California Waste Tire Market Report: 2018

Contractor's Report Produced Under Contract
By Boisson Consulting, Recycling Industry Development

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BOISSONCONSULTING
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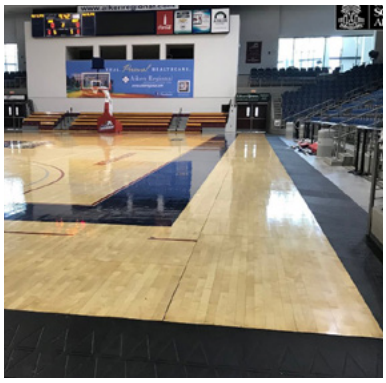

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In memory of

Richard Snyder, President and CEO, U.S. Rubber Recycling, Inc.

and

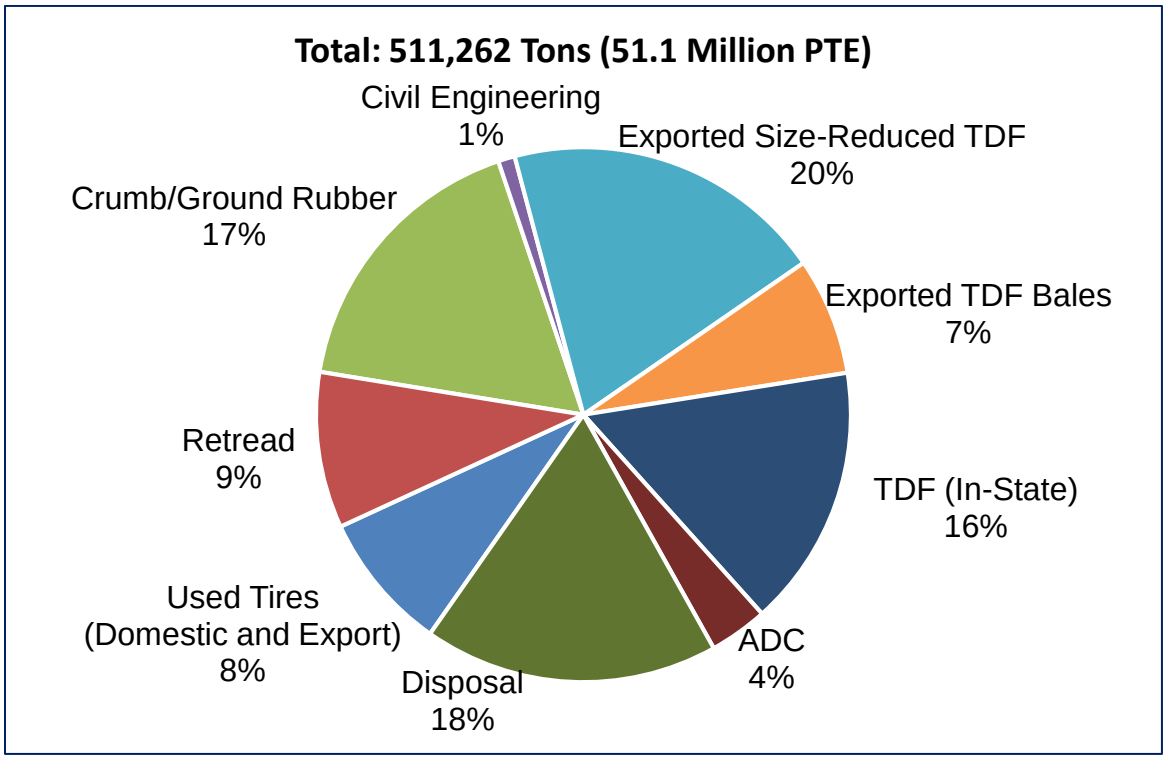
Robert Davis, President and Managing Director, Rubber Recovery, Inc.

1. Summary

This report summarizes California waste tire flows to different uses in 2018 and current trends as of spring 2019. The estimated flows are based on detailed analysis of information from California waste tire management companies, CalRecycle databases and other sources. Notwithstanding data gaps and inconsistencies, the authors believe this report, along with previous annual versions, provides reasonably accurate information that can be used to evaluate California's waste tire market trends over time.

In 2018, an estimated 511.3 thousand tons (51.1 million PTEs[1]) of California-generated waste tires were managed, a five percent increase over 2017 and the fourth straight annual increase, reflecting a strong economy and marking a break from the more-or-less stagnant waste tire quantities that prevailed after the 2008 financial crisis. California waste tires flowed to nine different market segments as shown in Figure 1.

Figure 1
California Waste Tire Flows in 2018

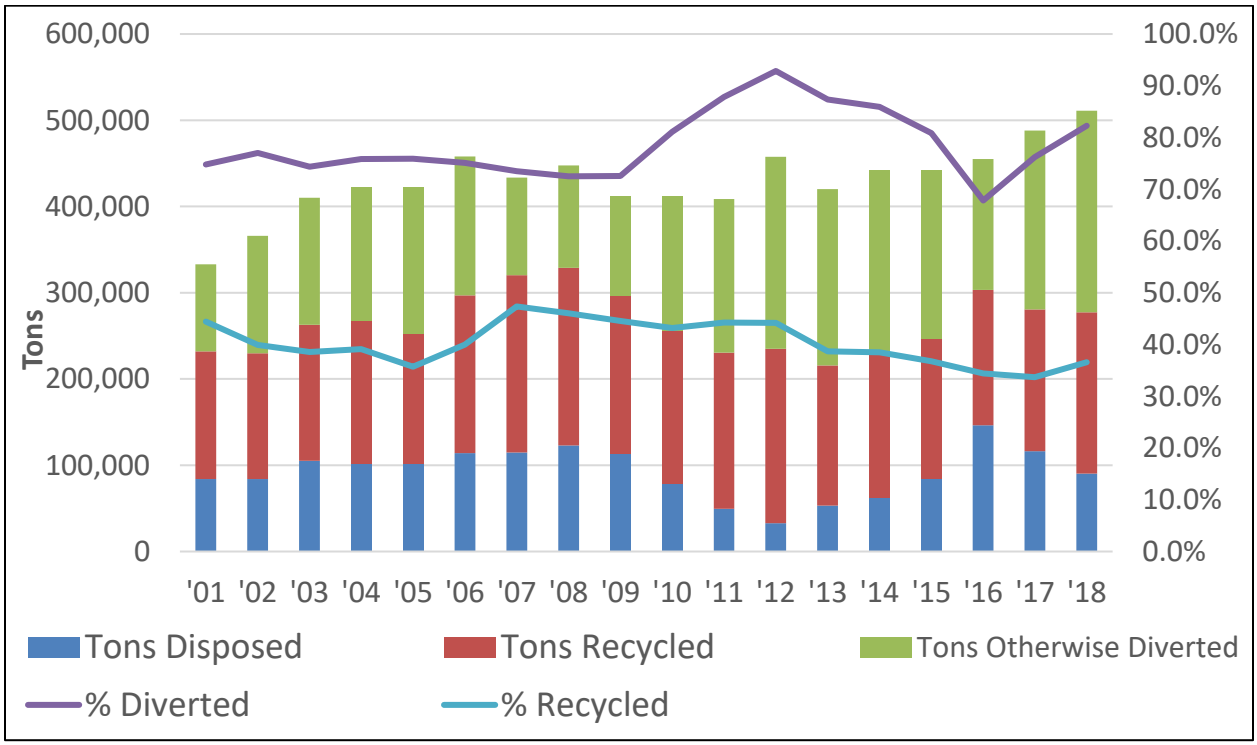


See source data for Figure 1 in Appendix C.

[1] PTE means Passenger Tire Equivalent, defined by CalRecycle (14 CCR § 17225.770) as 20 pounds. The PTE is useful for reporting purposes; but in practice passenger tire weights are often higher and waste tire weights vary significantly by tire type.

Figure 2 shows the 18-year trend for waste tire diversion, recycling, and disposal. After falling for four straight years and hitting a low of 68 percent in 2016, the diversion rate (including all uses other than landfill) increased for the second year in a row, from 76 percent in 2017 to 82 percent in 2018. This was led by surging tire-derived fuel (TDF) exports that increased by 19 percent to 135.2 thousand tons (13.5 million PTEs). TDF

Figure 2
Historical Waste Tire Recycling, Diversion and Disposal Trend[2]



exports were mainly to Japan, Korea, and India as Vietnam halted imports of baled tires early in 2018. Crumb/ground rubber production increased 29 percent and consumed an estimated 87.7 thousand tons of waste tires (8.8 million PTEs). Reuse was slightly up, accounting for 90.6 thousand tons, including about 47.9 thousand tons to retreading (a slight drop from 2017) and 42.6 thousand tons of used tires (an estimated three percent increase from 2017). There was a corresponding 22 percent drop in landfill disposal to

[2] Sources: 2002–2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007–present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary somewhat year- to- year as discussed in Appendix B. See Appendix C for chart source data. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25

90.5 thousand tons or 9.1 million PTEs. Use of tire-derived aggregate (TDA) in civil engineering projects dropped by 20 percent to 5.2 thousand tons (0.5 million PTEs). In addition, use of tire shreds as alternative daily cover (ADC) dropped slightly to 18 thousand tons (1.8 million PTEs).

The waste tire recycling rate hit an eighteen-year low point of 34 percent in 2017 but increased to 37 percent in 2018, driven by a strong increase in crumb/ground rubber. Consistent with a statewide goal to recycle 75 percent of all waste materials by 2020 (as codified in AB 341, Chesbro, Chapter 476, Statutes of 2011), CalRecycle defines waste tire recycling to include reuse but exclude alternative daily cover and TDF.
Although there are both drivers and barriers/risks, California's waste tire diversion and recycling rates may be poised to increase more sharply in 2019. Waste tire reuse remains strong, notwithstanding long-term threats to retreading caused by low-cost imported tires that have not yet impacted total levels in California in a major way.

Crumb/ground rubber production could potentially grow steadily in the next few years. California now has a significant amount of under-utilized crumb rubber production capacity and strong drivers are expected to boost demand for crumb rubber in both paving and the molded/other market segments. Most importantly these drivers include increased infrastructure funding through the Road Repair and Accountability Act of 2017 (SB 1, Beall, Chapter 5, Statutes of 2017), local transportation funding initiatives, and CalRecycle's Tire Incentive Program (TIP). However, the increase in paving projects is so far incremental as state and local agencies prepare bid documents.

Use of crumb rubber as infill in synthetic turf athletic fields has declined from near 100 percent a few years ago to an estimated 60–80 percent in California currently due to perceived concerns over environmental health and safety. Some stakeholders voiced concern that two long-awaited studies, one conducted by the California Office of Environmental Health Hazard Assessment (OEHHA) and funded by CalRecycle and another conducted by the United States Environmental Protection Agency (U.S. EPA), may be delayed and may not yield findings that can definitively address concerns about crumb rubber that have been aired in the media.

Civil engineering is poised to grow in 2019. Based on projections for seven CalRecycle-funded projects and one additional landfill's projection, TDA could increase three-fold to about 16 thousand tons (1.6 million PTEs). This would be the highest amount since 2010.

Both in-state TDF and exported TDF market segments are strong and could see further growth. Demand for size reduced TDF mainly by Japan, Korea, and India remains steady with supplies coming from many parts of the world. Vietnam is expected to re-start accepting baled TDF soon, and demand for both sized-reduced and baled TDF by India is significant.

Subject to the barriers and risks noted above, the net impact of these trends could potentially boost diversion and recycling rates in 2019 and position California for continued strong diversion and further growth in recycling.

2. Introduction

Under Senate Bill 876 (Escutia, Statutes of 2000, Chapter 838) the Department of Resources Recycling and Recovery (CalRecycle) oversees management of waste and used tires.[3] CalRecycle aims to achieve a 75 percent waste tire recycling rate consistent with the requirements of AB 341 (Chesbro, Chapter 476, Statutes of 2011) that established an overall 75 percent recycling rate goal by 2020. Affiliated goals include:

- Developing long-term, sustainable, and diversified market demand for California tire-derived products (TDPs).
- Ensuring the protection of public health, safety, and the environment while developing a safe, high-quality supply infrastructure to meet that demand.
- Fostering information flow and technology/product development.

The Five-Year Plan for the Waste Tire Recycling Management Program guides CalRecycle's efforts; an updated version was adopted in May 2019.

This report summarizes California waste tire flows in 2018 and current trends as of spring 2019. Boisson Consulting prepared the report with research, analysis and editorial support by DK Enterprises and Louis Berger Group. Findings are based on detailed analysis of information from numerous sources, including industry surveys and interviews, CalRecycle's Waste Tire Management System (WTMS) and grant and permitting documents, Caltrans, and other published sources. Following this introduction, Section 3 covers California's waste tire management infrastructure. Section 4 describes trends by market segment. Section 5 analyzes the outlook for increased diversion and recycling, and Section 6 offers concluding remarks.

Appendix A provides a glossary of key terms. Appendix B summarizes the report methodology and limitations, including notes on how to interpret findings. Findings quantify use of California-generated waste tires in different market segments, and do not include buffings from retreaders or out-of-state waste tires or tire-derived materials (TDM) that may pass through California facilities. All data are converted to tons during the analysis; however, findings are also reported in PTEs to facilitate comparison with other reports. The authors strive to develop the most complete and accurate estimates for each market segment, while avoiding double counting. Notwithstanding various data gaps, data quality issues, WTMS data entry and conversion issues, and conflicting

[3] 30 Public Resources Code (PRC) § 42807 defines a "waste tire" as a tire that is not mounted on a vehicle and is no longer suitable for use as a vehicle tire due to wear, damage, or deviation from manufacturer original specifications. 30 PRC § 42806.5 defines "used tire" as a tire that: a) is no longer mounted on a vehicle but is still suitable for use as a vehicle tire; b) meets applicable requirements of the Vehicle Code and Title 13 of the California Code of Regulations; and c) meets specified storage requirements.

sources of information, the authors believe this report provides reasonably accurate information that can be used to evaluate California's waste tire market trends over time. Finally, Appendix C provides notes on select figures and source data for graphs and charts to make this report fully accessible to readers of all abilities in compliance with the American Disabilities Act, Government Code sections 11546.7, 7405, and 11135, and Web Content Accessibility Guidelines 2.0.

3. California Waste Tire Management Infrastructure

Figure 3 illustrates how waste tires and tire-derived material (TDM) flow to and from different types of facilities involved in California waste tire management.

CalRecycle records currently identify 1,330 registered, active waste tire haulers in California, although this number fluctuates regularly. These firms, some of which also operate processing facilities or play other roles in waste tire management, offer waste tire collection services to over 23,000 registered waste tire generators (i.e. tire dealers, auto shops) located throughout the state The haulers also deliver used tires and size-reduced TDM to end-use destinations.

Currently 24 California facilities have a minor waste tire facility permit, which allows up to a maximum of 4,999 tires on site. Sixteen facilities have major waste tire facility permits that specify higher maximums ranging from 10,000 to 336,300 PTE on site. These permitted facilities may perform their own hauling, arrange hauling with outside firms, and/or receive waste tires from independent haulers.

