California Waste Tire Market Report: 2017

CalRecycle

California Department of Resources Recycling and Recovery

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Jerry Brown
Governor

Matthew Rodriquez
Secretary, California Environmental Protection Agency

DEPARTMENT OF RESOURCES RECYCLING AND RECOVERY

Scott Smithline
Director

Department of Resources Recycling and Recovery
Public Affairs Office
1001 I Street (MS 22-B)
P.O. Box 4025
Sacramento, CA 95812-4025
www.calrecycle.ca.gov/Publications/
1-800-RECYCLE (California only) or (916) 341-6300

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1. Summary

This report summarizes California waste tire flows in 2017 and current trends as of spring 2018. The estimated flows are based on detailed analysis of information gathered from California companies, CalRecycle databases, and other sources.

In 2017, an estimated 485,475 tons (48.5 million PTEs[1]) of California-generated waste tires were managed, and flowed through various market segments as shown in Figure 1.

Figure 1
California Waste Tire Flows in 2017

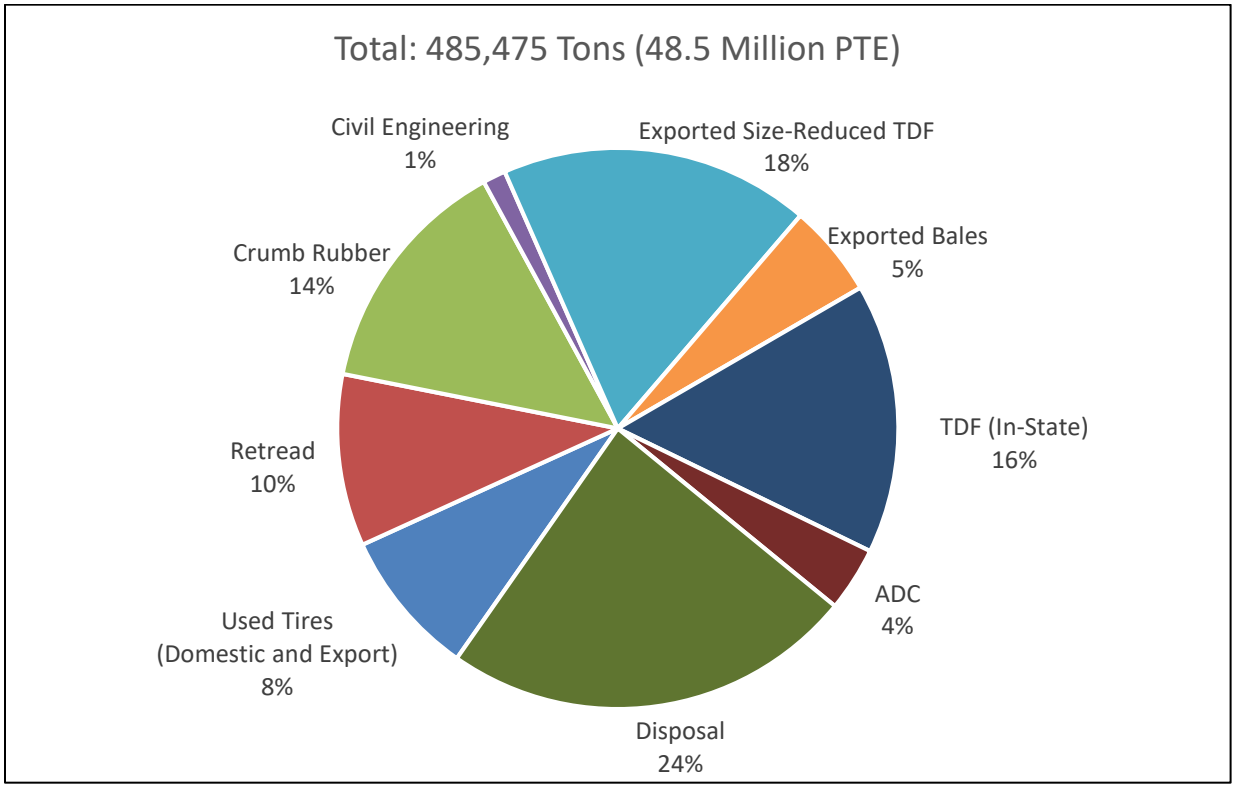
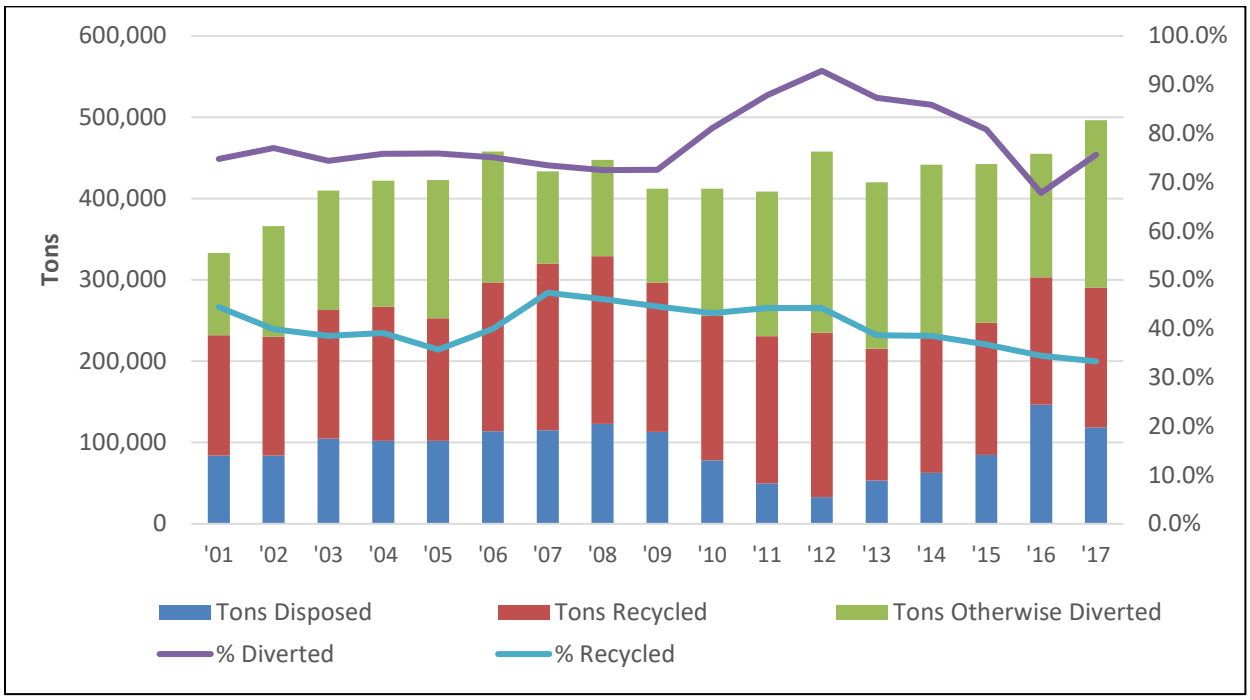


