ARRA funding has been especially helpful to the RAC ground rubber market.

Most processors and others involved in RAC believe future demand will likely remain strong, although if an economic rebound does not occur and additional stimulus funds are not made available, there is a threat that demand could soften in the short term.

SYNTHETIC TURF AND ATHLETIC FIELDS

The statewide use of ground rubber in synthetic turf and athletic fields in 2009 is estimated at 17.5 million pounds, equivalent to 1.3 million PTEs, which marks a 45 percent decline from 2008

levels. While some ground rubber producers report that sales to the synthetic turf and athletic field markets are rebounding in 2010, most indicate that this market segment may be poised for rapid decline as the industry shifts to alternative infill materials.

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.

Notwithstanding last year's decline, demand in synthetic turf and athletic field applications had grown steadily in recent years, and many in the industry expect growth to continue through 2010. According to the Synthetic Turf Council, more than 5,500 synthetic turf fields have been installed nationally, with 1,000 installed in 2008 alone. The organization had predicted that 2009 installations would remain flat, but no estimate of actual installations is currently available. Although initial costs are much higher than for natural turf fields, advantages include longer life, greater durability (e.g., more playing hours), and reduced maintenance and watering costs.

Some manufacturers/installers 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 CalRecycle has commissioned a study by the Office of Environmental Health Hazard Assessment that is due for completion later 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. Some market players have mentioned that the search is on for such substitutes.

LOOSE-FILL PLAYGROUND SURFACING, BARK AND MULCH

In this report, for the first time, the loose-fill playground surfacing market segment has been combined with the bark/mulch segment. This is because the two segments use material of the same specification and it is difficult for some producers to separate sales to the two different segments. In 2009, about 16.7 million pounds of ground rubber derived from approximately 1.3 million PTEs were used in loose-fill playground surfacing applications or sold as bark or mulch for landscaping and other applications in California, a 12 percent increase over the estimated levels in 2008. This material is generally of ¼- to ¾-inch size is colorized and used to replace wood bark and other playground surfacing materials or in a variety of landscaping applications.

Loose-Fill Playground Surfacing

Two ground rubber producers expressed some concerns about the loose-fill playground surfacing market, with at least one project being halted due to community concerns related to purported health concerns. According to stakeholders, this market segment may be more dependent upon CalRecycle grant funding than other segments, because municipalities and school districts, most of which have tight budget constraints, comprise a large portion of this market.

Loose-fill playground surfaces are marketed and installed in California by several firms based both in-state and out-of-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 artificial turf products (discussed above) sometimes arise with rubber bark, mulch, and loose-fill playground surfacing as well, indicating this issue could potentially constrain sales in coming years.

Bark/Mulch

Bark/mulch is the same material as that used in loose-fill playground surfacing, 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 Walmart, and this has contributed to significant market growth in recent years, especially on the East Coast.

Some industry observers have stated that West Coast demand for bark/mulch has yet to catch up to the very high levels seen on the East Coast, and the fact that sales increased during an otherwise down market may illustrate potential for growth.

Rubber bark/mulch benefit 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/mulch 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 CalRecycle policies requiring that California rubber be used whenever state funds are involved, which has generally resulted in higher ground rubber prices. Many in the industry feel that the bark/mulch market segment has substantial room for growth in coming years.

POUR-IN-PLACE/OTHER PLAYGROUND SURFACING

In 2009, about 3.8 million pounds of buffings, derived from about 300,000 PTE of truck tires, were used in pour-in-place playground surfacing applications, a 33 percent decrease from the estimated amount in 2008, which was up 70 percent over 2007. This amount 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.[6)] In this application, buffings are combined with a urethane binder and generally a virgin ethylene propylene dimonomer (EPDM) rubber surface layer to produce a bound surface.

Many of the loose-fill playground surfacing installers described above also install pour-in-place surfacing products. One market indicator is the shift in the supply-and-demand balance for buffings over the past 18 months. While in 2008 buffings were in short supply with material commonly shipped across country to meet demand, currently some firms report high inventories of buffing with pricing much lower than in recent years.

Pour-in-place markets benefit from the general tire-derived product benefits described above, although they do not qualify for CalRecycle grants unless they are made with buffings derived from California 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, and given its bound state is less vulnerable to concerns about fire and other health and safety factors. Partly for this reason, it has been suggested by stakeholders that the overall market for pour-in-place playground surfacing may exceed loose-fill playground surfacing.