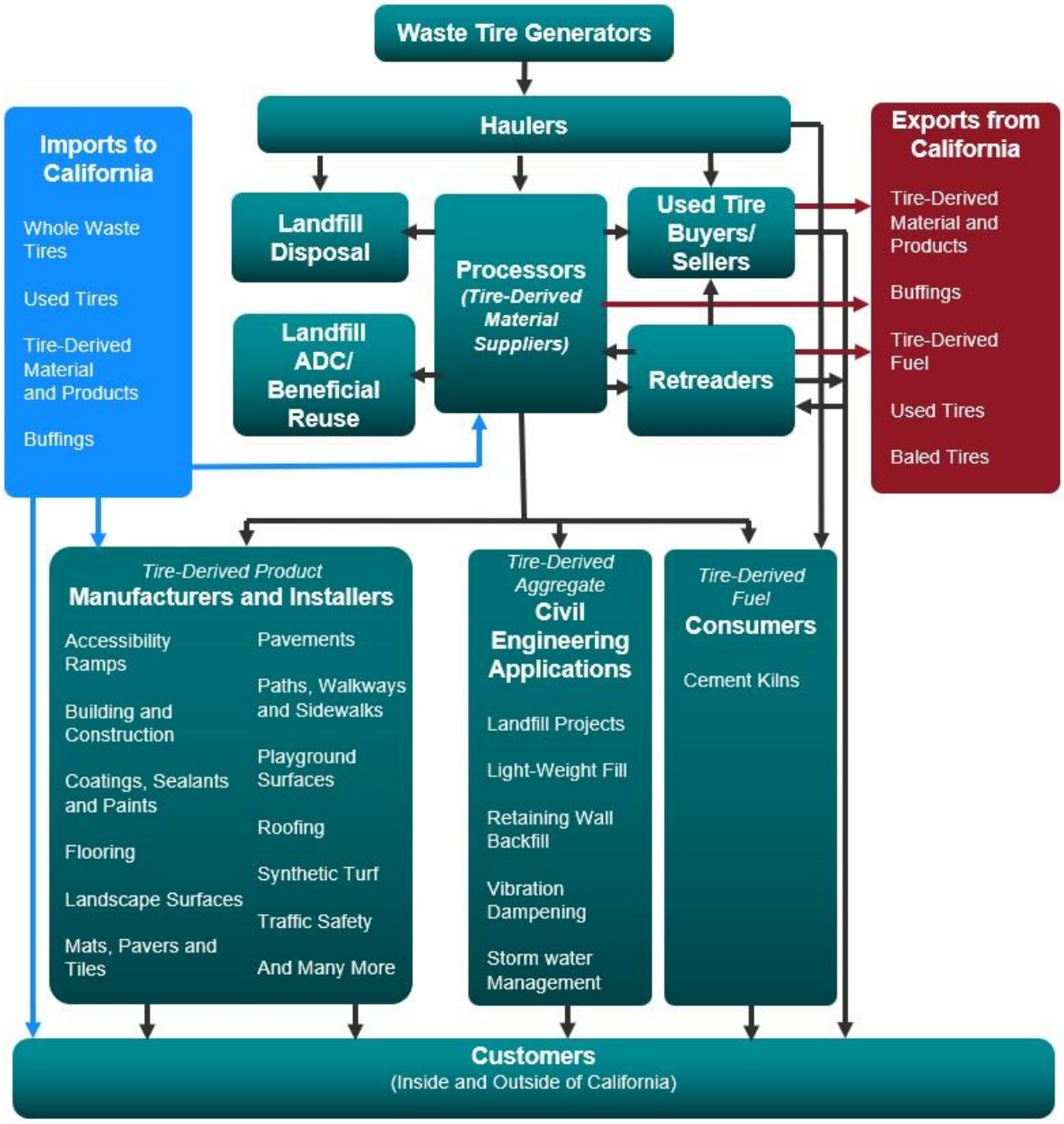
This study focused largely on analyzing flows to and from 21 facilities that managed over 80 percent of all California waste tires in 2018. The remaining 20 percent of waste tires were either culled by haulers or other processors to segregate used tires, hauled to one of three cement kilns using whole tire TDF[4] or to a landfill equipped to size reduce tires for disposal, or were casings destined for retreading. Flows to these markets were estimated through a combination of direct surveys, analysis of CalRecycle WTMS data and third-party data reports, or anecdotal information.

The 21 facilities that the study focused on shipped a mix of used tires and whole waste tires destined for use as TDF and/or TDM to a different range of market segments.

Fourteen facilities operating in 2018 have the capacity to produce size-reduced TDM of various specifications and therefore can ship to a variety of end markets. Eight of these TDM-equipped facilities have some level of capacity to produce crumb rubber and/or ground rubber, although in 2018 three of these facilities accounted for over 95 percent of such production in California. One new facility in 2018 is ceasing operations in 2019. Three other facilities reported minimal crumb/ground rubber production. Two additional permitted facilities in northern California have capacity to produce crumb rubber but have not yet begun production.

[4] A fourth cement kiln only accepts size reduced TDF meeting their specifications.

Figure 3
California Waste Tire Recycling Industry Flow Chart



Seven facilities were identified that engaged in baling and exporting whole waste tires in 2018, two in northern California and five in southern California (one of which ceased operations at the end of 2018). Because of the relatively low investment required to begin baling, new baling operations sometimes start up suddenly, and baling operations tend to close or establish new affiliations more frequently than other facility types.

Processing facilities derive revenue from the fees they charge to receive waste tires, and they compete to varying degrees for waste tire supplies. Some survey respondents reported concern that competition for waste tire supplies has reduced pricing and revenue streams in certain northern California areas.

Boisson Consulting identified 20 California tire-derived product manufacturers and installers that use California-sourced TDM, and an additional two California firms that are using TDM sourced from out of state. The firms currently using California TDM feedstocks produce a wide variety of products, such as roofing, flooring, waterproofing, and outdoor surfacing products. (This is not an exhaustive count of the many installers, distributors, designers and others that are involved in California's TDP industry, some of which may only use California-sourced TDM for in-state projects or upon request.)

In addition, several companies engaged in synthetic turf design, sales, and/or installation in California were identified, as were 16 companies that own asphalt rubber blending equipment and consume crumb rubber for use in various paving products and applications.

Thirty-nine retreaders were identified. While most handle truck tires, a few specialize in various types of airplane or industrial tires. The retread industry is very competitive and changes in business ownership through acquisitions and mergers are common.

Detailed information on California-made TDPs is available in CalRecycle's California Tire-Derived Product Catalog at https://www2.calrecycle.ca.gov/TDPCatalog.

In 2018, 19 landfills were identified that accepted waste tires or TDM. Of these, 15 reported disposing waste tires (although just seven landfills accounted for over 98 percent of total waste tire disposal). Five accepted TDA for use in civil engineering projects and three accepted tire shreds for use as ADC.

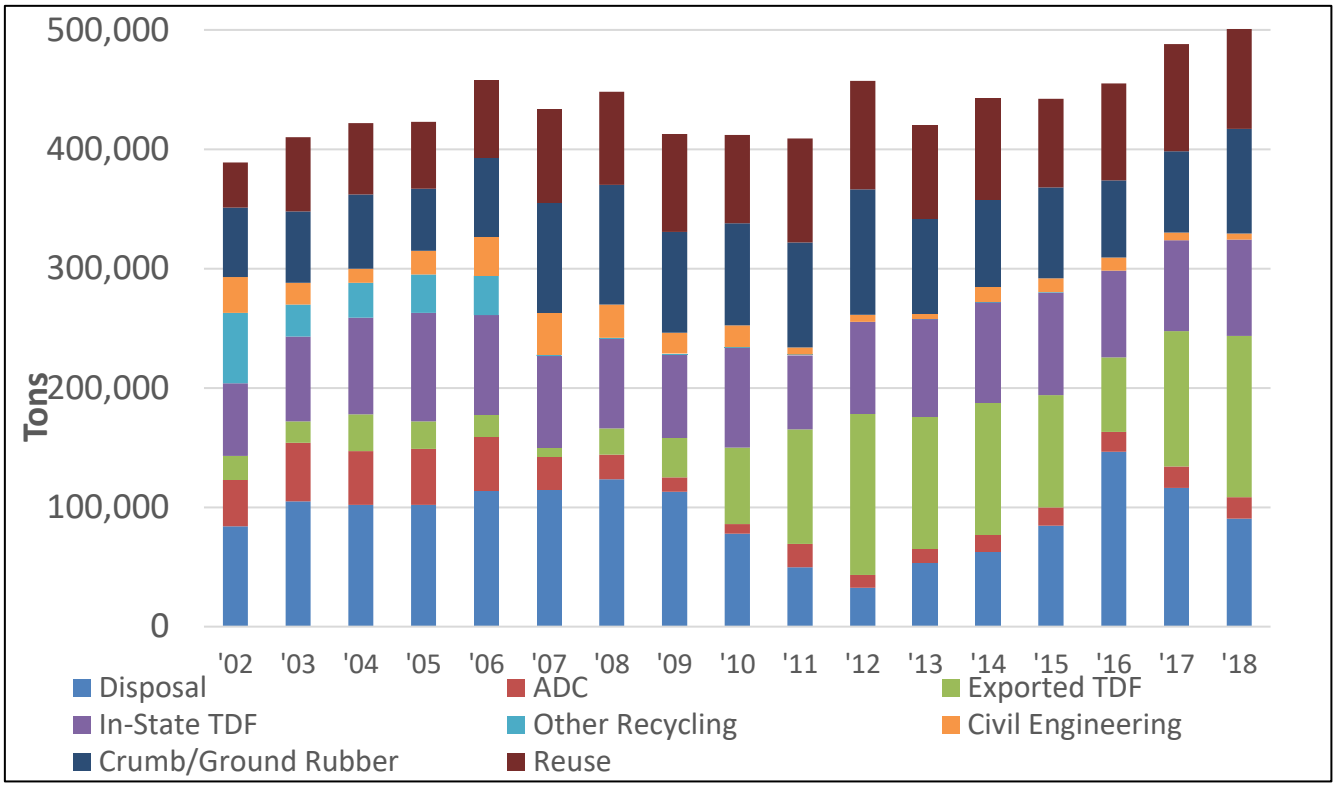
Companies periodically make inquiries about potentially setting up various types of waste tire management facilities in California, including crumb/ground rubber producers, pyrolysis operators, devulcanization operators, exporters, and a range of manufacturers and installers. CalRecycle and the California Governor's Office of Business and Economic Development (Go-Biz) provide these firms with referrals and publicly available information to assist them in evaluating opportunities.

4. Trends by Market Segment

Overview

Figure 4 shows the 15-year trend in use of California-generated waste tires, and Table 1 (on the next page) lists estimated flows and percentages in detail for the past three years.

Figure 4
Historical Market Trends by Segment[5]



[5] Sources: 2002–2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007–present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary somewhat year- to- year as discussed in Appendix B. See Appendix C for chart source data. All reports are available at http://www.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25 Due to changes in methodology over the years, findings between older and newer years may not be directly comparable. Changes in methodology are discussed in Appendix B, and more details are available in the historical reports published by CalRecycle online at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

Table 1
Estimated End-Uses for California-Generated Waste Tires, 2016–2018

Category	Sub-Category	2016 Tons	2016 Million PTEs	2016 Percent of Total	2017 Tons	2017 Million PTEs	2017 Percent of Total	2018 Tons	2018 Million PTEs	2018 Percent of Total	Percent Change '17 – '18
Reuse	Retread	42,341	4.2	9.3%	48,409	4.8	9.9%	47,925	4.8	9.4%	-1%
Reuse	Used Tires (In-State)	30,510	3.1	6.7%	34,174	3.4	7.0%	34,512	3.5	6.8%	1%
Reuse	Used Tires (Export)	8,522	0.9	1.9%	7,202	0.7	1.5%	8,180	0.8	1.6%	14%
Reuse	**Subtotal**	**81,373**	**8.1**	**17.9%**	**89,784**	**9.0**	**18.4%**	**90,617**	**9.1**	**17.7%**	**1%**
Crumb / Ground Rubber		**64,408**	**6.4**	**14.2%**	**68,142**	**6.8**	**14.0%**	**87,740**	**8.8**	**17.2%**	**29%**
Civil Engineering	Landfill Applications	7,083	0.7	1.6%	5,583	0.6	1.1%	4,021	0.4	0.8%	-28%
Civil Engineering	Non-Landfill Applications	3,878	0.4	0.9%	853	0.1	0.2%	1,106	0.1	0.2%	30%
Civil Engineering	**Subtotal**	**10,961**	**1.1**	**2.4%**	**6,436**	**0.6**	**1.3%**	**5,127**	**0.5**	**1.0%**	**-20%**
Other Recycling		**0**	**0.0**	**0.0%**	**76**	**Neg.**	**0.0%**	**3,455**	**0.3**	**0.7%**	**NA**
Exported TDF	Size-Reduced TDF	47,476	4.7	10.4%	87,317	8.7	17.9%	99,197	9.9	19.4%	14%
Exported TDF	Baled TDF	15,000	1.5	3.3%	26,089	2.6	5.3%	36,039	3.6	7.0%	38%
Exported TDF	**Subtotal**	**62,476**	**6.2**	**13.7%**	**113,405**	**11.3**	**23.2%**	**135,236**	**13.5**	**26.5%**	**19%**
Tire-Derived Fuel (In-State)		**72,723**	**7.3**	**16.0%**	**75,989**	**7.6**	**15.6%**	**80,603**	**8.1**	**15.8%**	**6%**
Alternative Daily Cover		**16,798**	**1.7**	**3.7%**	**18,108**	**1.8**	**3.7%**	**17,975**	**1.8**	**3.5%**	**-1%**
Landfill Disposal		**146,429**	**14.6**	**32.2%**	**116,214**	**11.6**	**23.8%**	**90,508**	**9.1**	**17.7%**	**-22%**
Estimated Total Managed		**455,168**	**45.5**	**100.0%**	**488,153[6]**	**48.8[5]**	**100.0%**	**511,262**	**51.1**	**100.0%**	**5%**
Total Diverted from Landfill		**308,738**	**30.9**	**67.8%**	**371,940**	**37.2**	**76.2%**	**420,754**	**42.1**	**82.3%**	**13%**
Total Recycled		**156,741**	**15.7**	**34.4%**	**164,438[5]**	**16.4[5]**	**33.7%[5]**	**186,939**	**18.7**	**36.6%**	**14%**
Imported Waste Tires		55,253	5.5	12.1%	49,906	5.0	10.2%	26,934	2.7	5.3%	-46%

[6] These findings were adjusted somewhat from original values published in the 2017 California Waste Tire Market Report.

A number of trends are impacting, or potentially could impact, California's waste tire markets. These include:

A strong economy and growing population are increasing tire sales, waste tire generation, and consumer demand. After staying more or less flat for several years after the financial crisis of 2008, California waste tire management volumes increased by seven percent in 2017 and then by five percent in 2018. This is due in part to the steady growth California's economy has seen in recent years. According to the U.S. Bureau of Economic Analysis, California gross domestic product (GDP) grew by over four percent in 2014 and 2015, and by over three percent in 2016 and 2017.[7] According to the federal Bureau of Economic Analysis, in 2018 California's GDP grew 3.5 percent.[8] Although 2018 numbers have not yet been released, one report projected the 2018 growth rate may decline somewhat, to 2.5 percent.[9] Although California's population growth rate has declined to less than one percent in recent years, the state's current population of about 39.9 million increased by approximately 189,000 in 2018, representing a 0.5 percent growth rate.[10] Tire sales are increasing. Nationally, the U.S. Tire Manufacturers Association projected that 2018 tire sales would increase by 2.7 percent over 2017 to 325.2 million units,[11] a rate that was exceeded with a preliminary estimate of 329.4 million units.