Figure 2 shows the 17-year trend for waste tire diversion, recycling, and disposal. The diversion rate (including all uses other than landfill) increased by eight percent in 2017, to 76 percent. This is after the diversion rate has fallen in each of the previous four years. This trend resulted from an 82 percent rebound in exports of size-reduced tire-derived fuel (TDF) shipped mainly to Japan, Korea, and baled whole tires destined for Vietnam and India (and assumed to be used as fuel).

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

On the other hand, the recycling rate (defined by CalRecycle to exclude alternative daily cover and TDF, whether used in state or exported) fell for the fifth year in a row, to 33 percent. Increases in crumb rubber and reuse were offset by a reduction in civil engineering uses, and a seven percent increase in the quantity of waste tires managed served to reduce the overall recycling rate. The increase in volumes of waste tires managed appears to be a result of both a stronger economy in recent years, as well as higher-than-typical unshipped inventories at the beginning of 2018 in some facilities. Survey responses suggest both diversion and recycling rates may increase in 2018, with potential increases in crumb rubber, civil engineering, and TDF (both export and in-state use).

Figure 2
Historical Waste Tire Recycling, Diversion and Disposal Trend



Following is a synopsis of trends by market segment.

Reuse: Overall, reuse increased by about twelve percent in 2017 to 89,784 tons (9.0 million PTEs), including retreads and used tires. An estimated 48,409 tons of tire casings (4.8 million PTEs) were retread in 2017. Despite strong industry concerns regarding the negative impacts of imported low-tier, low-price tires from China, this is about 14 percent higher than in 2016. An estimated 41,375 tons of used tires (4.1 million PTEs) were culled from waste tires flows and sold for reuse in 2017 about six percent higher than in 2016. About 17 percent of these used tires were exported, mainly to Mexico but also to other countries.

Crumb Rubber[2]**:** In 2017, about 68,142 tons of California waste tires (6.8 million PTEs) were used to produce crumb rubber, six percent more than in 2016. After falling from a peak of 105,200 tons (10.5 million PTEs) in 2012, California crumb rubber production could increase in coming years, with potentially increased demand in the paving, turf infill, and molded/other products segments. Three new tire-derived material production facilities have been permitted and could ramp up operations by late 2018.

Civil Engineering: Use of tire-derived aggregate (TDA) in civil engineering applications declined from 10,961 tons (1.1 million PTEs) in 2016 to 6,436 tons (0.6 million PTEs) in 2017. About 85 percent of this amount was used in projects at five landfills, with the remaining TDA being used in one low-impact development project in Santa Rosa. Based on TDA grant approvals in recent months, it appears civil engineering applications may consume about the same volume of TDA in 2018 as in 2017.

Alternative Daily Cover (ADC): In 2017, four landfills reported use of 18,108 tons of waste tires (1.8 million PTEs), about eight percent higher than in 2016. This amount is expected to decline significantly in 2018 as one of the landfills is slated to close.

Tire-Derived Fuel (In-State): Consumption of California whole waste tires and size-reduced TDF by four in-state cement kilns totaled 75,989 tons (7.6 million PTEs) in 2017, a four percent increase compared to 2016. An additional 16,329 tons (1.6 million PTEs) of TDF sourced from California processors was also consumed, but that material originated out-of-state. Also, 11,187 tons of tire fiber residual from crumb rubber facilities was consumed. TDF consumption is expected to increase slightly in 2018 as some users reported they used somewhat less than their maximum permitted capacity in 2017.

Exported Size-Reduced TDF and Bales: After peaking in 2012 at 135,000 tons (13.5 million PTEs), export of size-reduced TDF and baled waste tires dropped steadily to 62,476 tons (6.3 million PTEs) in 2016, and then rebounded sharply in 2017 to 113,405 tons (11.3 million PTEs). Exports continue to be strong thus far in 2018, buoyed by increased pricing for size-reduced TDF and an uptick in activity by California-based baling operations in Southern California.

Disposal: After hitting an all-time low in 2012 and then increasing for four consecutive years, waste tire disposal decreased 19 percent in 2017 to 116,214 tons (11.2 million PTEs). Disposal appears on track for continued decline in 2018 as exports, crumb rubber and civil engineering appear poised for growth. Some processors and tire-derived material producers say that disposal is the most profitable market outlet in some cases, until substantially stronger and more profitable markets are developed. Based on Waste Tire Manifest System data, disposal in the first third of 2018 is down by 25 percent compared to the 2017 pace.

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[2] In this report, “crumb rubber” means tire-derived material ¼ inch or smaller, and is also used to refer to the broad market segment that also includes ground rubber, typically ¼ to 1 inch in size, and nuggets, which may exceed 1 inch.

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. CalRecycle's goal is to achieve a 75 percent waste tire recycling rate. This is consistent with the requirements of AB 341 (Chesbro, Chapter 476, Statutes of 2011) that established a goal of achieving an overall statewide recycling rate of 75 percent by 2020. Affiliated goals include:

- Developing long-term, sustainable, and diversified market demand for California tire-derived products.
- 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.

CalRecycle's Five-Year Plan for the Waste Tire Recycling Management Program guides efforts to achieve these goals, and was last updated in May 2017. The next update will be prepared during the 2019 calendar year.

This report summarizes California waste tire flows in 2017 and current trends as of spring 2018. Boisson Consulting prepared the report with research and analysis support provided 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 summarizes 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. Most importantly, findings quantify use of California-generated waste tires in different market segments, and to do not include buffings from retreaders or out-of-state waste tires or tire-derived materials that may pass through California facilities. All data are converted to tons during the analysis; however, findings are also reported in Passenger Tire Equivalents (PTEs[3]) 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 sources of information, the

[3] PTE stands for Passenger Tire Equivalent, defined by CalRecycle regulations (14 CCR § 17225.770) to equal 20 pounds of tire rubber. The PTE is a useful reporting standard; however, actual waste tire weights vary significantly depending on their size, type, and amount of wear.

authors believe this report provides reasonably accurate information that can be used to evaluate California's waste tire market trends over time.