MOLDED AND EXTRUDED PRODUCTS

In 2009, about 10.8 million pounds of ground rubber, derived from about 800,000 PTEs, were used to produce molded and extruded products, a 30 percent decrease in the estimated volume since 2008. 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 were several anecdotal reports of high inventories in this sector. On the other hand, CalRecycle's TBAP program has seen recent success in assisting some grantee product manufacturers to expand use of ground rubber in molded products, and this may bode well for the future of molded and extruded products.

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 and new product development 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

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

high-value products that command a higher price in the marketplace. 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.

OTHER GROUND RUBBER APPLICATIONS

In 2009 about 1.6 million pounds of ground rubber was derived from about 100,000 PTEs and used to make a variety of products, including horse arena material, products used in ballistics applications, and buffings from truck tires used in products other than pour-in-place surfacing. Comparison with previous years is difficult for two reasons. First, the horse arena category, which was previously broken out as a separate category, was combined with the "other ground rubber" category for the 2009 report. Second, previous reports included unspecified uses in the "other" category that could not be documented, but in the current report only a small amount of "other" was identified. Because the total amount is small in comparison to other ground rubber categories, this uncertainty is unlikely to impact the findings discussed above for ground rubber market segments.

Civil Engineering

Civil engineering applications used about 1.8 million PTEs in California during 2009, a 38 percent decline from the estimated volume in 2008. However, as discussed below, landfill civil engineering definition and reporting adjustments may account for a portion of this decline. 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 TDA 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, and in some applications can result in the need for fewer project inputs (such as steel and concrete) due to its lighter weight, resulting in reduced costs for the project;
- It 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 TDA 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 2009 an estimated 1.4 million PTEs were used as TDA in civil engineering applications at landfills, a 32 percent decrease from the amount reported in 2008. However, these landfill civil engineering use estimates should not be used as a benchmark for evaluating future progress as they were necessarily based on reported usage that could not be validated by CalRecycle, and which in some cases may not be consistent with CalRecycle-defined civil engineering applications. CalRecycle intends to define specific landfill civil engineering applications for the purpose of reporting and to establish a confirmed baseline when conducting the 2010 market analysis in early 2011. Tonnages reported by processors, landfill surveys, and through CalRecycle's disposal reporting system are often inconsistent, and there is consequently a need for greater standardization, guidelines and verification. Notwithstanding this, only one specific change in reporting/definition approach between 2008 and 2009 occurred—reported use of about 130,000 PTEs in tire bales used in stabilization applications at one landfill that were counted as civil engineering in 2008 were excluded in 2009. Further, one large landfill that regularly reports very high usage of civil engineering TDA states that tonnages may decline somewhat until 2012 when they expect to launch new landfill cell construction projects. This suggests that the overall activity has, in fact, declined. However, CalRecycle has identified landfill TDA applications as a priority and plans to increase financial, educational, and technical assistance to expand use of TDA in this application. Given the number of landfills that could potentially use TDA, there is a good possibility that the number of waste tires used in this application will expand in coming years.

The range of TDA uses at landfills includes leachate collection and redistribution layers, gas collection layers, and landfill road construction, generally replacing rock aggregate materials. The specification of TDA used in these applications varies, and sometimes a rough shred with a forgiving specification can be used. Landfill TDA is a low- or no-value-adding market. Processors delivering TDA 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.

Use at a single landfill may vary tremendously, but can exceed 1.5 million PTEs 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 TDA, its use can increase as facilities expand or decrease abruptly as they adjust operations and/or close.

However, as aggregate prices increase as a result of the shortage of new aggregate supplies, the market for TDA use in landfill applications could increase in coming years. A landfill can benefit from TDA use by reducing its costs for aggregate and by taking advantage of the availability of waste tires and the need for beneficial use opportunities. In some cases, landfill engineers lacking experience with TDA may be reluctant to use it, and there may be some situations when it is not appropriate or is prohibitively expensive due to long hauling 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 2009 about 400,000 PTEs were used in non-landfill civil engineering applications in California, mainly in a single transportation project in Santa Rosa, which is a decline from about 700,000 PTEs used in several projects in 2007.

As with landfill civil engineering, non-landfill applications may involve a small number of relatively large projects. Especially as CalRecycle continues its efforts to boost Caltrans' and others' use of tire-derived aggregate, abrupt increases or decreases in use are likely to occur. Non-landfill applications include the use of TDA in landslide stabilization projects by local governments, use by regional Caltrans offices as lightweight fill in retaining wall projects, and use of TDA as vibration dampening for light-rail trains. In situations where the material qualities of TDA 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 TDA in residential and commercial septic systems is widespread. In contrast to landfill TDA applications, TDA 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 mainly limited to date to state-sponsored projects conducted by Caltrans contractors and a handful of local government projects, all conducted with considerable financial and/or technical support from CalRecycle.