Low unemployment rates and rising wages are impacting profitability and exacerbating the challenge of finding and retaining qualified employees. Several respondents have cited this issue.

Global trade trends and shifting trade policies have impacted some markets but the eventual extent of impacts remains uncertain. There are several related issues.

- China imports of low-cost truck tires are impacting retreading markets, although a system of elevated antidumping and countervailing duties and tariffs were

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[7] California Department of Finance Web Page accessed on April 20, 2019. http://www.dof.ca.gov/Forecasting/Economics/Indicators/Gross_State_Product/

[8] Bureau of Economic Analysis, accessed on June 12, 2019. https://www.bea.gov/news/2019/gross-domestic-product-state-fourth-quarter-and-annual-2018

[9] Los Angeles County Economic Development Corporation. "Economic Forecast and Industry Outlook." February 2018. https://laedc.org/2018/02/21/economic-forecast/

[10] California Department of Finance Press Release. May 1, 2018. http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-1/documents/E-1_2018PressRelease.pdf

[11] U.S. Tire Manufacturers Association Press Release. December 6, 2018. https://www.ustires.org/increase-expected-2018-us-tire-shipments-0

imposed in 2018. (Such measures had previously been tentatively adopted but then the U.S. International Trade Commission in 2017 surprised stakeholders by opting to not formally adopt them.)

- China's National Sword policies restricting a variety of scrap imports are not expected to impact future waste tire exports as China had already officially banned waste tire imports from the U.S. several years ago. But waste tire bales have continued to flow to China through Vietnam, albeit with some disruptions. In early 2018 Vietnam halted waste tire bale imports, although they are expected to open again in 2019. The reason for the stoppage is reportedly the need for Vietnam to secure a permit with China to import waste tires. This is apparently unrelated to Vietnam's recent restrictions on other types of scrap material such as plastics, which was triggered by rapidly growing imports of scrap materials of all kinds in the wake of China's National Sword policy.

- Some TDP manufacturers said they have difficulty competing with low-cost imported products from China (which may or may not be made from tires) and that increasing tariffs and/or trade restrictions with China may open opportunities for increased California-based production.

- Export of used tires to Mexico has continued steadily within the boundaries of a quota system that allows about 770,000 tires to be imported each year. Recent renegotiation of the North American Free Trade Association has reportedly not impacted this arrangement.

New California state and local infrastructure funding could strongly benefit the paving and civil engineering market segments. Adoption of the Road Repair and Accountability Act (SB 1, Beall, Chapter 5, Statutes of 2017) promises over $50 billion (over 10 years) in infrastructure spending, which could benefit paving and possibly civil engineering markets significantly. Several local infrastructure funding initiatives have also been adopted in recent years, strengthening this trend. A November 2018 ballot initiative (Proposition 6) that would have repealed the SB1 funding mechanisms was not approved by voters.

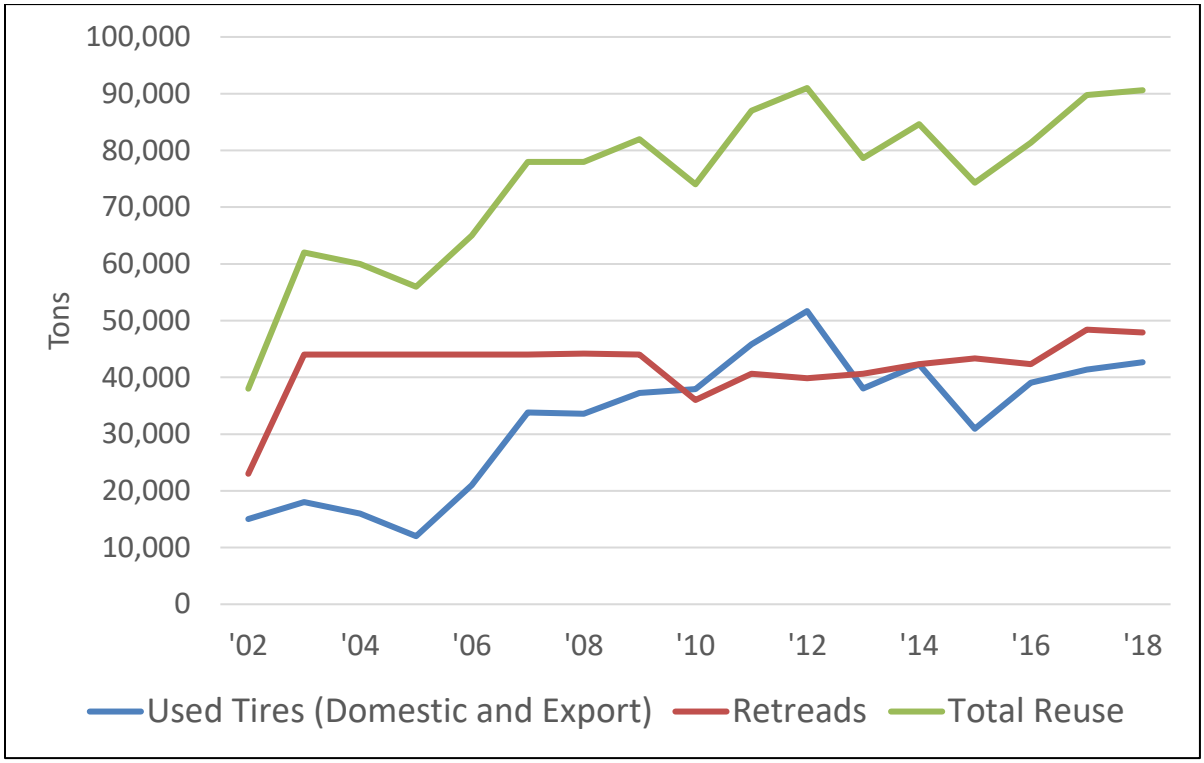
Two crumb rubber studies are underway, but there is uncertainty over the timing of their release and their potential role in addressing perceived concerns. Two long-awaited studies intended to address perceived concerns over crumb rubber used as turf infill and in playground applications are still underway. These include a CalRecycle-sponsored study being prepared by the California Department of Environmental Health Hazard Assessment (OEHHA) and a separate study by the U.S. Environmental Protection Agency (U.S. EPA). Some stakeholders expressed concern about whether these studies may be delayed and whether their design will yield findings that can definitively address concerns about crumb rubber that have been aired in the media.

As appropriate, the above trends and potential impacts are further addressed in the discussion of each market segment below. Section 6 describes some more far-reaching, long-term trends that could impact waste tire management over several years.

Reuse

As illustrated by Figure 5, both retreading and culling of used tires continue to be strong and profitable market segments that are relatively stable. Based on industry feedback and analysis of available data, total California tire reuse in 2018 is estimated at 90.6 thousand tons (9.1 million PTEs), a slight increase over 2017. Firms involved in these market segments continue to be concerned over large sales of low-cost, low-tier tires imported from China. These tires negatively impact reuse in several ways. First, some customers, especially small, independent trucking fleets, may be more likely to purchase low-price new tires rather than retread tires, even if they may be of lower quality. Second, these tires have a lower potential for reuse or retreading due to lower quality standards. As discussed further below, despite this trend we anticipate that the used tire and retread markets tires will remain strong and viable for the foreseeable future.

Figure 5
California Waste Tire Reuse: 17 Year Trend[12]



Retread Tires

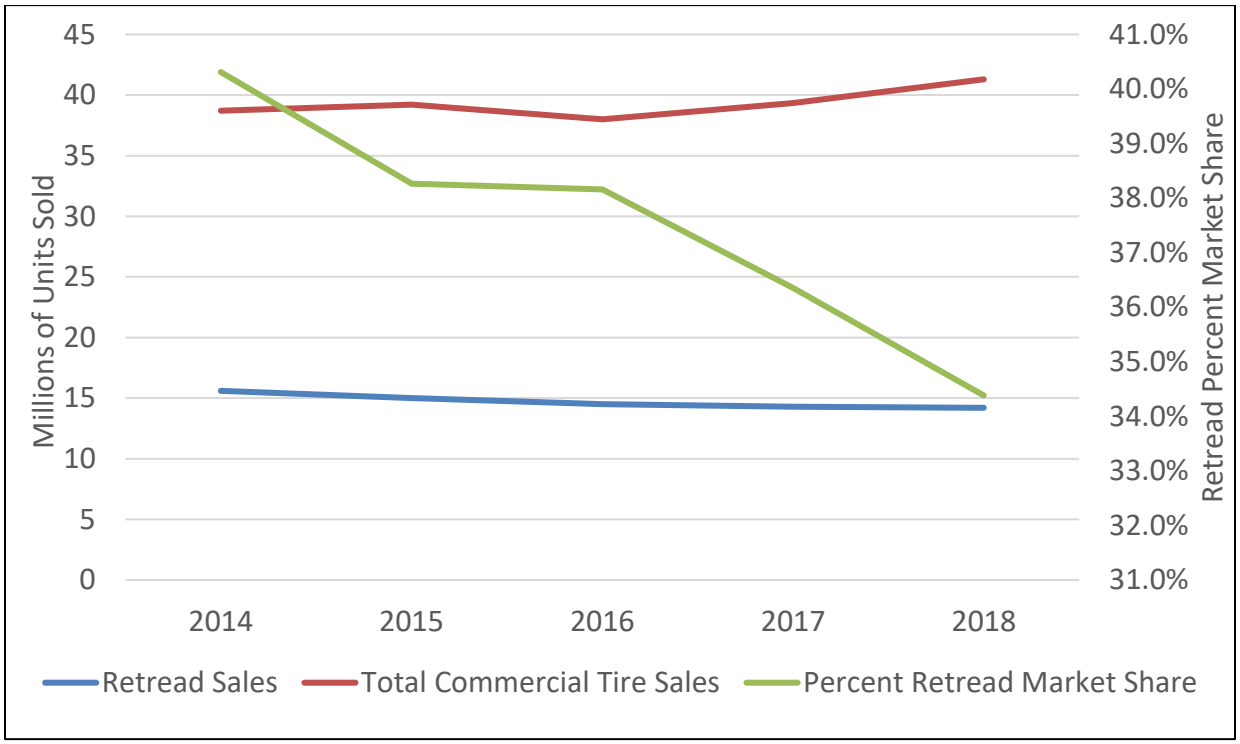
Based on stakeholder feedback, limited survey data, and national data, we estimate that the quantity of tires retreaded in California in 2018 declined slightly from 2017 at about 47.9 thousand tons (4.8 million PTEs). In 2018, 39 operating retreading facilities were identified. In 2017, survey responses suggested the average California retreading facility was utilizing only about 64 percent of its full retreading capacity. The industry is highly competitive and facility ownership and operations are constantly in flux due to mergers, acquisitions, start-ups, and closures. There is a general trend towards

[12] Sources: 2002 – 2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007 – present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. See Appendix C for chart source data. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25

consolidation, and nationally five companies now account for over 96 percent of the retreader market.[13]

Nationally, the retreading industry has been in a slow, steady stagnation for several years. As illustrated in Figure 6, the total quantity of retread tires has declined modestly from 15.6 million units in 2014 to 14.3 million units in 2018 with retread market share (i.e., the percentage of total commercial truck sales that were retreads) declining from 40.3 percent to 34.4 percent. Stakeholders point to strong sales of low-cost, low-grade truck tires from China as the main factor in this trend. According to one analysis,

Figure 6
National Trend in Retreader Share of U.S. Commercial Truck Tire Market[14]



between 1998 and 2016 the market share of ultra-low-cost new tires (mainly from China) increased from four percent to 17 percent while the number of retread plants in the U.S. and Canada declined from 1,123 to 668.

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[13] David Stevens, Tire Retread Information Bureau. "U.S. Retread Market and Ways Forward for the U.S. Retread Industry." Presentation to CalRecycle Tire Conference, August 2018.

[14] Source: Adapted from U.S. data from Modern Tire Dealer as presented by Clif Armstrong, Marangoni, at the Clemson University Tire Conference, April 2019. 2018 data is projected. See Appendix C for chart source data.

Despite these downward trends, California retreaders continue to report mixed results, with roughly half reporting sales declines and half reporting sales increases. While the net impact is difficult to quantitatively assess due to limited data, the project team relied on qualitative feedback and the national data above to estimate that California retreader volumes probably declined slightly from the 2017 estimate, which was based on a more robust survey response.

The U.S. tire and retreading industry has lobbied the U.S. government to remedy the harms they say are being caused by low-cost Chinese tire imports. In February 2017, the U.S. International Trade Commission surprised industry observers by not adopting tariffs that had been preliminarily imposed on select low-tier, low-cost Chinese truck and bus tire imports. While temporary, the initial imposed tariffs appear to have reduced the imported quantity, with Chinese tire imports declining from 9.4 million units in 2015 to 6.5 million units in 2017. But after the decision not to impose the tariffs was announced, Chinese tire imports again surged by over 42 percent to 9.2 million units in 2018.[15]

Now the tariff situation has again changed, although there is still considerable uncertainty over how the market will respond. In January 2019, the U.S. International Trade Commission reversed its 2017 opinion and determined that there was in fact injury to the U.S. tire industry because of Chinese imports. According to Rubber and Plastic News, the new decision will be reviewed by the U.S. Court of International Trade and, if upheld, the Commerce Department will issue orders to Customs and Border Protection to collect countervailing and antidumping duties against Chinese truck and bus tire imports.[16]

Used Tires

An estimated 42.7 thousand tons of used tires (4.3 million PTEs) were culled from waste tires flows and sold for reuse in 2018, slightly more than in 2017, with an estimated 19 percent of these being exported, primarily but not exclusively, to Mexico. Each year, Mexico establishes a quota limiting the number of used tires imported from California. According to data from the Mexico Secretary of the Economy, the 2018 authorized quota was 786,090 used tires of which 760,421 were imported. Reportedly, the failure to fully meet the quota was in part caused by new documentation requirements for importers.[17]

Reuse is buoyed by the relatively strong economy, with consumers choosing to purchase new tires or vehicles sooner than they otherwise might, leaving a larger pool

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[15] "U.S. Tire Trade Deficit Falls Again." Rubber & Plastics News, April 8, 2019. Page 3.

[16] "ITC Reverses Opinion in Chinese Tire Import Case." Rubber & Plastics News, February 11, 2019.

[17] Data provided by Reynaldo Rojo-Mendoza, School of Public Affairs, San Diego State University.

of used tires satisfying quality standards. Stakeholders generally said the quantity of used tires in the stream was up in 2018.

Crumb Rubber and Ground Rubber

Overview

In 2018, 87.7 thousand tons of California waste tires (8.8 million PTEs) were estimated to have been used to produce crumb/ground rubber, a 29 percent increase over the amount in 2017. This amount excludes about 1.3 thousand tons of waste tires (0.1 million PTE) that were imported from out of state and flowed to California crumb/ground rubber producers. Buffings from retreaders are excluded from crumb rubber estimates and are not included in recycling rates (since the retreaded tires they originated from are already counted under retreads). Buffings are used extensively in certain market segments, especially pour-in-place playground surfacing, molded products, and landscape mulch products. Buffings continue to be in high demand.