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 identify 1,358 registered waste tire haulers in California. These firms, some of which also operate processing facilities, offer waste tire collection and delivery services to a variety of generators located throughout the state, such as tire dealers and auto repair shops.

Twenty-nine companies have minor waste tire facility permits, which allow up to a maximum of 4,999 tires on site. Fourteen companies have major waste tire facility permits that specify higher maximums, the highest of which is 336,000 PTE on site at a given time. These permitted facilities may perform their own hauling, arrange hauling with outside firms, and/or receive waste tires from independent haulers. Some of the firms are primarily haulers and may use their facility primarily for culling and grading used tires prior to delivery of waste tires to a TDM producer or other facility.

This study focused on analyzing flows of waste tires to and from 22 waste tire facilities that handled over 75 percent of all California waste tires in 2017. The remaining 25 percent were either culled to segregate used tires, hauled to one of three cement kilns using whole tire TDF[4] or to a landfill, or were casings destined for retreading. Of the 22 facilities accepting whole tires that the study focused on:

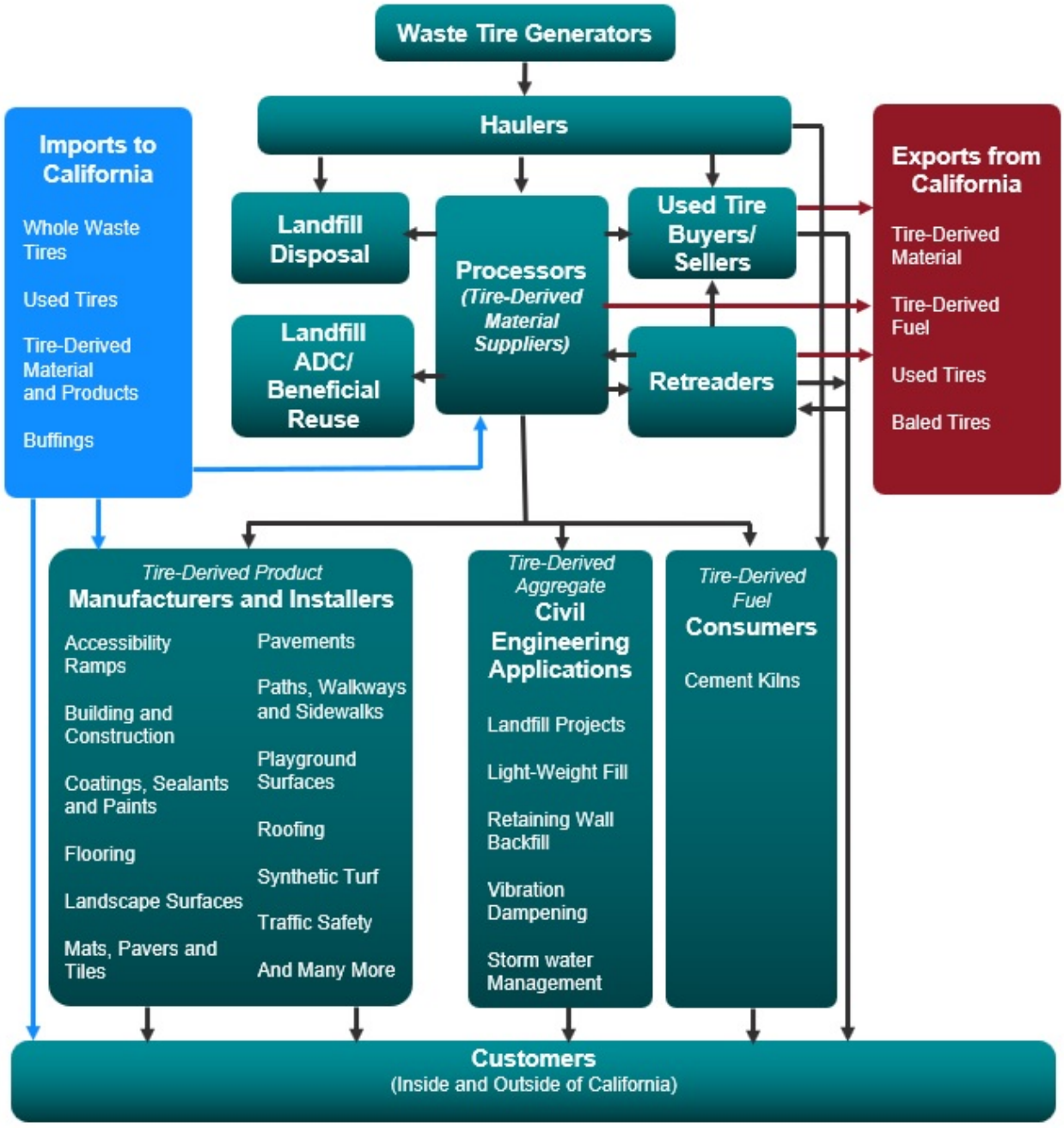
- Fifteen shipped a variety of culled tires, tire-derived materials, or tire-derived products to various end-use market segments, depending on which is most profitable and advantageous to the company's growth.
- Three facilities primarily produced crumb rubber. However, seven facilities in all have some level of capacity to produce crumb rubber or ground rubber, with three of these accounting for over 90 percent of such production in 2017. Three new crumb or ground rubber production facilities have been issued permits. One in Southern California has started operations, while two others in Northern California may begin operations later in 2018.
- Four facilities primarily engaged in baling and exporting waste tires, one in Northern California and three in Southern California.

These facilities may compete, to varying degrees, for waste tire supplies. In past years, and especially as waste tire exports peaked in 2012, competition sometimes became

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

aggressive and some were forced to reduce the fees they charge to pick up or receive tires.

Figure 3
California Waste Tire Recycling Industry Flow Chart



In recent years, however, pricing has largely stabilized and competitive pressures related to securing supplies have lessened. As new tire-derived material (TDM)

processing facilities become operational, it is possible that competition for waste tires may increase. But while demand for crumb rubber, tire-derived aggregate, and TDF (both in-state and export) may increase in 2018 and 2019, survey respondents did not report concerns over potential disruptions to their waste tire supplies and/or pricing.