Despite the relatively small amount of TDA used to date in these applications, 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 TDA can offer clear price and performance benefits over traditional aggregate in some situations, some challenging barriers are hindering its large-scale use. These include:

- **Storage and Supply**—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 TDA is not widely used in California, some decision-makers and engineers may be reluctant to use TDA.
- **Price**—TDA does not always provide the lowest-cost solution to aggregate needs, for example in situations where low-cost rock aggregate is suitable and locally available. However, its light weight and corresponding low density provides advantages that do provide relative cost benefits in some cases, especially in applications where lightweight fill is called for.
- **TDA Suppliers**—A few processors have stated they are interested in being a large-scale supplier of TDA. 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, CalRecycle is making a significant investment in TDA 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 TDA market could grow in coming years to be a major use of California waste tires.

Alternative Daily Cover

In 2009, approximately 1.2 million PTEs were shredded and used as alternative daily cover (ADC) in landfills, a 42 percent decline from the amount reported in 2008. While this segment is subject to some of the same measurement challenges discussed for landfill civil engineering above, the declining trend is clear, although use is expected to stabilize in 2010. Tire shreds are 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 have zero cost for delivering tire shreds to landfills for use as ADC.

Four landfills reported using tire shreds as ADC in 2008, with the vast majority of tonnage occurring in Northern California. Like landfill civil engineering projects, tire shreds for use as ADC face 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 PTEs.

Other Recycling Uses

In 2009 about 100,000 PTEs were used in a variety of applications classified in this report as "other recycling," about the same quantity reported in 2008. Products in this category include rings cut from truck tires used to weigh down agricultural film plastic 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, waste tires are used as tire-derived fuel (TDF) in two applications: cement kilns that often burn coal or coke and cogeneration facilities producing electric power generally from biomass. At the national level, use of TDF in pulp and paper mills has increased significantly in recent years, but California has no pulp and paper mills permitted to use TDF. In 2009, about 7.0 million PTEs went to TDF facilities, a 7 percent decrease from 2008.

CEMENT PLANTS

In 2009, about 6.4 million PTEs were used as TDF in California cement plants as a fuel source, an apparent slight decline from the 6.7 million PTEs reported in 2008. However, this estimate for California tires consumed was adjusted downward by about 360,000 PTEs to account for estimated imported tires that were ultimately used as TDF in California (See imports and exports section below). Most cement plants use whole tires, which they may receive with no revenue or at no cost, or for a small tip fee. One California plant uses processed waste tires for which they must pay.

In 2009 there were five California cement plants using TDF. Of these, four used more than 5.2 million PTE of whole tires. One of these plants shut down in late 2009 and one other plant is operating only intermittently. While some of this production has reportedly been shifted to other plants, 2010 is expected to see a reduction by approximately 1 million PTE in the amount of tires used as TDF in cement plants. One additional plant uses processed TDF. Several of the plants

have indicated a desire to increase TDF use, even above historic levels in some cases, if and when the economy rebounds and demand for cement increases.

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

A major threat to cement plant TDF use, and by extension to California waste tire diversion rates, is the proposed U.S. EPA rule that would redefine use of whole waste tires as MSW, triggering vastly less favorable economics of TDF use and the need to secure costly new permits. This rule would take effect in 2013 and has the potential to substantially decrease, if not eliminate, use of TDF by California cement plants that rely on whole tires. The public comment period on the rule has been extended into early August 2010.

COGENERATION

In 2009, about 600,000 PTEs were used as TDF by one California cogeneration facility, a 30 percent decline from 2008. However, as with cement plants, it appears that the decline in TDF use by cogeneration plants may have stabilized, with an official at the one remaining plant that is using TDF stating that they plan to continue doing so at current levels.

Disposal

In 2009 about 11.3 million PTEs were disposed in landfills, an 8.5 percent decrease from 2008. This estimate is based on analysis of 23 landfills identified as accepting tires through surveys, CalRecycle's Disposal Reporting System and the Waste Tire Manifest System (WTMS). For the first time, the 2009 estimate includes a downward adjustment (of about 630,000 PTEs) to account for estimated imported tires that found their way into California disposal facilities. The primary factor leading to a reduction in waste tire disposal is reduced overall waste tire generation. However, there is anecdotal evidence that the increase in waste tire exports is pulling some tires directly from disposal, especially in Southern California.