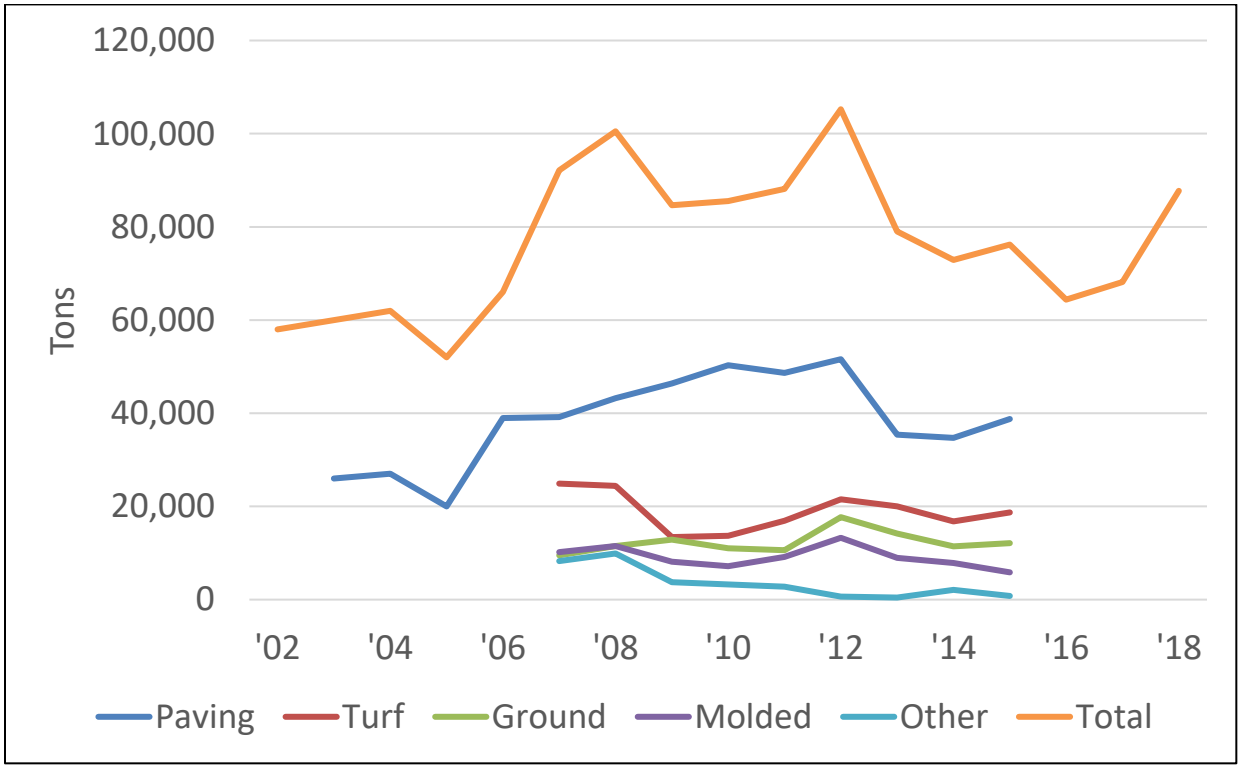
As in the last two California Waste Tire Market Reports, this report does not include specific, quantified estimates of the amount of California waste tires used to produce each market sub-category (e.g., paving, turf infill, ground rubber, and molded/other), although estimates of the amount of outbound TDM shipped to customers in each sub-category are presented as a range. This is mainly to protect confidentiality as only three TDM feedstock producers currently account for over 95 percent of California crumb/ground rubber production. Also, while a complete estimate is not available for the quantity of tire wire and fiber residuals generated by California crumb rubber producers in 2017, the majority of both were diverted to recycled end uses. A Southern California cement kiln reportedly consumed more than 9.5 thousand tons of fiber.

As illustrated in Figure 7, the use of California waste tires to produce crumb/ground rubber hit a peak in 2012 of 105.2 thousand tons (10.5 million PTEs) but then annually declined to hit a 12-year low of 64.5 thousand tons (6.5 million PTEs) in 2016. Since then, crumb/ground rubber production has increased two years in a row and appears to be poised for a sustained growth period driven by paving and molded/other sub-categories, notwithstanding declines in the turf infill sub-category.

Nationally, stakeholders indicate that crumb rubber demand currently exceeds supply for the 10 – 18 mesh size. In certain regions, shortages of material for the turf infill market segment were reported in 2018 and are anticipated to occur again in 2019. To maximize returns, crumb rubber producers prioritize production of certain specifications to meet demand by certain market segments. As a result, they may opt to forgo producing certain specifications of crumb rubber and may require an investment to enable them to meet some specifications or to increase production. Due to regional variations in crumb rubber production, shortages may occur even as some TDM producers have inventories of other specifications such as 30 mesh material, which is a by-product of producing crumb rubber.

How quickly California producers will ramp up production should demand broadly and significantly increase is not certain. There is significant under-utilized crumb rubber production capacity in California. Two facilities in northern California are permitted but have yet to begin production, and some existing facilities have the potential to increase production of crumb rubber and/or ground rubber but have not due to uncertainty over future market trends, including the outcomes of the crumb rubber studies mentioned earlier. Some said they are in a "wait and see mode" as expected significant increases in crumb rubber demand for paving have been slow to materialize as agencies prepare bid documents, and due to concerns over the results of the two major environmental health and safety study results and timing, as discussed earlier.

Figure 7
California Waste Tires Used to Produce Crumb/Ground Rubber: 17-Year Trend[18]



[18] Source: 2002–2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007–present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. See Appendix C for chart source data. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25 Note that flows to crumb/ground rubber sub-categories have not been published in recent years due to the small number of producers.

Also, with strong demand in other market segments such as in-state and export TDF, some crumb/ground rubber facilities may have difficulty securing adequate supplies of suitable types of California waste tires at acceptable terms. In some cases, operational challenges could hamstring rapid increases in production. Still, as discussed below, markets appear to be in a growth mode for paving and molded/other sub-categories and if this plays out as hoped and expected it could result in another strong uptick in California crumb rubber production in coming years.

In a development that could help to strengthen crumb rubber use, ASTM International 's Committee on Rubber and Rubber-like Materials balloted and approved two updated standards (D5644 and D5603) proposed by the Recycled Rubber Task Work that have been two years in the works. The effort was spearheaded by DK Enterprises and supported in part by CalRecycle's Feedstock Conversion Technical Assistance and Material Testing Services contract.

Following is a summary of market segments within the crumb/ground rubber category.

Paving

Use of crumb rubber in California paving projects is estimated to have increased in 2018 by about 2–10 percent, with most stakeholders cautiously expecting another 5-10 percent increase in 2019. Generally, due to greatly increased state and local funding for road infrastructure projects and some favorable policies, there is widespread optimism that paving volumes in general and use of asphalt rubber applications in particular will steadily increase and remain strong over the next several years.

For the first time in this annual report series, Boisson Consulting conducted a survey of California companies that own asphalt rubber blending units, used to produce rubberized hot mix asphalt (RHMA). We estimate that 16 California firms own a total of 40 blending units. The survey confirmed fourteen firms with a total of 38 blending units, plus an additional two firms were identified that are believed to own at least one additional unit each. Some of these firms use their blenders at their hot mix asphalt (HMA) plants to produce asphalt rubber binder for their own projects. Some are "custom blenders" that make their blender units available to other asphalt paving companies, and some supply RHMA to other paving firms. Generally, most firms reported that they are not utilizing their blending units at their maximum capacity and therefore, subject to numerous logistical and market/economic issues, they have potential to significantly increase their crumb rubber usage with existing equipment. Two firms indicated they are considering investing in additional blender capacity, while most said they are in a "wait and see" mode as they monitor the expected increases in asphalt rubber demand.

After adjusting to eliminate double counting, eleven firms owning a total of 33 blending units reported using a total of 78 million pounds of crumb rubber in 2018. Since five firms owning at least seven blending units did not report their crumb rubber usage, it is reasonable to conclude that the actual use of crumb rubber was significantly higher than 78 million pounds. For comparison, Caltrans reported consuming 61 million pounds of

crumb rubber in 2017 paving projects,[19] but this does not include local government RHMA projects. Given that stakeholders reported a modest increase in asphalt rubber use in 2018, these figures appear to validate the conclusion that well over 78 million pounds of crumb rubber was consumed in asphalt rubber paving in 2018.

We further estimate that California crumb rubber producers supplied between 68–78 million pounds to this market segment. (We are reporting this as a range due to the small number of producers serving this market.) It is also reasonable to conclude, therefore, that a significant amount of crumb rubber was imported in 2018 to meet California demand in the asphalt rubber paving market segment. However, the source of such imports could not be confirmed. CalRecycle requires that crumb rubber produced from California waste tires be used in all local projects funded by CalRecycle grants. However, Caltrans requires only that U.S. suppliers be used.

According to CalRecycle Staff, because Caltrans receives federal funds, it must use the lowest cost material from within the United States and this may sometimes result in the use of imported crumb rubber. Additionally, some local government paving projects also include federal funds, which sometimes results in local governments being uncertain whether specifying the use of California-generated crumb rubber would be in conflict with federal funds requirements. CalRecycle Staff performed an analysis of the estimated 76-80 million pounds of crumb rubber used in 2015 in California for rubberized pavement. Based on that analysis, CalRecycle estimates that 20-30 million pounds of crumb rubber was imported, consistent with the Boisson Consulting analysis presented here for 2018.

Notwithstanding this, some blenders said that Caltrans sometimes does request California-sourced material and that consequently, suppliers may be reticent to acknowledge the use of out-of-state material.

Cautious optimism over growing paving demand is widespread in the industry. According to the California Asphalt Paving Association's (Cal-APA's) annual "better or worse" survey[20] respondents were more optimistic than ever. Overall 67 percent said they expected 2019 to be better for business than 2018, with many citing the new availability of consistent, dedicated funding and a positive business climate. Some also expressed concerns such as those related to capacity, workforce recruitment, retention, and training.

Drivers for increased paving and use of asphalt rubber products include:

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[19] Caltrans, "2017 Annual Report on Caltrans' Use of Waste and Used Tires." Available online at: http://www.dot.ca.gov/design/bill/1016/2017%20Final%20Annual%20Report.pdf

[20] Available online at: https://issuu.com/calcontractor/docs/cam_forecast_2019_-_issuu?e=6185870/67277020&utm_source=190204+CalAPA+Asphalt+Insider&utm_campaign=California+asphalt+industry+news+from+CalAPA&utm_medium=email

- ***New funding for state and local roads infrastructure***. As noted above, a large infrastructure-funding bill SB 1 (Beall, Chapter 5, Statutes or 2017) will funnel an estimated $50 billion to infrastructure projects over the next 10 years, with much of these funds focused on road projects and funding split 50/50 between state and local projects. For the past several years, Caltrans paving levels have been relatively low, and this new funding could greatly increase volumes of hot mix asphalt used, including rubberized asphalt products. A voter initiative was defeated in November 2018 ballot (Proposition 6) that would have repealed the SB 1 funding mechanisms. Moreover, several local governments have also adopted additional new infrastructure funding policies that further boost this trend.
- ***Caltrans plans for increased paving***. Consistent with the new funding, Caltrans' 2017 State Highway System Management Plan lays out plans to significantly increase paving levels across the state.
- ***Caltrans RHMA surface pavement of choice policy***. Some cite the Caltrans 2015 policy to establish Rubberized Hot Mix Asphalt as the surface pavement of choice as helping to establish a more stable level of demand. Combined with long-standing use by certain local governments (especially in Southern California), this has helped establish a solid base of demand for asphalt rubber products and applications. It also ties a portion of crumb rubber use directly to the total amount of surface paving performed. Some complain, however, that some districts fail to consistently enforce this policy.
- ***CalRecycle Rubberized Pavement Grants***. CalRecycle continues to allocate significant funding to local government rubberized paving grants. Most recently in December 2018 and March 2019, CalRecycle approved a total of 48 grant awards totaling $9.9 million. This contrasts with the 2017 rubberized pavement grant cycle which was undersubscribed ($5.8 million awarded of the $7.75 million available).
- ***Caltrans asphalt rubber use mandate***. Caltrans is required by statute (AB 338, Levine, Chapter 709, Statutes of 2005) to use tire rubber in 35 percent of its paving projects, for an average of 11.6 pounds per metric ton of total asphalt paving materials used. Prior to 2015, this statute specifically required use of rubber asphalt or "field blend" (also referred to as the "wet process"). As of January 2015, Caltrans may choose any paving technology to achieve the required levels. According to Caltrans' 2017 Annual Report on Caltrans' Use of Waste and Used Tires,[21] "Of the total 4.3 million metric tons of paving asphalt Caltrans used [in 2017], 1.7 million metric tons contained crumb rubber, which is an average of 39.5 percent." This equated to 60.9 million pounds of crumb rubber use according to the report. The Caltrans report also

[21] Available online at: http://www.dot.ca.gov/design/bill/sb876.html.

projected they would use an additional 1 million tons of RHMA in 2018, but this high level of usage was not confirmed through surveys and the agency has not yet published a report covering 2018. At the time the 2017 report was completed (the report is not dated), Caltrans districts were estimating the percentage use of RHMA in 2019 would be 48 percent, suggesting a large increase in crumb rubber demand given the increased overall level of paving anticipated.

Some stakeholders also expressed some concerns or skepticism regarding asphalt rubber trends. Virtually all said they were being very cautious about projecting large increases in demand for RHMA in 2019 due to the time required to develop and publish bid documents as well as limitations on staff resources or priorities at Caltrans and local agencies alike. Some said the asphalt rubber use in 2018 was constrained by issues related to satisfying the "Hamburg wheel track test." To address this, on April 2, Caltrans issued a directive[22] providing guidance to resident engineers on interim changes for rubberized hot mix asphalt designed to overcome these issues. Some also said Caltrans was not uniformly enforcing RHMA usage requirements under the "surface of choice" policy mentioned above, or requiring and compiling information from required reporting forms documenting crumb rubber usage. Additionally, under its *PG+X Initiative* Caltrans continues to work with paving industry stakeholders to test alternative approaches that could potentially further boost use of crumb rubber in paving. Proposed policies under this initiative have been controversial and most stakeholders expressed skepticism as to the proposed ideas as well as whether and when new specifications could be implemented.

Turf Infill

Use of crumb rubber as infill in synthetic turf athletic fields continues to be a key market for California. Nationally, industry representatives say turf sales continue to grow steadily at a rate of between 5–15 percent per year. However, the amount of California crumb rubber used in this market segment has declined by approximately half over the last several years, including an estimated 5–15 percent drop in 2018.

Two trends are serving to reduce the amount of crumb rubber used in this market segment.