Boisson Consulting identified and contacted eighteen tire-derived product manufacturers using California-sourced TDM for this study. These firms produce a wide variety of products, such as roofing, flooring, waterproofing, and outdoor surfacing products. In addition, a sampling of product brand owners and installers were contacted who offer on-site applications such as playground and other outdoor surfacing, synthetic turf athletic systems, and/or emulsified, porous mulch products. A wide variety of such firms operate in California, many of which may only use California-sourced TDM for in-state projects, and sometimes not at all. In addition, a sampling of firms in the paving industry were contacted, including asphalt producers, blenders and prime contractors.

Boisson Consulting identified and contacted thirty-six retreaders for this study. While most handle truck tires, a few specialize in various types of airplane or industrial tires.

Detailed information on California-made TDPs is available in CalRecycle's California Tire-Derived Product Catalog at www.calrecycle.ca.gov/Tires/Products/Catalog/.

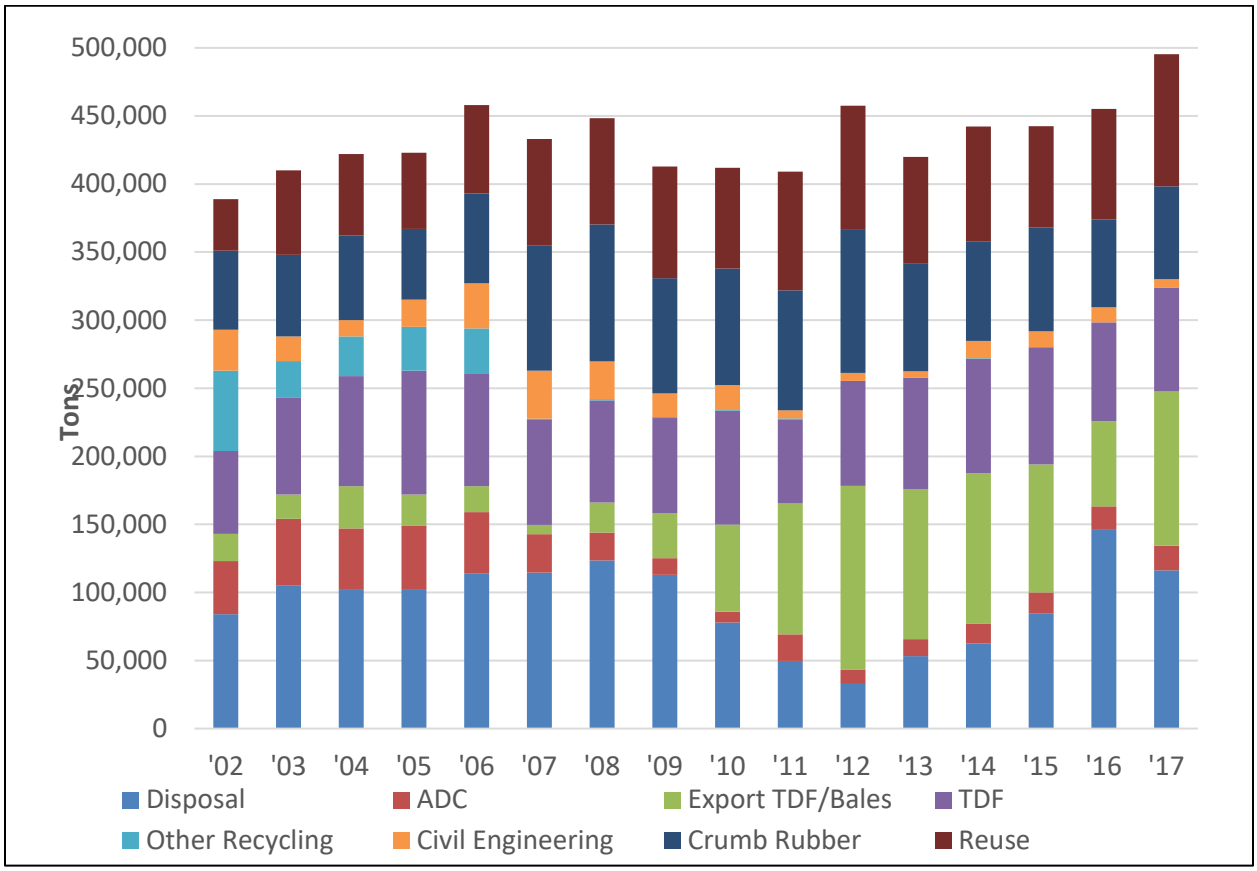
In 2017, 17 landfills were identified that accepted tires for disposal, with the top 10 of these handling over 95 percent of all waste tires disposed in the state. Since whole waste tires cannot be landfilled in California, these disposed tires were either shipped to a landfill equipped to size reduce whole tires, or were processed prior to delivery to the landfill. In addition, five landfills reported using TDA in civil engineering projects, and four landfills reported using tire shreds as ADC. One landfill in northern California that accepted waste tires for use as ADC will close in 2018.

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 for the past three years.

Figure 4
California Waste Tire Recycling Industry Flow Chart[5]



[5] 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 http://www.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