Landfills remain the ubiquitous "market" of last resort, and continue to consume more California waste tires than any other single end use. The Azusa landfill in Southern California, in particular, receives more than 70 percent of all disposed tires in California. Factors that tend to drive the disposal of waste tires include: favorable economics due to proximity, or in some cases, preferred tipping rates; insufficient demand for tire shreds at an acceptable price; lack of processing capability to produce higher value diversion products; and the inertia resulting from 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, they also are shipped to many different parts of the

world, including other Latin American countries, India, and Asian nations. No estimate of the number of used tires imported into California is available, although relatively small quantities are likely shipped from neighboring states.

In 2009, used tire exports from California were estimated to be 1.8 million PTEs, up from 1.5 million PTEs in 2008. 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-$8 each, 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 due to 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 was to be enacted.

WASTE TIRE IMPORTS AND EXPORTS

Until 2007, 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 into Oregon, Nevada, and 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 PTEs. In 2008, the estimated quantity exported increased to about 2.2 million PTEs. This trend continued in 2009 with an estimated 3.3 million PTEs exported, primarily to Asian countries. (See the 2008 Scrap Tire Market Report for a more detailed discussion of export trends and factors driving demand in China in particular.) Anecdotally, waste tire exports appear to be continuing to grow in 2010 and could continue to expand significantly in the coming year.

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 waste 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 while some processors and others have called for CalRecycle to take action to reduce or stop exports, CalRecycle does not have any authority over export regulations and is limited to its role in regulating the shipment and management of waste tires in California. Issues raised include questions about verifying how waste tires are used, environmental controls at tire-derived fuel and other facilities, and concerns that exporting waste 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 foreign countries develop their own waste tire recovery systems. This is roughly the situation that American plastics reclaimers have found themselves in today. Some processors who compete with exporters have raised concerns that the delivery of whole waste tires to ports does not comply with established regulations. CalRecycle staff is currently analyzing this issue, but it is clear that CalRecycle does not have the authority to either allow or disallow exports beyond its role in ensuring that waste tire shipments adhere to current regulations. .

While difficult to predict in detail, demand for waste tires in the export market is likely to continue to increase, though the pace of increase may moderate in comparison to the past two years of rapid growth. To date, it appears that increasing exports have not steered waste tires away from high-value markets such as reuse and ground rubber. Based on changes in certain processors reported flows between 2008 and 2009, it does appear that some waste tires previously sent to disposal in Southern California and to alternative daily cover in Northern California are now being sent to the export market.

In addition to other countries, some California waste tires were also exported and imported to other states. Based on processor estimates, waste tire imports into California in 2009 totaled about 1.5 million PTEs, up from the 0.5 million PTEs reported in 2008. Import 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. 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.

As discussed in detail in the 2008 Scrap Tire Market Report, ground rubber and buffings from retread operations are also imported and exported from and to California. While imported ground rubber competes with in-state production, and sometimes benefits from subsidies (e.g., in British Columbia, Alberta, and Utah), to date there have not been widespread complaints that these producers are out-competing California producers. If demand continues to soften with increased production capacity across the continent, however, that situation could change and a supply glut could lead to far more aggressive competition, with subsidized producers at a relative cost advantage over California producers. Moreover, some have observed that while California does not provide a direct per-ton subsidy, the state does support certain segments through a variety of means, including grants to local agencies purchasing TDPs and technical assistance and loans to producers and processors.

Conclusions

Given the magnitude of the recent recession and continuing weakness in the economy, the California waste tire industry entered 2009 in a relatively strong position, with good markets, a robust and expanding processing infrastructure and sufficient state resources for market development programs. Trends into 2010 indicate that there is a good chance that the industry may weather the economic storm well, with some key market segments like RAC and bark/mulch continuing to grow despite the economic downturn. With a relatively significant recent increase in ground rubber production capacity, if the economy does rebounds and potential market threats do not materialize, ground rubber could expand significantly yet again and resume its growth curve of the past several years.

Although it has declined somewhat, TDA may be poised for growth given that several applications are now viewed as "proven" and potential users are increasingly aware of the benefits. Among the potential threats to California's waste tire markets, the U.S. EPA's proposed rule to redefine whole tire TDF as MSW could have the largest and most clearly negative impact, with up to 5.2 million PTE of demand in 2009 in jeopardy beginning in 2013.