First, several years of persistent media reports related to perceived environmental health and safety issues have prompted the industry to explore alternative infill materials. Crumb rubber and sand mixtures are still the most commonly used type of infill, but industry representatives say this infill product is losing market share to alternatives such as cork, coconut hulls, or other organic infill materials, or EPDM rubber. In California, it appears that alternative infill materials have gained more market share than in the rest of the country. Based on a range of industry perspectives, we

[22] Available online at: http://www.dot.ca.gov/hq/construc/CPDirectives/documents/2019/cpd19-8.pdf.

estimate that between 60 and 80 percent of new turf fields in California were constructed with crumb rubber infill mixtures in 2018, down from nearly 100 percent just a few years ago. As described above at the beginning of Section 4, industry representatives are anxiously awaiting the release of two major crumb rubber studies, a CalRecycle-sponsored study by the California Office of Environmental Health Hazard Assessment (OEHHA) and a separate study led by U.S. Environmental Protection Agency with involvement by several other federal agencies. Turf and crumb rubber industry stakeholders expressed concern that the studies may be delayed and/or that the study design may not yield the information needed to address the key issues. For example, some said this is the case because testing conditions were unrealistically extreme and because alternative infill materials, which have seen minimal testing and scrutiny compared to crumb rubber, were not analyzed in the study.

Second, a growing number of existing synthetic turf athletic fields are reaching the end of their useful life and must be replaced. There is a growing trend to reuse some of the end-of-life crumb rubber infill mixtures from these fields, either as infill or in the base layer of the replacement field or sometimes in other reuse applications at a different location. Drivers for this practice include cost savings through reduced purchase of new crumb rubber and disposal cost avoidance. The tight supply situation in some markets may have exacerbated this trend in 2018 at the national level, and there are indications this could occur again. CalRecycle is currently separately researching trends in end-of-life management for tire-derived products and may release an update later in 2019.

Based on information from select turf industry representatives, we estimate that about 90-110 new synthetic turf athletic fields were installed in California in 2018, and that an additional 25-35 replacement fields were installed. Based on data provided by survey respondents, we further estimate that total demand for crumb rubber infill in these projects was at about 15–25 million pounds. While some industry representatives suggest higher numbers than these, this report takes a conservative approach due to several sources of uncertainty in the data and conflicting information. The conservative, wide ranges we are reporting is due to limited survey responses, variation in industry estimates of the number of new and replacement fields, the percentage of fields made using crumb rubber infill material, the amount of crumb rubber infill used and the amount of EOL crumb rubber infill materials reused in replacement fields. We estimate that 12-18 million pounds of California crumb rubber were sold into the turf market, with about 10–15 percent of this shipped to out-of-state field construction projects. Researchers were able to confirm only one instance of out-of-state crumb rubber being used for a California turf project; however, the findings above suggest it is possible that additional amounts were also imported.

Given the trends above, the turf infill market appears likely to remain an important market for California crumb rubber in the short-term, but whether and when the trend of declining use may turn around is uncertain.

Ground Rubber/Nuggets

This segment includes ground rubber typically of 3/8–7/8-inch size used in landscape and playground surfacing, ground cover, porous walkways, paths and bike trails, arena footing, and military ballistics. In 2018, production of California TDM in the ground rubber and nugget market category is estimated to have increased significantly by 75–125 percent with a total of 4–9 million pounds produced. Part of the reason for the increase was production by a new facility in 2018 that is now closing operations in 2019.

Molded and Other Tire-Derived Products

This diverse market segment includes a range of products such as flooring, roofing, industrial gaskets and parts, traffic safety devices and tiles among others. In 2018, this market segment increased markedly by about 75-100 percent, with 20 identified companies consuming an estimated 25-35 million pounds of California crumb rubber. (Some products in this segment are made with crumb rubber and/or buffings from retreading but this estimated usage excludes buffings.) Growth was likely buoyed by CalRecycle's Tire Incentive Program (TIP) with additional support provided through the Feedstock Conversion Technical Assistance and Material Testing Services contract. Qualified TDP manufacturers received 10 to 50 cents per pound through TIP for use of California crumb rubber in pre-approved products which are sold. TIP participants reported purchasing 21.5 million pounds of crumb rubber and buffings combined, of which 12.5 million pounds were used to make products that were sold and reported to the program for incentive payments. In at least one case, the CalRecycle incentive payments appear to have induced a California TDP manufacturer to shift from out-of-state crumb rubber suppliers to in-state suppliers.

In addition to the TIP Program, CalRecycle's Tire-Derived Product Grant Program supports many of the products in this market segment. CalRecycle has steadily shifted funding from the TDP Grant Program to the TIP Program in recent years, and the last TDP grants were announced in February 2017. However, a new TDP Grant solicitation is currently out with applications due in May 2019; $1 million has been allocated for this cycle.

The ability for this market segment to sustain such growth levels over time and reach much higher total crumb rubber demand levels is uncertain. On the positive side, the segment includes a wide variety of companies with established products and some new ones under development in a very diverse range of market niches, and some firms said they had the potential to significantly increase crumb rubber use as they increase sales in coming years. Six firms who responded to capacity questions said they are utilizing on average about 41 percent of their production capacity. On the other hand, many of these firms use a relatively small amount of crumb rubber and their potential annual usage is also rather low. Also, successfully developing new, profitable TDPs is challenging. Over the last decade or so at least eleven California manufacturers have developed TDPs only to see their use of California crumb rubber slow or stop in future years. Some of those who developed new TDP's or expanded their product line either

stopped manufacturing or reduced the quantity of tire rubber used. Reasons for this include unanticipated marketing challenges, operational and technical challenges, and high costs and prioritization of other products that may be viewed as more profitable. Two of these are still operating in California but use lower cost, out-of-state suppliers.

Civil Engineering

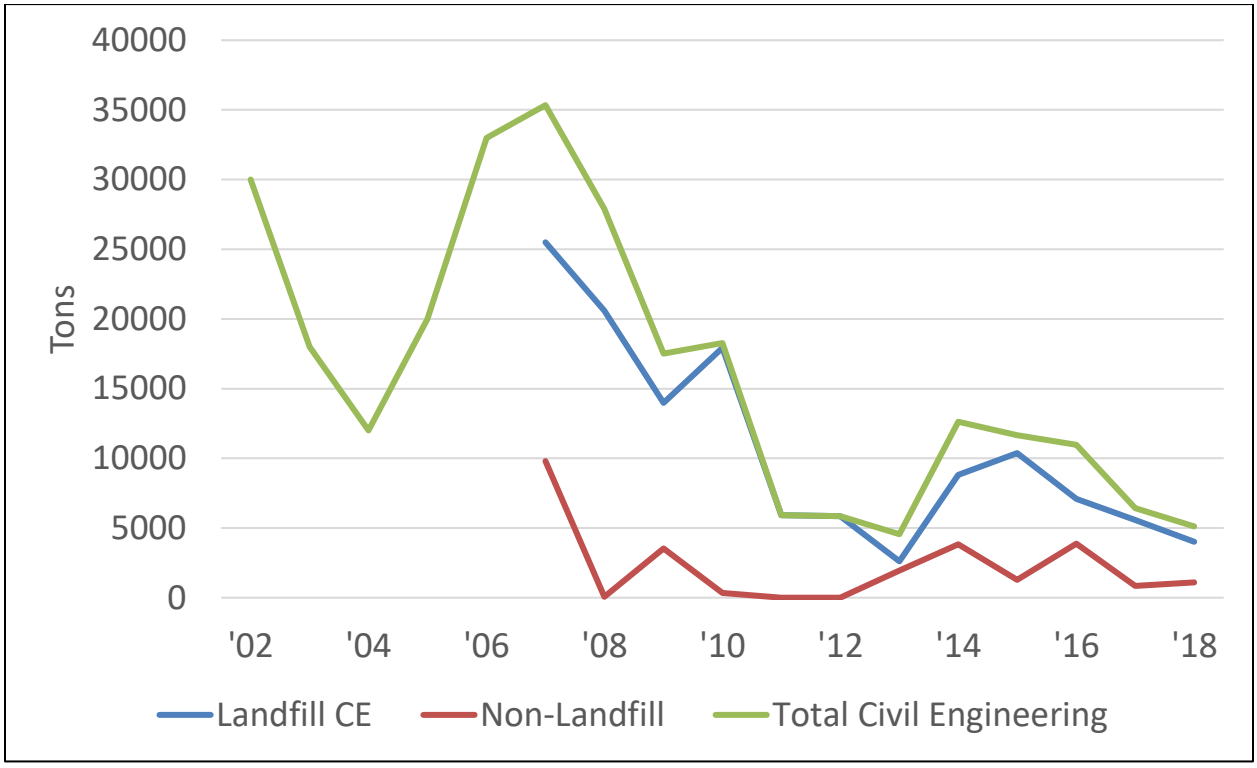
As shown in Figure 8 on the following page, use of TDA in civil engineering applications had two historical peaks of 30 thousand tons (3.0 million PTE) or more, in 2002 and again back-to-back in 2006 and 2007. But since then, TDA use has been somewhat sporadic, especially in non-landfill applications. In 2018, total TDA use was estimated at 5.2 thousand tons (0.5 million PTEs), a twenty percent drop from 2017. However, in 2019 TDA appears likely to surge, with a total of eight projects planned that would use a projected 15.9 thousand tons of TDA (1.6 million PTEs) in five landfill and four non-landfill projects. If this materializes, it would more than triple the 2018 usage.

For the 2019-20 fiscal year, $850,000 is available through CalRecycle's TDA Grant Program. Applications will be accepted in three cycles with deadlines of August 1, 2019, October 31, 2019, and January 30, 2020.

Landfill Civil Engineering Applications

In 2018 five landfills (three in southern, one in central, and one in northern California) reported using a total of 4.1 thousand tons of TDA (0.4 million PTE) in civil engineering projects mainly tied to landfill gas collection operations. This was more than 25 percent drop from the 5.6 thousand tons (0.6 million PTEs) used by five landfills in 2017. In 2019, these same five landfills project they will use a total of 5.7 thousand tons of TDA. Four of the landfills have already been awarded CalRecycle TDA grants.

Figure 8
California Waste Tires Used in Civil Engineering: 17-Year Trend[23]



Non-Landfill Civil Engineering Applications

In 2018, two non-landfill civil engineering projects used a combined total of 1.1 thousand tons (0.1 million PTEs). These projects included a low-impact storm water capture and treatment system for a roadway in Ukiah and use of TDA as bottom fill for roadside horizontal drains in Stanislaus county. This 2018 usage is an increase from the 0.9 thousand tons (< 0.1 million PTEs) used in 2017 at one low-impact development project in Santa Rosa. In 2019, four non-landfill projects in central and northern California have already received CalRecycle grant funding and are projected to use a total of 10.1 thousand tons (1.0 million PTEs). These include roadway repair projects in

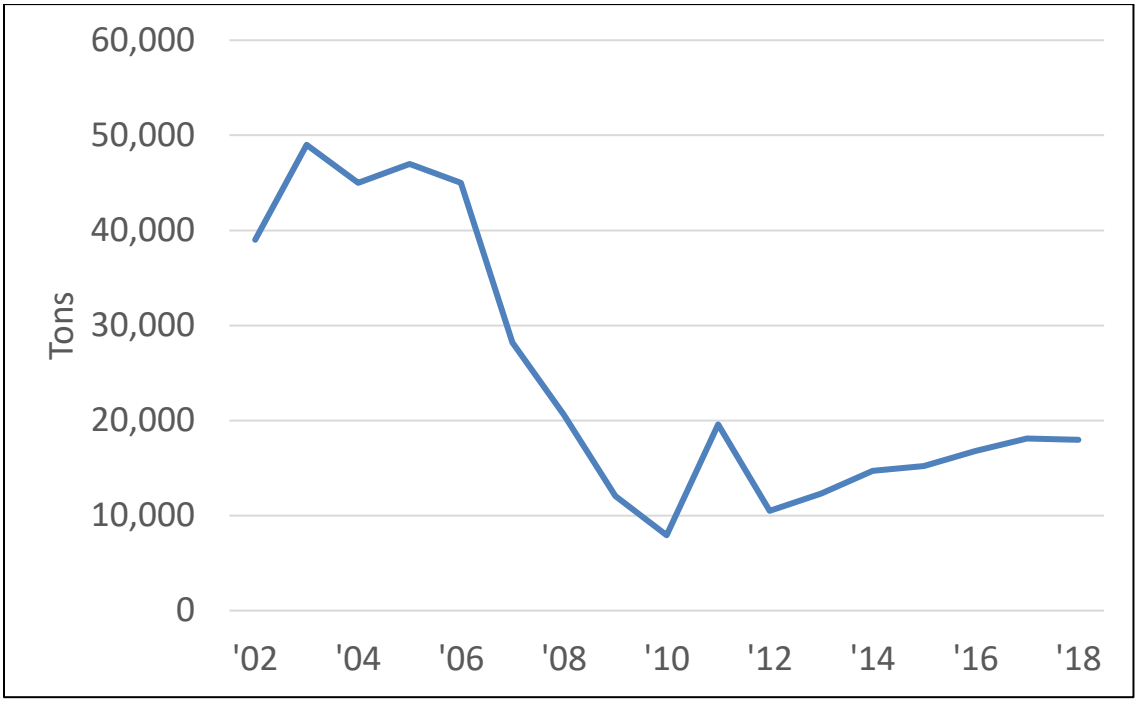
[23] Source: 2002 – 2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007 – present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. See Appendix C for chart source data. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

Napa, Santa Barbara, Tuolumne, and Yuba counties, mostly tied to landslides. The uptick in roadway repair projects may have been partially triggered by the extremely wet winter that California experienced in the 2016-17 winter season, which caused numerous landslides and road failures. Heavy rains again in the 2018-19 winter could remain a driver for roadside repair civil engineering projects.

Alternative Daily Cover

Tire shreds are used as ADC at some landfills to cover disposed waste at the end of each day. As shown in Figure 9, ADC consumption has fallen off from the high levels of 2002–2006. In 2018, three landfills in central and northern California reported combined use of 18.0 thousand tons of tire shreds (1.8 million PTEs) as ADC, slightly less than in 2017 when four landfills reported tire ADC use. This amount is expected to decline in 2018 as one of these landfills is scheduled to close in 2019.