Table 1
Estimated End-Uses for California-Generated Waste Tires, 2015–2017

Category	Sub-Category	2015			2016			2017			Percent change '16 - '17
		Tons	Million PTEs	Percent of Total	Tons	Million PTEs	Percent of Total	Tons	Million PTEs	Percent of Total	
Reuse	Retread	43,358	4.3	9.8%	42,341	4.2	9.3%	48,409	4.8	10.0%	14%
	Used Tires (Domestic)	23,800	2.4	5.4%	30,510	3.1	6.7%	34,174	3.4	7.0%	12%
	Used Tires (Export)	7,128	0.7	1.6%	8,522	0.9	1.9%	7,202	0.7	1.5%	-15%
	Subtotal	**74,285**	**7.4**	**16.8%**	**81,373**	**8.1**	**17.9%**	**89,784**	**9.0**	**18.5%**	**10%**
Crumb Rubber	Paving	38,736	3.9	8.8%	Steady			Up 5 – 15%			NA
	Turf Infill	18,686	1.9	4.2%	Down 20-40%			Up 5 – 15%			NA
	Ground Rubber/Nuggets	12,144	1.2	2.7%	Down 25-35%			Down 5 – 10%			NA
	Molded & Other	6,629	0.7	1.5%	Steady			Up 5 – 15%			NA
	Subtotal	**76,195**	**7.6**	**17.2%**	**64,408**	**6.4**	**14.2%**	**68,142**	**6.8**	**14.0%**	**6%**
Civil Engineering	Landfill Applications	10,374	1.0	2.3%	7,083	0.7	1.6%	5,583	0.6	1.1%	-21%
	Non-Landfill Applications	1,294	0.1	0.3%	3,878	0.4	0.9%	853	0.1	0.2%	-78%
	Subtotal	**11,668**	**1.2**	**2.6%**	**10,961**	**1.1**	**2.4%**	**6,436**	**0.6**	**1.3%**	**-41%**
Other Recycling		**533**	**0.1**	**0.1%**	**0**	**0.0**	**0.0%**	**76**	**0.0**	**0.0%**	**NA**
Exported TDF	Size-Reduced TDF	65,614	6.6	14.8%	47,476	4.7	10.4%	87,317	8.7	18.0%	84%
	Baled Waste Tires	28,426	2.8	6.4%	15,000	1.5	3.3%	26,089	2.6	5.4%	74%
	Subtotal	**94,040**	**9.4**	**21.3%**	**62,476**	**6.2**	**13.7%**	**113,405**	**11.3**	**23.4%**	**82%**
Tire-Derived Fuel (In-State)		**85,721**	**8.6**	**19.4%**	**72,723**	**7.3**	**16.0%**	**75,989**	**7.6**	**15.7%**	**4%**
Alternative Daily Cover		**15,217**	**1.5**	**3.4%**	**16,798**	**1.7**	**3.7%**	**18,108**	**1.8**	**3.7%**	**8%**
Landfill Disposal		**84,699**	**8.5**	**19.1%**	**146,429**	**14.6**	**32.2%**	**116,214**	**11.6**	**23.9%**	**-21%**
Estimated Total Managed		**442,358**	**44.2**	**100.0%**	**455,168**	**45.5**	**100.0%**	**485,475**	**48.5**	**100.0%**	**7%**
Total Diverted from Landfill		**357,659**	**35.8**	**80.9%**	**308,738**	**30.9**	**67.8%**	**369,262**	**36.9**	**76.1%**	**20%**
Total Recycled		**162,680**	**16.3**	**36.8%**	**156,741**	**15.7**	**34.4%**	**161,760**	**16.2**	**33.3%**	**3%**
Imports		23,382	2.3	5.3%	55,253	5.5	12.1%	49,906	5.0	10.3%	-10%

A number of macro-level trends are impacting, or potentially could impact, California waste tire markets. These include:

- Pending Legislation – AB 2908 (Frazier), if adopted, would authorize CalRecycle to expend reserves from the Waste Tire Fund and then to implement an additional fee of up to $1.00 per tire sold in California, with the proceeds used to implement a new and expanded Tire Recycling Incentive Program. As currently drafted, CalRecycle would have the authority to adjust many aspects of the program; however, at least 50 percent of funds would go to rubberized paving projects. Analysis of specific potential impacts is beyond the scope of this study.

- Strong Economy – This increases waste tire generation, used tire supply and demand, and demand for many market segments.

- Trade Policies in the U.S. and Abroad – Concerns by some in Mexico over used tire imports from the U.S. could potentially trigger changes in export volumes to Mexico, especially in the context of negotiations to update NAFTA. China's National Sword policies restricting a variety of scrap imports are not expected to impact future waste tire exports as baled waste tires from California are typically shipped to Vietnam and reportedly continue to flow into China unimpeded from there. U.S. tariffs on steel and aluminum could potentially increase domestic demand and pricing for tire wire and steel, while negatively affecting export markets for steel. The decision by the U.S. International Trade Commission in 2017 to not adopt tariffs on select low-tier, low-cost Chinese truck and bus tire imports may trigger growing concerns for retreads and used tire markets, amid continued uncertainty surrounding U.S.-China trade negotiations.

- Petroleum Pricing – After dropping to as low as $30 a barrel in 2014, crude oil prices have more than doubled and are continuing to rise.[6] This is reportedly helping to trigger growth in size-reduced TDF exports; if oil prices continue to rise significantly, it could benefit certain tire recycling markets such as TDF, certain feedstock conversion markets where crumb rubber replaces virgin rubber or polymers, and/or emerging technologies such as devulcanization.

- California State and Local Infrastructure Funding Strong but Possibly Threatened – Adoption of SB 1 in 2017 promises over $50 billion (over 10 years) in infrastructure spending, which could benefit paving and civil engineering markets significantly. However, a voter initiative has qualified for the November 2018 ballot (Proposition 6) that would repeal the funding

[6] Macro Trends. Accessed online on May 20, 2018 at http://www.macrotrends.net/1369/crude-oil-price-history-chart.

mechanisms that were adopted as part of SB1 (i.e., gas and diesel tax increases and vehicle registration fees). Many local governments have also adopted new infrastructure funding policies recently, and a large number of construction projects are already moving forward.

- Low Unemployment rate, Increasing Minimum Wage, Increasing Workers Compensation Insurance Rates – Several survey responses cited these increasing costs as detrimental, both to profitability and the challenge of finding and retaining qualified employees.

- Increasing Population – California's population continues to grow steadily, and is currently at 39.8 million. This increases waste tire generation and the need for expanded infrastructure and products to meet growing demand.

As appropriate, these trends and potential impacts are further described in the discussion of each market segment below.