CalRecycle has conducted a detailed review of its waste tire market development program over the past year, and will use the findings from the effort to target and optimize its efforts, as will be reflected in the upcoming Five-Year Plan planning process due to be complete in spring 2011. The Program Evaluation Report includes 25 recommendations for CalRecycle consideration that are intended to optimize current efforts. The main elements involve expanding outreach and education, increasing coordination across programs and targeting top priority market segments, identified as RAC, bark/mulch, molded products, and civil engineering applications. Despite the lingering slow economy, California seems well poised to regain momentum in diversion expansion and diversification, although threats loom that merit continuing scrutiny.

Appendix A
Methodology and Data Limitations

This appendix briefly summarizes the methodology used for this report, the level of accuracy and sources of uncertainty, and differences with previous CalRecycle 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 waste tire flow studies generally. Exceptions to this general statement include retreads, for which a static estimate of 4.4 million PTEs has been used for the past four years due to challenges in firming up the estimate, and landfill civil engineering, for which some reported estimates could not be validated. CalRecycle intends to refine the methodology used for these segments for the next market analysis to be conducted in early 2011. This is consistent with a general trend toward increasing accuracy and refinement in CalRecycle market studies over nearly two decades. While adjustments to the methodology can complicate comparisons, they ultimately provide increasingly more useful information to help guide CalRecycle and private sector market players.

The estimates cited in this report are based on surveys, interviews, analysis of data in CalRecycle'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 CalRecycle typically use a standard conversion factor of 20 pounds per tire, even though waste 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; and 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, CalRecycle estimates that approximately 25 percent of comprehensive trip log (CTL) reports have errors.

- **Un-Manifested Flows and Off-the-Books Transactions—**Some tire flows are not manifested, either due to CalRecycle-approved exemptions or through failure to submit required CTLs. 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 Output**s: 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 waste tire inputs to make them were received. Due to softening demand, inventories were reported to generally be much greater than usual at the end of 2009 as firms sought to move materials into a market place weakened by the severe recession.

- **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.
- **Interpretation of Market Segment Definitions and Requested Data—**While every attempt is made to clearly explain data requested through surveys, it is possible that in some instances respondents are interpreting categories or units differently. For example, in this report the categories of loose-fill playground and bark/mulch have been combined because of past confusion over these market segments which use material with the same specification.
- **Waste Tire Generation vs. Documented Flow—**It should be noted that this report does not attempt to explicitly estimate waste tire generation. Rather, the total generation figure presented in Table 2 represents the total documented flow of waste tires, which is thought to represent a very high percentage of actual generation in the study years.
- **Tire Diversion Rate Not Adjusted for Residuals—**As with many other state and national tire recycling market studies, in this report the tire diversion rate is not adjusted for steel and fiber residuals that occur as a result of producing ground rubber. While these materials are often recycled, to date the project team has chosen not to comprehensively gather this data in order to simplify the survey process. This will be revisited for the 2010 analysis and stakeholder input is welcome.

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 CalRecycle staff through 2006. However, there are some key differences that complicate direct comparisons with these earlier market reports, 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, TDP 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 waste 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 CalRecycle reports.

Finally, this analysis of 2009 waste tire flows reflects additional adjustments compared to the 2008 analysis, including:

- **Adjustments for Imports—**The 2008 Scrap tire Market Report used a CalRecycle staff estimate for waste tire imports that was based on WTMS data. This 2009 analysis uses data provided by two processors that reported receiving imports. This allowed imports to be allocated across all of the market segments these processors sent material to, resulting in relatively small reductions in the amount that otherwise would have been reported for certain segments.

- **Redefinition of "Other Ground Rubber"—**This category was redefined to include horse arena material, which was included as its own category in the 2008 analysis.
- **Combined Loose-Fill Playground and Bark/Mulch**—These two categories were combined for this report, both in reporting 2009 flows as well as presenting 2008 and 2007 flows for comparison.
- **Landfill Civil Engineering Applications—**Use of waste tire bales at one landfill were counted as civil engineering in 2008, but not in 2009. CalRecycle intends to clarify reporting guidelines and protocols for landfill civil engineering activity for the 2010 market analysis report, which will be prepared in early 2011.
- **Retreads—**This report assumes the same volume of retreading as the previous three market reports. However, a range of options for evaluating retreads were considered. While the approaches each produce a different estimate of retreading activity, they tend to converge on the 4.4 million PTE estimate used in this report.