Figure 9
California Waste Tires Used as Landfill Alternative Daily Cover: 17-Year Trend[24]



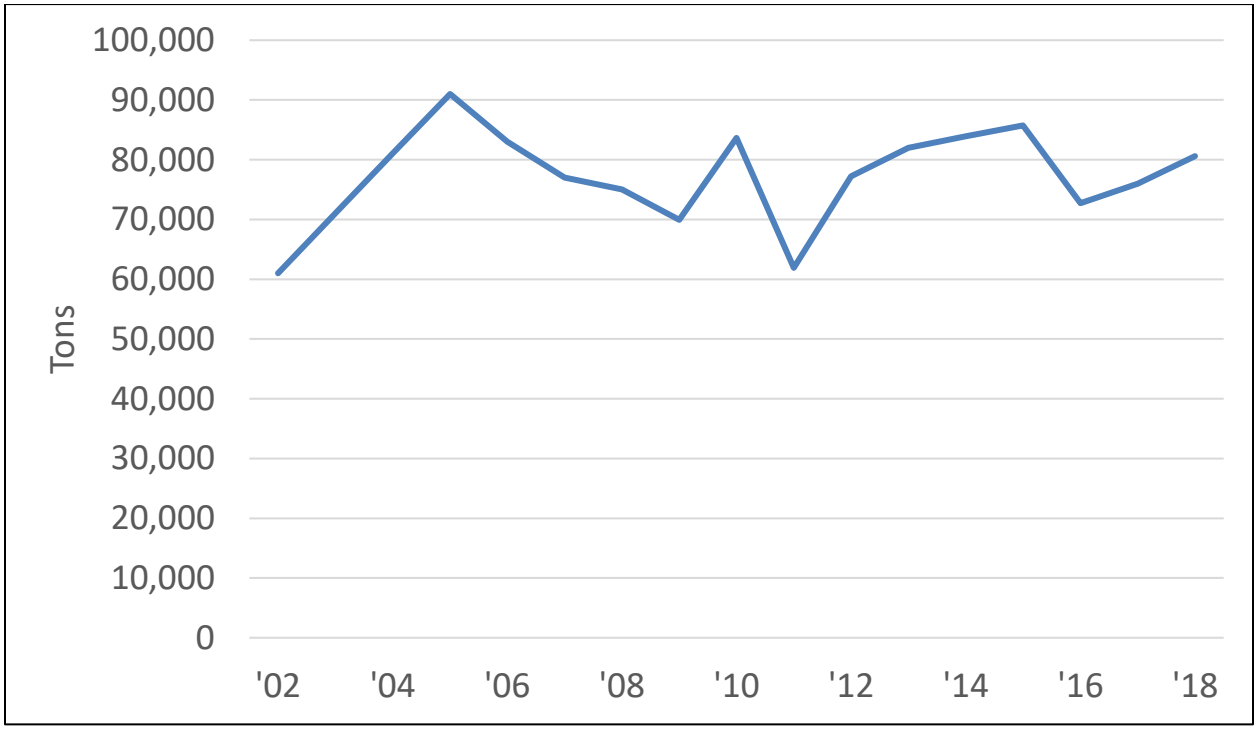
[24] Source: 2002 – 2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007 – present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. See Appendix C for chart source data.All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

Tire-Derived Fuel

Four California cement kilns use large quantities of size-reduced or whole tire TDF as shown in Figure 10. These facilities provide a strong, steady market that thrives without government support. (Statute precludes CalRecycle from promoting TDF. [25]) In 2018, these plants consumed 90.2 thousand tons (9.0 million PTEs). However, about 9.7 thousand tons (1.0 million PTEs) of this was originally generated out of state. Therefore, the net estimated quantity of California-generated waste tires used by in-state TDF markets in 2018 is 80.6 thousand tons (8.1 million PTEs), six percent more than 2017. In addition, 9.5 thousand tons of fiber derived from California waste tires also was consumed as fuel. These cement kilns are already using TDF near their maximum potential, but surveys indicate a slight increase in 2019 is possible.

[25] Public Resources Code 42873(b)(1) States, “The board may not expend funds for an activity that provides support or research for the incineration of tires. For the purposes of this article, incineration of tires, includes, but is not limited to, fuel feed system development, fuel sizing analysis, and capacity and production optimization.”

Figure 10
California Waste Tires Consumed at In-State Cement Kilns: 17-Year Trend[26]



Imports and Exports

Used Tires and Casing Imports and Exports

In 2018, an estimated 8.2 thousand tons of used tires (0.8 million PTEs) were culled from waste tire flows and exported for resale and reuse, mainly to Mexico but also to several other countries. A large quantity of used tires was also imported into California from other states either for sale or further export. Each year Mexico establishes a quota limiting the number of used tires imported from California. According to data from the Mexico Secretary of the Economy, the 2018 authorized quota was 786,090 used tires of which 760,421 were imported.[27] Truck tire casings also flow into California from other

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[26] Source: 2002 – 2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007 – present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. See Appendix C for chart source data.All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

[27] Data provided by Reynaldo Rojo-Mendoza, School of Public Affairs, San Diego State University.

states for retreading. Although an estimate is not available for 2018, in 2017 an estimated 2.7 thousand tons came from other states (0.3 million PTEs).

Waste Tire Imports and Exports

In 2018, an estimated 55.2 thousand tons of whole waste tires (5.5 million PTEs) were imported from out of state and flowed to California processors. The processors importing these waste tires, in turn, shipped whole tire TDF, culled used tires, and/or TDM derived from these tires to a variety of market segments. This share of their shipments was subtracted from the market segment estimates presented in Table 1 for California-generated tires. The number of imported tires or TDM subtracted from the flows from California processors to each market segment is shown in Table 2. Additionally, 3.7 thousand tons of waste tires (0.4 million PTEs) were exported to an out-of-state landfill.

Export of Size-reduced and Baled TDF

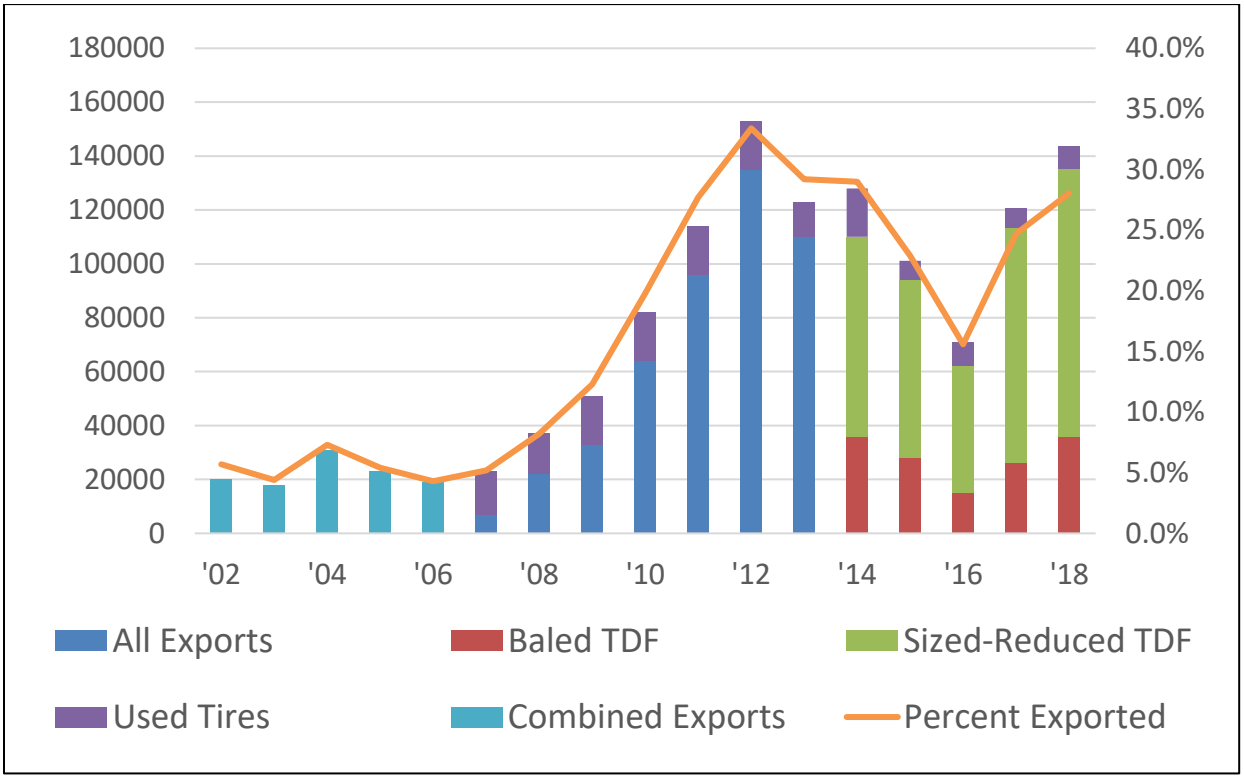
As shown in Figure 11, after peaking in 2012 at 135.0 thousand tons (13.5 million PTEs), export of size reduced and baled TDF dropped steadily to 62.5 thousand tons (6.3 million PTEs) in 2016, and then rebounded sharply in 2017 to 113.4 thousand tons (11.3 million PTEs). In 2018, this trend intensified with a total of 146.1 thousand tons (14.6 million PTEs) of sized-reduced and baled TDF exported by California facilities. However, as with in-state TDF, a portion of this was derived from out-of-state tires flowing through California processors, resulting in an estimated net flow of 135.2 thousand tons (13.5 million PTEs) of California-generated TDF exported. Of these California-generated exports, 99.2 thousand tons (9.9 million PTEs) was size-reduced TDF, a 14 percent increase over 2017, and 36.0 thousand tons were bales, a 38 percent increase from 2017. In addition to baled whole waste tires, baled tire treads are also now exported for use as TDF.

Table 2
Estimated Market Disposition of Waste Tires Imported to California Processing Facilities (2018)

Category	Sub-Category	Adjustments Made to Shipments from California Processors to Account for Imported Tires (Tons)
Reuse	Retread	NA
Reuse	Used Tires (Exported)	1,349
Reuse	Used Tires (Domestic)	3,637
Reuse	**Subtotal**	**4,986**
Crumb / Ground Rubber	Paving	1,856
Crumb / Ground Rubber	Turf & Athletic Fields	0
Crumb / Ground Rubber	Ground Rubber / Nuggets	0
Crumb / Ground Rubber	Molded & Extruded	0
Crumb / Ground Rubber	Other	0
Crumb / Ground Rubber	**Subtotal**	**1,856**
Civil Engineering	Landfill Applications	149
Civil Engineering	Non-Landfill Applications	0
Civil Engineering	**Subtotal**	**149**
Other Diversion		**0**
Alternative Daily Cover		**0**
Export of TDF	Size-Reduced TDF	9,595
Export of TDF	Baled TDF	0
Export of TDF	**Subtotal**	**9,595**
Tire-Derived Fuel (In-State)		9,649
Landfill Disposal		784
Total Imports		**26,934**

TDF exports were mainly to Japan, Korea, and India, as Vietnam halted imports of baled tires early in 2018. TDF exports appear to be very strong and could see further growth. Demand for size reduced TDF mainly by Japan and Korea remains steady with supplies coming from many parts of the world. Vietnam is expected to restart accepting baled tires soon, and demand for both sized-reduced TDF and baled tires by India is also significant.

Figure 11
Export of Size-Reduced TDF, Baled TDF and Used Tires: 17-Year Trend[28]



Crumb/Ground Rubber and TDP Imports and Exports

As discussed in the crumb rubber section, we estimate that significant quantities of crumb rubber are imported into California and likely flows to all the crumb rubber sub-markets to varying degrees. We were unable to quantify the total amount flowing from different out-of-state sources to California markets and between TDM suppliers. Most cited lower pricing for out-of-state crumb rubber along with customer relationships. Importing companies said that they always use California-derived crumb rubber when a project is funded by CalRecycle. Some attribute the imports to large across-the-board incentive payments offered in locations such as Utah and British Columbia, and favorable operating conditions in some states or countries (i.e., lower operating costs).

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[28] Source: 2002–2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007–present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. See Appendix C for chart source data. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

In at least one case, CalRecycle incentive payments appear to have helped to induce a California manufacturer to shift from out-of-state crumb rubber suppliers to in-state TDM suppliers.

Disposal

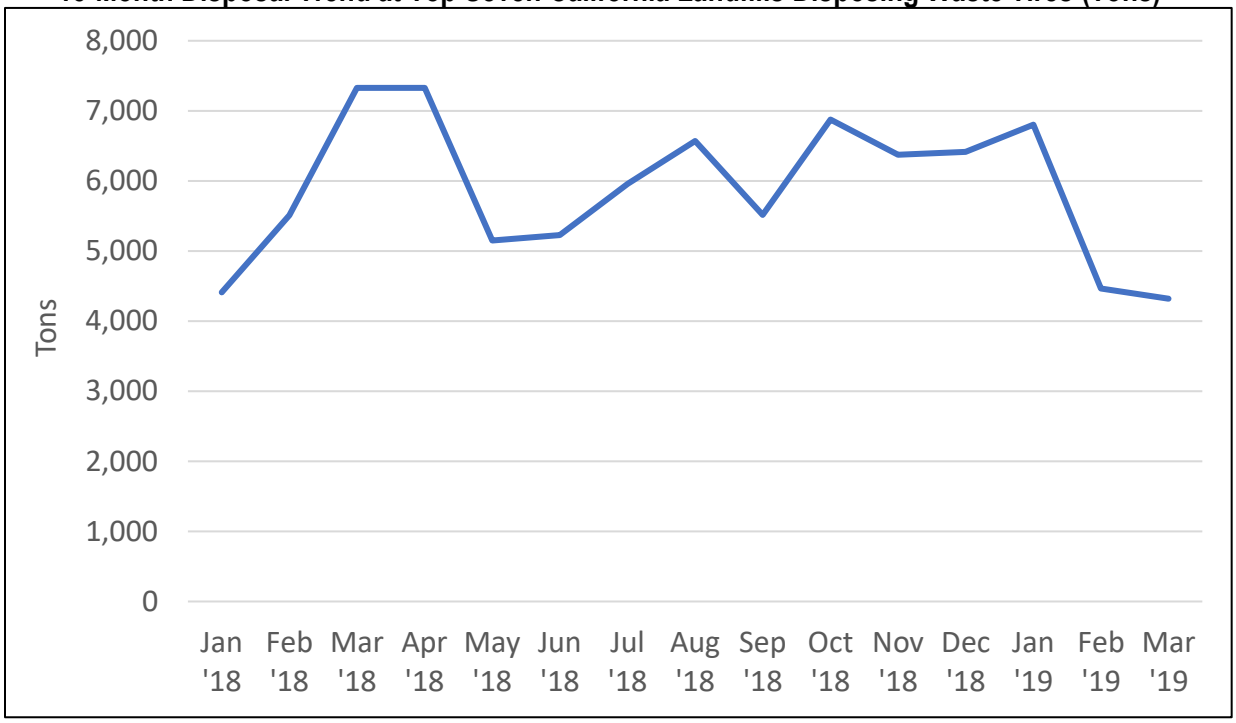
As shown in Figure 12, disposal of California-generated waste tires has varied widely in recent years, hitting an all-time low in 2012 of 32.7 thousand tons (3.3 million PTEs) and then four years later in 2016 a seventeen-year high of 146.4 thousand tons (1.5 million PTEs). Over the last two years the trend has reversed again, with disposal declining in 2018 to 90.5 thousand tons (9.1 million PTEs), a 22 percent decline from 2017. Some landfills don't accept whole tires and/or accept them and have a hauler take them to another TDM supplier for processing. Many landfills especially in southern California have increased their tire disposal rates, driving haulers to deliver to TDM suppliers. In addition, disposal amounts are also influenced by demand and pricing in the high-volume export market for size reduced and baled TDF, as well as by trends in other recycling and diversion markets.

Figure 12
California Waste Tire Disposal: 17-Year Trend (Tons)[29]

[29] Source: 2002 – 2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007 – present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. See Appendix C for chart source data. All reports are available at

With export markets expected to remain strong and even grow further, along with potential increases in crumb rubber and civil engineering volumes, 2018 disposal could decline further. While it does not appear likely that disposal will reach the 2012 all-time low level in 2019, the preliminary trend data presented in Figure 13 suggest that 2019 is on track for a 30 percent reduction in waste tire disposal. It must be noted, however, that this is a preliminary conclusion that could change as additional WTMS data becomes available and as trends play out during 2019. The data in this figure are based solely on WTMS data and show the difference between reported deliveries and pick-ups at seven landfills that together comprised 98 percent of all waste tire disposal in 2018. Unlike the annual total waste tire disposal estimates shown in Figure 12 above, these data have not been adjusted based on landfill and processor surveys.