Reuse

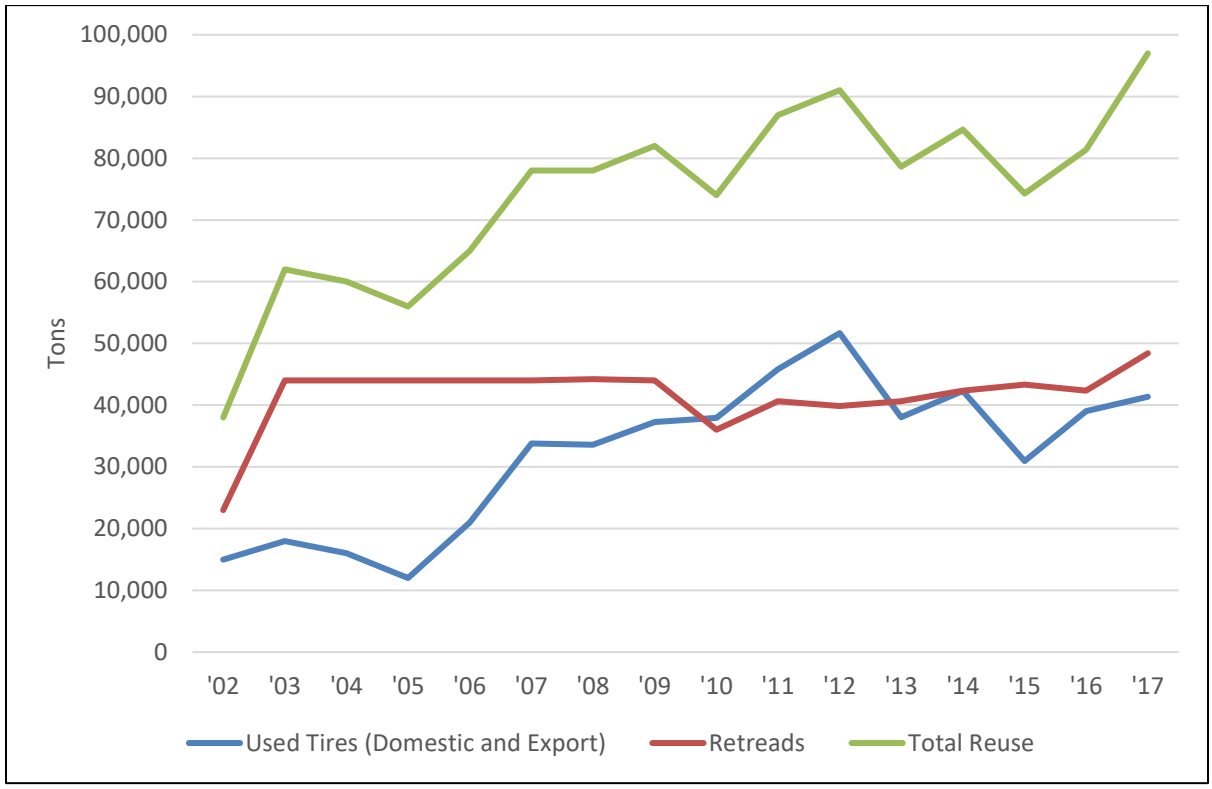
As shown in figure 5, both retreading and sale of used tires continue to be very strong, profitable market segments that are relatively stable with little room for additional growth. Overall, estimated California tire reuse increased by about ten percent in 2017, to 89,784 tons (9.0 million PTEs). Survey responses suggest growth in reuse may be driven mainly by a stronger economy, with more trucking to fuel retreading and consumers choosing to purchase new tires or vehicles sooner than they otherwise might.

Firms involved in these market segments continue to be concerned over the growing number 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 often have a lower potential for reuse or retreading due to lower quality standards. In a surprise move, in March 2017 the U.S. International Trade Agency rejected a system of tariffs that the Department of Commerce proposed and had already implemented on an interim basis. The retread industry and some tire manufacturers are advocating to reinstate the tariffs.

Retread Tires

An estimated 48,409 tons of tire casings (4.8 million PTEs) were retread in 2017. Despite widespread strong industry concerns regarding the negative impacts of imported low-tier, low-price tires from China, this is about 14 percent higher than in 2016. There is plenty of capacity to increase retreading; based on survey responses, the average retreader is operating at about 64 percent of maximum capacity. As in previous years, retreaders reported very mixed trends as some gain or lose market share and compete for growing demand.

Figure 5
California Waste Tire Reuse: 15 Year Trend



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. All reports are available at http://www.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

In 2017:

- Twenty-nine percent said business was down, by an average of 4.6 percent.
- Forty-one percent said business was up, by an average of 9.9 percent.
- Twenty-nine percent said business was about the same as in 2016.

Looking forward to 2018:

- Nine percent said they expect business to be down, by an average of ten percent.
- Sixty percent said they expect business to be up, by an average of 8.6 percent.
- Twenty-seven percent said they expect their business to be about the same as in 2017.

Used Tires

An estimated 41,375 tons of used tires (4.1 million PTEs) were culled from waste tires flows and sold for reuse in 2017, about six percent higher than in 2016, with about 17 percent of these used tires exported mainly to Mexico but also to other countries. Each year Mexico establishes a quota limiting the number of used tires imported from California. While there is strong demand for used tires there, Mexican tire dealers argue it undercuts their sales, and some argue that a significant number of waste tires are included in the exported graded used tires. In 2017, these concerns contributed to a delay in setting the quota, which cut-off "formal" used tire exports until late March when a 2017 quota of about 800,000 tires (similar to recent years) was finally established.[7] Growth in used tires appears to be driven by increased economic activity, with some retreaders reporting reduced volumes as a result of lost sales and reduced reuse opportunities attributed to the low-cost, low-tier Chinese tire imports.

Crumb Rubber

Overview

In 2017, about 68,142 tons of California waste tires (6.8 million PTEs) were estimated to have been used to produce crumb rubber, four percent more than in 2016. The 2017 estimate excludes an additional 2,359 tons (0.2 million PTEs) used by California crumb rubber producers that originated in other states. Buffings from retreaders are excluded from crumb rubber estimates and are not included in recycling rates (since the retread

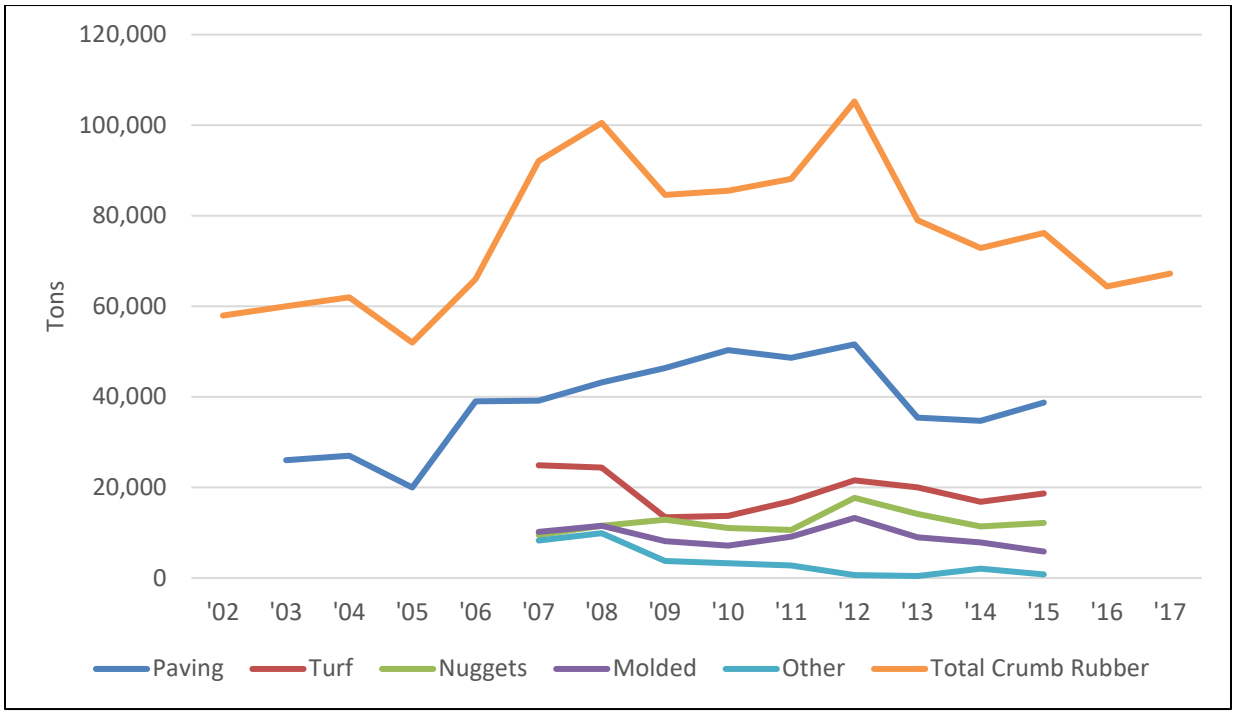
[7] UniMexicali, March 17, 2017. Accessed online at: http://www.unimexicali.com/noticias/tijuana/470909/liberan-cuota-de-importacion-de-llantas-usadas-para-bc.html

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 are currently in high demand.

As in 2016, this report does not include specific, quantified estimates of the amount of California-produced crumb rubber shipped to each segment. This is to protect confidentiality, since one large producer closed in 2016. Additionally, 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. Over 11,000 tons of fiber was reportedly consumed by California cement kilns for fuel.

As shown in Figure 6, the use of California waste tires to produce crumb rubber hit a peak in 2012 of 105,200 tons (10.5 million PTEs), but has fallen in recent years. This trend could turn around in 2018. As discussed further below, demand in the paving and molded/other product segments is growing and, after sharp declines in 2016, the turf infill and ground/nugget segments may be stabilizing and rebounding.

Figure 6
California Waste Tires Used to Produce Crumb Rubber: 17-Year Trend



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. All reports are available at http://www.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

Three new crumb rubber production facilities are planning to ramp up operations in 2018. One Southern California facility has begun production, while two others in

Northern California have not yet begun production (as of May 2018). In 2017, some crumb producers reportedly imported some supplies from out of state to meet their customers' needs as demand in the paving segment increased. The extent to which the California production of crumb rubber grows will depend on how much demand increases in 2018, and the extent to which new California crumb producers can capture market share, or establish partnerships with existing producers to help satisfy their customers' needs. Following is a summary of market segments within the "crumb rubber" category.

Paving

In recent years, the paving segment has consumed about half of all California-produced crumb rubber. According to crumb rubber and paving industry representatives, use of crumb rubber in paving applications in 2016 was roughly flat compared to 2015 but grew in 2017, by approximately 5 to 15 percent.

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. In the most recent published annual report[8] covering 2015, Caltrans reported total asphalt use of over 4.1 million tons, and use of asphalt containing crumb rubber of 1.7 million tons, for a usage rate of 41.3 percent, exceeding the statutory goal by more than six percent. Caltrans estimates this equates to total use of 61 million pounds of crumb rubber in state paving applications. In addition to Caltrans' state project consumption of of crumb rubber, CalRecycle Grants Program data indicate that about an additional 11 million pounds of California crumb rubber was used in local rubberized pavement grant projects in 2015 (based on a share of the grants funded in fiscal years 2013/14, 2014/15 and 2015/16, since grantees have three years to expend funds). The combined total of 72 million pounds used in paving does not include use of crumb rubber in local paving projects outside of CalRecycle grants. Industry surveys suggest the amount of crumb rubber used in California paving projects grew modestly between 2015 and 2017. Taken together, this suggests that a significant amount of crumb rubber was sourced from out-of-state suppliers to meet paving demand.

Most are optimistic that crumb rubber demand in the paving segment will grow significantly in 2018 and over the next several years. Reasons for this optimism include:

- A large infrastructure-funding bill was adopted in 2017 (SB1, Beall) that will funnel $52 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

[8] California State Transportation Agency, "2015 Crumb Rubber Report." http://www.dot.ca.gov/hq/maint/Pavement/Offices/Planning_Programming/PDF/2015_Crumb_Rubber_Report.pdf

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. Several local governments have also adopted additional new infrastructure funding policies that could further boost this trend. On the down side, a voter initiative has qualified for the November 2018 ballot (Proposition 6) that would repeal the funding mechanisms that were adopted as part of SB1 (i.e., gas and diesel tax increases and vehicle registration fees). While approval of this measure would eliminate the anticipated benefits of SB1 in coming years, many projects are already planned or underway.

- Consistent with the new funding, Caltrans' 2017 State Highway System Management Plan lays out plans to significantly increase paving levels across the state.
- 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, at least in some Caltrans districts. Combined with long-standing use by certain local governments (especially in Southern California), this has helped establish a solid base demand for rubberized asphalt products and applications. It also ties a portion of crumb rubber use directly to the total amount of surface paving performed.
- As documented by the California Asphalt Paving Association (CalAPA), paving industry stakeholders widely expect paving levels to increase substantially. According to one observer, "SB1 will provide a whole lot of money that may create funding opportunities that exceed any prior year by five times, creating more projects and work."[9]
- CalRecycle continues to allocate significant funding to local government rubberized paving grants. Most recently in December 2017, CalRecycle approved 34 awards totaling $5.8 million. As noted above, pending legislation (AB 2908, Frazier) would significantly increase and restructure CalRecycle funding programs. As currently written, 50 percent of funding would flow to local paving projects.
- Caltrans continues to work with paving industry stakeholders to test alternative approaches to further boost use of crumb rubber in paving. The so-called *PG + X* working group hopes to complete several pilots and ultimately develop new specifications over the next several years. There is a significant amount of controversy over the specific approach and details of

[9] California Asphalt: The Journal of the California Asphalt Paving Association. 2018 Forecast Issue. Page 18. (Quote edited for clarity.)

this effort, and it is currently uncertain what its outcomes may be and when they may impact use of crumb rubber.