Figure 13
15-Month Disposal Trend at Top Seven California Landfills Disposing Waste Tires (Tons)[30]



https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

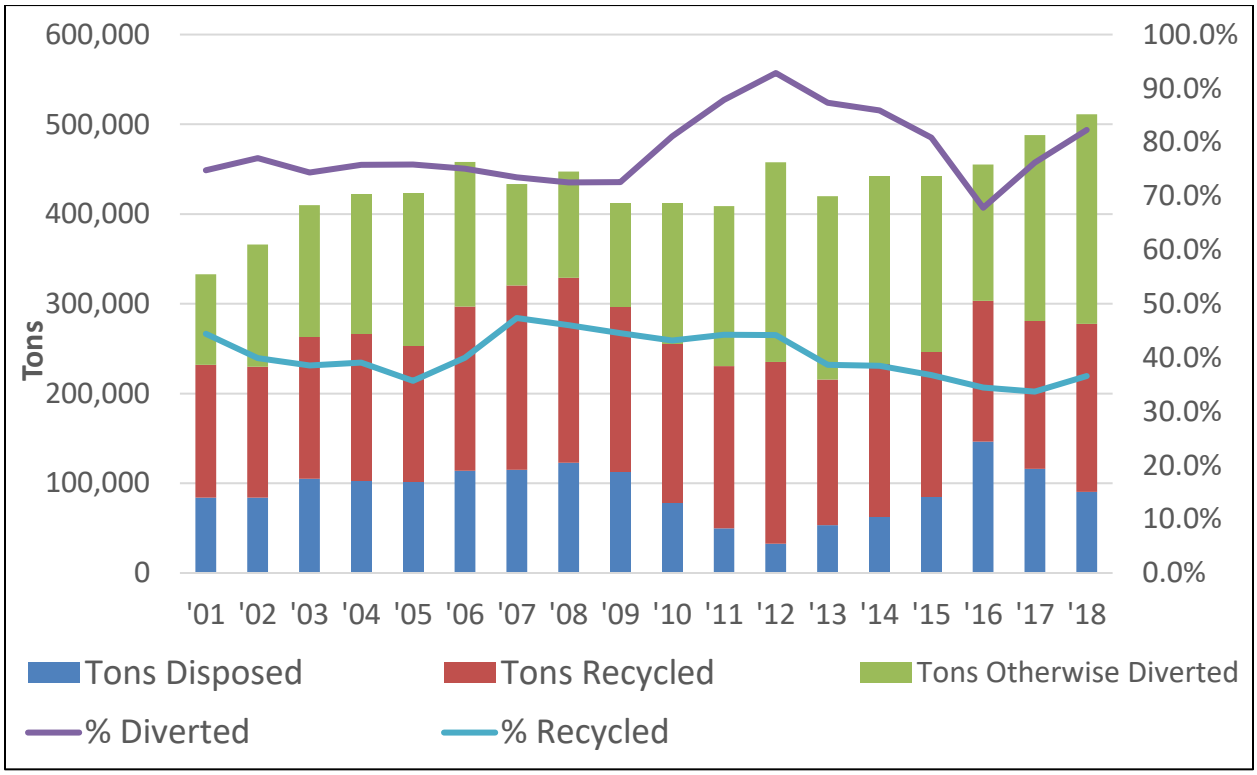
[30] Source: This chart is based on monthly drop-off and pick-up data from comprehensive trip log forms submitted and analyzed through CalRecycle's WTMS system. The chart is presented solely to illustrate the trend. The monthly WTMS data have not been adjusted based on landfill and processor surveys, as the 2018 annual estimate was. See Appendix C for chart source data.

5. Diversion and Recycling Outlook

As detailed in Section 1, California has a 75 percent recycling rate goal for all waste, including tires, by 2020 per AB 341 (Chesbro, Chapter 476, Statutes of 2011) and, while not codified in statute, CalRecycle has also adopted this goal specifically for waste tires.

In 2018, waste tire diversion and recycling both increased. Consistent with AB 341, the recycling rate measurement excludes ADC and TDF (both exported TDF and domestic TDF at in-state cement kilns). As shown in Figure 14, the California waste tire recycling rate reversed a nine-year slide in 2018, increasing by nearly three full percentage points from 33.7 percent to 36.6 percent. The amount of tires recycled increased by about 22.5 thousand tons (2.3 million PTEs), a 14 percent increase.

Figure 14
Waste Tire Diversion and Disposal Trends[31]



[31] Source: 2002 – 2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007 – present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. See Appendix C for chart source data. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

The diversion rate includes all uses other than landfill disposal (including both in-state and exported ADC and TDF). By this measure, after falling for five straight years and hitting an all-time low of 68 percent in 2016, the diversion rate has now increased for two consecutive years and reached 82.3 percent in 2018. This was driven largely by the aforementioned gain in crumb/ground rubber use combined with the surge in exports.

As shown in Table 3 on the following page, California could potentially see solid increases in both diversion and recycling in coming years.

Positive trends include:

- Expected sustained growth in paving volumes and the use of crumb rubber in asphalt rubber products and applications.
- Growing momentum for the molded/other product market segment likely due to CalRecycle's TIP program.
- An expected surge in civil engineering applications in 2019, with generally increasingly steady use of TDA in landfill engineering applications.
- Expected strong export demand for both size-reduced TDF and baled tires.
- Sustained strong reuse and in-state TDF demand.

Some trends that could constrain diversion and recycling growth include:

- Continued concerns over the perceived environmental health and safety of crumb rubber used in turf infill and playground applications.
- Uncertainty over the pace at which pavement demand increases will occur.
- The potential lag time in expanding California crumb rubber production in certain specifications and markets if demand surges rapidly.

In addition, several important barriers continue to constrain California's waste tire market development efforts, including:

- TDF exports are subject to periodic disruptions for a number of reasons.
- High in-state operating, labor, and land costs combined with strict environmental regulations can make competition with out-of-state TDP or conventional product producers difficult.
- A host of challenges related to developing new TDPs or implementing feedstock conversion products (i.e., replacing other feedstocks to recycled tire rubber).
- Manufacturers may not have the equipment, customer demand, or financial resources to enable them to be competitive with some out-of-state manufacturers.

Considering the information gleaned during research for this report, Table 3 summarizes projections for short-term (i.e., 1-2 years) and long-term (i.e., 2021 and beyond) recycling and diversion of California waste tires. In the short term, recycling and diversion are projected to increase in 2019. Long-term projections are more difficult, but at the present time California appears reasonably well positioned to sustain or grow current diversion and recycling levels.

Table 3
The Outlook for Diversion and Recycling

Category	2018 1,000 Tons	2018 Million PTEs	2018 % of Total	Short-Term Outlook (2019-2020)	Long-Term Outlook (2021 and Beyond)
Reuse	90.6	9.1	17.7%	**Steady** Mature and relatively stable.	**Steady with Potential for Retread Decline** Continuing competition with, and poor reuse potential of, imported lower-tier Chinese tires.
Crumb / Ground Rubber	87.7	8.8	17.2%	**Growth** Continued steady growth in paving and molded/other expected, tempered by further turf infill decline.	**Wait and See** Significant in-state under-utilized production capacity could boost production if demand continues to increase and be sustained.
Civil Engineering	5.1	0.5	1.0%	**Growth** 15.9 thousand tons projected use in 2019 in specific projects would more than triple 2018 amount used.	**Increasingly Steady Use with Periodic Dips** Growing acceptance; growing range of applications; sustained CalRecycle funding. But historic peaks and valleys likely to persist.
Overall Recycling	186.9	18.7	36.6%	**Modest Growth** Crumb and civil engineering growth could offset potential turf declines and boost recycling modestly.	**Growth Signals but Challenges/Risks Too** Potentially driven by crumb and civil engineering growth; risks from EH&S/enforcement concerns.
ADC	18.0	1.8	3.5%	**Slight Decline** One ADC-using landfill expected to close in 2019.	**Steady** Current levels have been sustained for many years.

Category	2018 1,000 Tons	2018 Million PTEs	2018 % of Total	Short-Term Outlook (2019-2020)	Long-Term Outlook (2021 and Beyond)
TDF (In-State)	80.6	8.1	15.8%	**Steady** Sustained use for years at near maximum capacity.	**Steady** Growth would require new permits and investments.
Export of TDF and Bales	135.2	13.5	26.5%	**Continued Steady and Possible Growth** Strong demand for size reduced TDF and expectation that Vietnam bale demand will rebound.	**Steady with Intermittent Fluctuations** Demand is strong but will likely suffer inevitable periodic interruptions, spikes, and declines.
Overall Diversion	420.8	42.1	82.3%	**Growth** Increasing segments appear likely to outweigh any potential declines.	**Continued High Rates but with Fluctuations** California market diversity and growth potential appears able to sustain relatively high diversion baring major disruptions.

6. Concluding Remarks

This report focuses on trends in California waste tire recycling and diversion. The bottom line is that a three-percentage point uptick in the 2018 waste tire recycling rate has broken a nine-year downward trend, and there is good potential for further increases in both recycling and diversion over the next few years.

In the long-term, it appears that significant increases in waste tire recycling that approach the 75 percent goal may remain elusive. As detailed in past Waste Tire Market Reports, achieving this level of recycling would require development of new markets that have yet to be identified, combined with major investments in production facilities and broad shifts of waste tire supplies away from highly profitable market segments like in-state TDF.

Notwithstanding this, California has a well-developed and mature waste tire management system that consistently achieves very high diversion rates through a very diverse set of markets. This not only keeps large quantities of waste tires out of the landfill but also avoids the accumulation of waste tire stockpiles as has occurred in the past.

Appendix A
Glossary of Terms

ADC	Alternative Daily Cover used at landfills instead of soil.
Buffings	Tire rubber produced as a by-product of the tire retreading process.
Caltrans	California Department of Transportation.
CARB	California Air Resources Board.
Comprehensive trip log (CTL)	Paper or electronic forms used by haulers and waste tire facilities to document waste and used tire pickup or delivery transactions. Forms are submitted to CalRecycle and entered into the Waste Tire Manifest System database.
Crumb rubber	Tire-derived material less than ¼ inch in size, free of wire and fiber.
End-of-Life (EOL)	Refers to products that have reached the end of their useful life and are ready to be discarded and managed, whether through reuse, recycling, disposal or another means.
Feedstock conversion	The process whereby a manufacturer of an existing, commercially proven product converts a portion of the raw materials used to make the product from existing one (e.g., virgin rubber, plastic, or other materials) to crumb rubber made from recycled tires.
Ground rubber	Tire-derived material ¼ inch to 1 inch in size, free of wire and fiber, sometimes referred to as nuggets.
OEHHA	California Office of Environmental Health Hazard Assessment.
Passenger tire equivalent (PTE)	Defined as 20 pounds of tire rubber for the purpose of making consistent comparisons in this and other reports. (The actual weight of waste passenger tires may vary considerably.)
Tire-derived aggregate (TDA)	Tire-derived material used to replace conventional aggregates like rock in civil engineering applications.

Tire-derived fuel (TDF)	Whole waste tires or tire-derived material consumed as fuel (referred to as size-reduced TDF in this report).
Tire-derived material (TDM)	Tires processed to meet market specifications, for example, crumb rubber, ground rubber, tire-derived aggregate, and tire-derived fuel.
Tire-derived product (TDP)	Product made entirely or in part from tire-derived material.
Tire Incentive Program (TIP)	A CalRecycle program launched in June 2015 to promote feedstock conversion and the use of crumb rubber as feedstock by California manufacturers.
Waste Tire Manifest System (WTMS)	Waste Tire Management System. A database containing information on waste tire management firms, permits, and submitted comprehensive trip log data.

Appendix B
Methodology

Interpreting Results

Readers should consider the following when using this report's findings:

Findings Quantify Use of California-Generated Waste Tires: The main findings in Table 1 quantify California-generated waste tire flows to different markets. Unless otherwise stated, they don't include flows of TDM or TDPs entering California from outside the state or buffings from retread operations. Consequently, the findings do not estimate total market size. Also, when out-of-state waste tires are received by a California processor, the share of outputs to different market segments is reduced proportionately to not over-state use of California-generated tires.

Tire Recycling and Diversion Rates Are Not Adjusted for Residuals or Disposed TDPs: As in most tire studies, diversion and recycling rates are not adjusted for the relatively small amount of steel and fiber residuals generated by TDM producers that is disposed. In California, the majority of the steel is recycled, and most fiber is combusted at California cement kilns. Also, most TDPs are currently disposed at the end of their useful life, but rates are not adjusted to reflect this common practice.

Reasonably Accurate Trend Information: The authors strive to develop the most complete and accurate estimates for each market segment, while avoiding double counting. However, estimating California waste tire flows is challenging due to data gaps, data quality issues, WTMS data entry and conversion issues, and conflicting sources of information. Nevertheless, the authors believe this report provides data that can reasonably be used to evaluate California's waste tire market trends over time.

Methodology and Conversion Factors

In short, the study methodology involves the following steps:

Step 1: Gathering data and information via direct surveys and interviews of California-based waste tire processors, balers, haulers, landfill operators, cement kilns, retreaders, TDP manufacturers, installers and asphalt rubber blenders, among other knowledgeable stakeholders.

Step 2: Compiling and analyzing CalRecycle data from Comprehensive Trip Logs (CTLs) as entered into the Waste Tire Manifest System; the Disposal Reporting System; facility permitting activity; and grant program data.

Step 3: Reviewing third-party information from sources such as Caltrans; the U.S. Tire Manufacturers Association; trade associations and other online or published sources.

Step 4: Key data from these sources is entered into a customized spreadsheet model and systematically scrutinized to identify all flows as completely and accurately as possible while avoiding double counting. This is an iterative process in which researchers identify issues and follow up with facilities to refine the analysis.

All reported quantities are converted tons. Except for retreaders, surveys request flow data in tons. Retreaders report the number of different types of tires retreaded and their average weight. Occasionally facilities provide data in the number of tires or cubic yards, and the most accurate conversion factor available is used to convert to tons.[32] WTMS data are used to estimate the approximate magnitude of tires flowing to and from facilities. This is very helpful in eliminating double counting, and also helps identify issues to resolve through interviews. However, WTMS data generally provide only rough approximates of actual tonnage flows due to conversion factor issues. CalRecycle's WTMS database provides all data in PTEs (defined as 20 pounds). But the basis for WTMS data are CTLs submitted by haulers and facilities, which may enter amounts in either tons, cubic yards, or the actual number of tires (regardless of the tire size or type). CalRecycle converts cubic yards to PTEs using 10 PTEs/cubic yard, which generally tends to under-estimate actual tonnages. For this report, WTMS data is downloaded in PTEs and then converted to tons using the 20 pound per PTE standard. Where necessary, researchers also examine a sampling of CTLs for a given facility to analyze potential errors related to conversion factors. When the final analysis is complete, tons are also converted to PTEs to allow comparison with past reports.

Methodology Refinements

The methodology for conducting this report has been relatively unchanged since 2007. However, refinements are made from time to time. Refinements this year included:

- For the first time, the study included a survey of California companies that own asphalt rubber blending units, and of national synthetic turf industry firms who are active in California. The main goal of these new surveys was to estimate total demand for crumb rubber in these market segments, separate from the processor-focused information used to estimate use of California-produced crumb rubber.
- As in the last two California Waste Tire Market reports, estimates of the quantity of California crumb/ground rubber flowing to each of the four sub-market categories was not published (e.g., paving, turf infill, ground rubber/nuggets and molded/other. However, this year we did publish estimated flows as a range (in

[32] For example, according to the U.S. Tire Manufacturers Association (formerly the Rubber Manufacturers Association), on average light duty tires such as scrap passenger tires weigh 22.5 pounds, commercial tires such as scrap truck and bus tires weigh 120 pounds, and the average of all light duty and commercial scrap tires (excluding off-the-road tires) is 32.8 pounds. Source: "2013 U.S. Scrap Tire Management Summary." November 2014, page 4. https://www.ustires.org/sites/default/files/MAR_027_USTMA.pdf

Section 4). Because just three producers currently account for over 95 percent of California crumb/ground rubber production, these measures are intended to help safeguard sensitive, confidential information.

- "Baled waste tires" was changed to "baled TDF" to reflect that some companies are now exporting baled tire treads in addition to bales of whole waste tires.
- The term "crumb rubber" was previously used to refer to both crumb rubber and ground rubber but starting this year we are distinguishing between the two.

Appendix C
Accessibility Notes

Source Data for Figure 1 California Waste Tire Flows in 2018

Category	Million PTE	Percent of Total
Used Tires (Domestic and Export)	4.3	8.4%
Retread	4.8	9.4%
Crumb/Ground Rubber	8.8	17.2%
Civil Engineering	0.5	1.0%
Exported Size-Reduced TDF	9.9	19.4%
Exported TDF Bales	3.6	7.0%
TDF (In-State)	8.1	15.8%
ADC	1.8	3.5%
Disposal	9.1	17.7%
Other Recycling	0.3	0.7%
Total	**51.1**	**100.0%**

Source Data for Figure 2 Historical Waste Tire Recycling, Diversion and Disposal Trend

Year	Tons Disposed	Tons Recycled	Tons Otherwise Diverted	% Diverted	% Recycled
'01	84,000	148,000	101,000	74.8%	44.4%
'02	84,000	146,000	136,000	77.0%	39.9%
'03	105,000	158,000	147,000	74.4%	38.5%
'04	102,000	165,000	155,000	75.8%	39.1%
'05	102,000	151,000	170,000	75.9%	35.7%
'06	114,000	183,000	161,000	75.1%	40.0%
'07	115,000	205,230	113,150	73.5%	47.4%
'08	123,000	206,090	118,390	72.5%	46.1%
'09	113,046	183,629	115,681	72.6%	44.5%
'10	77,993	178,029	156,093	81.1%	43.2%
'11	49,700	180,896	178,236	87.8%	44.2%
'12	32,688	202,330	222,695	92.9%	44.2%
'13	53,320	162,263	204,451	87.3%	38.7%
'14	62,579	170,138	209,189	85.9%	38.5%
'15	84,699	162,680	194,978	80.9%	36.8%
'16	146,429	156,741	151,997	67.8%	34.4%
'17	116,214	164,438	207,502	76.2%	33.7%
'18	90,508	186,939	233,814	82.3%	36.6%

Sources for Figure 2: 2002–2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007–present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary somewhat year to year as discussed in Appendix B. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

Accessibility Notes for Figure 3, California Waste Tire Recycling Industry Flow Chart

This chart illustrates how California waste tires, tire-derived material (TDM) and tire-derived products (TDPs) flow between various entities. Haulers pick up waste tires from generators and may deliver them to either: a landfill for disposal; a process (who may produce TDM); a used tire buyer/seller; or a TDF consumer (i.e., one of four California cement kilns). Processors may send tires or TDM to: a landfill for disposal, use in civil engineering projects or other beneficial uses; a used tire buyer/seller; an exporter; a

TDP manufacturer or installer; a TDF consumer; or a civil engineering project. Imports into California include: whole waste tires; culled used tires; TDM; TDPs; and buffings from retreaders. These imports may flow to California: processors; TDP manufacturers and installers; TDF consumers; or directly to customers. Exports include: TDM and TDPs; buffings from retreaders; TDF (either baled or size-reduced); and used tires. Exports may flow from California: processors; TDP manufacturers; used tire buyer/sellers and retreaders.
There are several categories of manufacturers and installers including:

- Accessibility ramps.
- Building and construction.
- Coatings, sealants and paints.
- Flooring.
- Landscape surfaces.
- Mats, pavers and tiles.
- Pavements.
- Paths, walkways and sidewalks.
- Playground surfaces.
- Roofing.
- Synthetic turf.
- Traffic safety.

Types of civil engineering applications include:

- Landfill projects.
- Light-weight fill.
- Retaining wall backfill.
- Vibration dampening.
- Storm water management.

Finally, TDP manufacturers and installers; civil engineering project leads and TDF consumers sell products directly to their customers, inside and outside of California.

Source Data for Figure 4 Historical Market Trends by Segment

The source data for this chart is presented in three separate tables below.

A) 2002 Through 2007 (Tons)

Category	'02	'03	'04	'05	'06	'07
Disposal	84,000	105,000	102,000	102,000	114,000	114,510
ADC	39,000	49,000	45,000	47,000	45,000	28,200
Exported TDF	20,000	18,000	31,000	23,000	19,000	7,000
In-State TDF	61,000	71,000	81,000	91,000	83,000	77,000

Other Recycling	59,000	27,000	29,000	32,000	33,000	950
Civil Engineering	30,000	18,000	12,000	20,000	33,000	35,340
Crumb/Ground Rubber	58,000	60,000	62,000	52,000	66,000	92,130
Reuse	38,000	62,000	60,000	56,000	65,000	78,000
Total Managed	366,000	410,000	422,000	423,000	458,000	433,000

B) 2008 Through 2013 (Tons)

Category	'08	'09	'10	'11	'12	'13
Disposal	123,490	113,046	77,993	49,700	32,688	53,320
ADC	20,580	12,042	7,928	19,589	10,486	12,316
Exported TDF	22,000	33,000	64,000	96,000	135,000	110,000
In-State TDF	75,020	69,926	83,675	61,911	77,209	81,982
Other Recycling	790	713	490	735	0	152
Civil Engineering	27,890	17,510	18,274	5,915	5,844	4,557
Crumb/Ground Rubber	100,510	84,614	85,521	88,135	105,200	79,038
Reuse	78,000	82,000	74,000	87,000	91,000	78,635
Total Managed	448,000	412,000	411,000	408,000	458,000	420,000

C) 20014 Through 2018 (Tons)

Category	'14	'15	'16	'17	'18
Disposal	62,579	84,699	146,429	116,214	90,508
ADC	14,691	15,217	16,798	18,108	17,975
Exported TDF	110,404	94,040	62,476	113,405	135,236
In-State TDF	83,934	85,721	72,723	75,989	80,603
Other Recycling	564	533	0	76	3,455
Civil Engineering	12,632	11,668	10,961	6,436	5,127
Crumb/Ground Rubber	72,887	76,195	64,408	68,142	87,740
Reuse	84,619	74,285	81,373	89,784	90,617
Total Managed	442,311	442,358	455,168	488,153	511,262

Sources for Figure 4: 2002–2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007–present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary somewhat year to year as discussed in Appendix B. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

Source Data for Figure 5 California Waste Tire Reuse: 17 Year Trend

Year	Used Tires (Domestic and Export, Tons)	Retreads (Tons)	Total Reuse (Tons)
'02	15,000	23,000	38,000
'03	18,000	44,000	62,000
'04	16,000	44,000	60,000
'05	12,000	44,000	56,000
'06	21,000	44,000	65,000
'07	33,800	44,000	78,000
'08	33,600	44,200	78,000
'09	37,266	44,000	82,000
'10	37,942	36,018	74,000
'11	45,823	40,651	87,000
'12	51,678	39,838	91,000
'13	38,033	40,635	78,635
'14	42,278	42,341	84,619
'15	30,927	43,358	74,285
'16	39,032	42,341	81,373
'17	41,375	48,409	89,784
'18	42,692	47,925	90,617

Sources for Figure 6: 2002 – 2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007 – present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25

Source Data for Figure 6 National Trend in Retreader Share of U.S. Commercial Truck Tire Market

Item	2014	2015	2016	2017	2018
Retread Sales (Million Units)	15.6	15	14.5	14.3	14.2
Total Commercial Tire Sales (Million Units)	38.7	39.2	38	39.34	41.3
Retread Market Share (Percent)	40.3%	38.3%	38.2%	36.3%	34.4%

Source for Figure 6: Adapted from U.S. data from Modern Tire Dealer as presented by Clif Armstrong, Marangoni, at the Clemson University Tire Conference, April 2019. 2018 data is projected.

Source Data for Figure 7 California Waste Tires Used to Produce Crumb/Ground Rubber: 17-Year Trend

Year	Paving (Tons)	Turf (Tons)	Ground Rubber (Tons)	Molded / Other (Tons)	Total Crumb and Ground Rubber (Tons)
'02					58,000
'03	26,000				60,000
'04	27,000				62,000
'05	20,000				52,000
'06	39,000				66,000
'07	39,200	24,900	9,500	18,500	92,100
'08	43,200	24,400	11,500	21,400	100,500
'09	46,400	13,420	12,897	11,897	84,614
'10	50,307	13,724	11,047	10,443	85,521
'11	48,629	16,958	10,611	11,937	88,135
'12	51,600	21,552	17,700	13,931	105,244
'13	35,422	20,040	14,175	9,401	79,038
'14	34,708	16,821	11,404	9,953	72,887
'15	38,736	18,686	12,144	6,629	76,195
'16					64,408
'17					68,142
'18					87,740

Sources for Figure 7: 2002–2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007–present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

Note that flows to crumb/ground rubber sub-categories have not been published in recent years due to the small number of producers.

Source Data for Figure 8 California Waste Tires Used in Civil Engineering: 17-Year Trend

Year	Landfill CE (Tons)	Non-Landfill CE (Tons)	Total Civil Engineering (Tons)
'02			30,000
'03			18,000
'04			12,000
'05			20,000
'06			33,000
'07	25,500	9,800	35,340
'08	20,600	73	27,890
'09	13,975	3,535	17,510
'10	17,924	350	18,274
'11	5,915	0	5,915
'12	5,844	0	5,844
'13	2,612	1,945	4,557
'14	8,806	3,826	12,632
'15	10,374	1,294	11,668
'16	7,083	3,878	10,961
'17	5,583	853	6,431
'18	4,021	1,106	5,127

Sources for Figure 8: 2002 – 2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007 – present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25

Source Data for Figure 9 California Waste Tires Used as Landfill Alternative Daily Cover: 17-Year Trend

Year	ADC (Tons)
'02	39,000
'03	49,000
'04	45,000
'05	47,000
'06	45,000
'07	28,200
'08	20,580
'09	12,042
'10	7,928
'11	19,589
'12	10,486
'13	12,316
'14	14,691
'15	15,217
'16	16,798
'17	18,108
'18	17,975

Sources for Figure 9: 2002 – 2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007 – present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25

Source Data for Figure 10 California Waste Tires Consumed at In-State Cement Kilns: 17-Year Trend

Year	In-State TDF (Tons)
'02	61,000
'03	71,000
'04	81,000
'05	91,000
'06	83,000
'07	77,000
'08	75,020
'09	69,926
'10	83,675
'11	61,911
'12	77,209
'13	81,982
'14	83,934
'15	85,721
'16	72,723
'17	75,989
'18	80,603

Sources for Figure 10: 2002 – 2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007 – present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25

Source Data for Figure 11 Export of Size-Reduced TDF, Baled TDF and Used Tires: 17-Year Trend

Year	All Exports (Tons)	Baled TDF (Tons)	Sized-Reduced TDF (Tons)	Used Tires (Tons)	Combined Exports (Tons)	Percent Exported
'02					20,000	5.7%
'03					18,000	4.4%
'04					31,000	7.3%
'05					23,000	5.4%
'06					19,000	4.3%
'07	7,000			16,000		5.2%
'08	22,000			15,000		8.2%
'09	33,000			18,000		12.3%
'10	64,000			18,000		19.8%
'11	96,000			18,000		27.7%
'12	135,000			18,000		33.4%
'13	110,144			12,678		29.2%
'14		36,000	74,000	18,000		29.0%
'15		28,000	66,000	7,128		22.9%
'16		15,000	47,476	8,522		15.6%
'17		26,089	87,317	7,202		24.7%
'18		36,039	99,197	8,180		28.1%

Sources for Figure 11: 2002–2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007–present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25

Source Data for Figure 12 California Waste Tire Disposal: 17-Year Trend (Tons)

Year	Disposal (Tons)
'02	84,000
'03	105,000
'04	102,000
'05	102,000
'06	114,000
'07	114,510
'08	123,490
'09	113,046
'10	77,993
'11	49,700
'12	32,688
'13	53,320
'14	62,579
'15	84,699
'16	146,429
'17	116,214
'18	90,508

Sources for Figure 12: 2002 – 2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007 – present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

Source Data for Figure 13 15-Month Disposal Trend at Top Seven California Landfills Disposing Waste Tires (Tons)

Month	Net Tons (Deliveries Minus Pick-Ups)
Jan '18	4,409
Feb '18	5,512
Mar '18	7,328
Apr '18	7,328
May '18	5,152
Jun '18	5,227
Jul '18	5,960
Aug '18	6,569
Sep '18	5,515
Oct '18	6,875
Nov '18	6,374
Dec '18	6,414
Jan '19	6,805
Feb '19	4,467
Mar '19	4,320
Total	**88,254**

Source for Figure 13: This chart is based on monthly drop-off and pick-up data from comprehensive trip log forms submitted and analyzed through CalRecycle's WTMS system. The chart is presented solely to illustrate the trend. The monthly WTMS data have not been adjusted based on landfill and processor surveys, as the 2018 annual estimate was.

Source Data for Figure 14 Waste Tire Diversion and Disposal Trends

Year	Tons Disposed	Tons Recycled	Tons Otherwise Diverted	% Diverted	% Recycled
'01	84,000	148,000	101,000	74.8%	44.4%
'02	84,000	146,000	136,000	77.0%	39.9%
'03	105,000	158,000	147,000	74.4%	38.5%
'04	102,000	165,000	155,000	75.8%	39.1%
'05	102,000	151,000	170,000	75.9%	35.7%
'06	114,000	183,000	161,000	75.1%	40.0%
'07	115,000	205,230	113,150	73.5%	47.4%
'08	123,000	206,090	118,390	72.5%	46.1%
'09	113,046	183,629	115,681	72.6%	44.5%
'10	77,993	178,029	156,093	81.1%	43.2%
'11	49,700	180,896	178,236	87.8%	44.2%
'12	32,688	202,330	222,695	92.9%	44.2%
'13	53,320	162,263	204,451	87.3%	38.7%
'14	62,579	170,138	209,189	85.9%	38.5%
'15	84,699	162,680	194,978	80.9%	36.8%
'16	146,429	156,741	151,997	67.8%	34.4%
'17	116,214	164,438	207,502	76.2%	33.7%
'18	90,508	186,939	233,814	82.3%	36.6%

Sources for Figure 14: 2002–2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007–present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary somewhat year to year as discussed in Appendix B. All reports are available at https://www2.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25