Turf Infill

In recent years, roughly a quarter of California-produced crumb rubber has been used as infill in synthetic turf athletic fields. However, persistent media reports related to environmental health and safety issues significantly impacted use of crumb rubber as turf infill over the past couple years. In 2016, industry representatives estimated such use was down nationally by approximately 30 percent, and last year's California's Waste Tire Market Report estimated California crumb use in turf infill was down 20 to 40 percent in 2016. However, use of crumb rubber in turf infill projects appears to have rebounded in some areas since 2016. While use of crumb rubber infill remains low in certain parts of Northern California, it has increased in other areas of the state. Overall, survey responses indicate that in 2017 use of crumb rubber infill in California turf projects increased by approximately 5 to 15 percent over the relatively low levels in 2016. Out-of-state sources met an undetermined amount of this demand.

The rebound is supported by favorable findings in reports published in the last year or two by Washington State Department of Health (the State from which initial controversy originated),[10] the Netherlands National Institute for Public Health and the Environment,[11] and the European Chemical Agency[12] (ECHA)

Two major, additional ongoing studies in the U.S. could provide the most in-depth analysis and conclusions regarding the safety of crumb rubber infill to date. Under contract to CalRecycle, the California Office of Environmental Health Hazard Assessment (OEHHA) is conducting a study, with preliminary results expected in 2019. A coalition of federal agencies—including the U.S. Environmental Protection Agency (U.S. EPA), the Centers for Disease Control and Prevention (CDC), Agency for Toxic Substances and Disease Registry (ATSDR), and the Consumer Product Safety Commission (CPSC)—is also conducting a study. This study may also be available in 2019.

Ground Rubber/Nuggets

This segment includes several different products such as nuggets used as ground cover, emulsified rubber, porous mulch applications, equestrian surfacing, and ballistics applications. It also includes use of loose ground rubber as playground surfacing,

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[10] Washington Department of Health, "Investigation of Reported Cancer Among Soccer Players in Washington State." 2017.

[11] The Netherlands National Institute for Public Health and the Environment, "Evaluation of Health Risks of Playing Sports on Synthetic Turf Pitches with Rubber Granulate." December 2016.

[12] European Chemical Agency. "An Evaluation of the Possible Health Risks of Recycled Rubber Granules used as Infill in Synthetic Sports Fields." February 2017.

although there were reportedly little or no such uses in 2017. These market segments are grouped together because they all use ground rubber (i.e., TDM of ¼ inch to ¾ inch in size) or nuggets (which may range in size to more than 1 inch). In 2017, consumption of California TDM in the ground rubber and nugget market category is estimated to have declined by five to 10 percent.

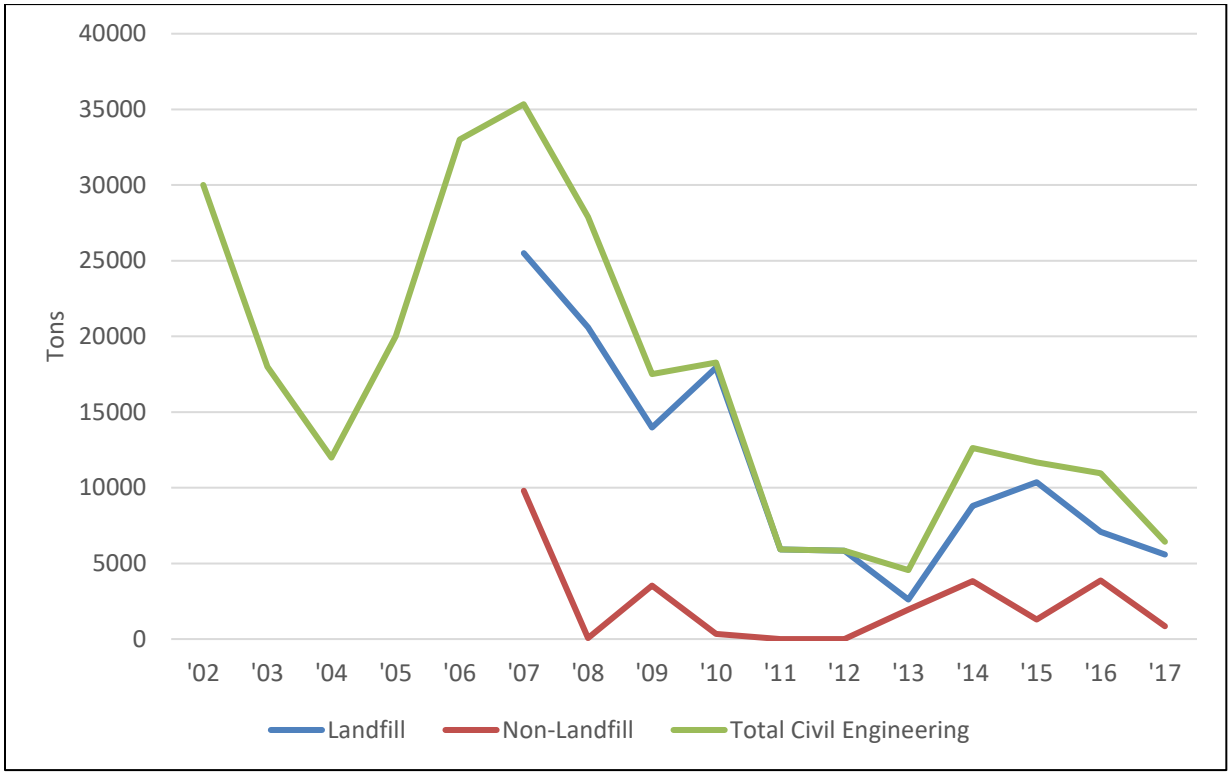
Molded and Other Tire-Derived Products

In recent years, this market segment has consumed about 15 percent of California crumb rubber. In 2017, use of California-produced crumb rubber to manufacture molded tire-derived products appears to have increased by approximately five to 10 percent, buoyed in part by CalRecycle's Tire Incentive Program that provides 10 to 50 cents per pound for use of California-produced crumb rubber in select manufactured products. As in past years, this market segment includes the most diverse range of producers and products. While many are well established, others have seen slow or no growth and continue to use only small amounts of crumb rubber in their products. In the short term, usage in this segment is expected to continue growing modestly. However, if new funding is secured through the pending legislation discussed above, it could further catalyze increased product innovation and marketing, potentially further boosting these levels.

Civil Engineering

As shown in Figure 7, estimated use of tire-derived aggregate (TDA) in civil engineering applications declined from 10,961 tons (1.1 million PTEs) in 2016 to 6,436 tons (0.6 million PTEs) in 2017. About 85 percent of this amount flowed to landfill civil engineering projects at five landfills, with the remaining TDA being used largely in one road repair project in Santa Rosa. Based on TDA grant approvals in recent months, it appears civil engineering applications may consume about the same volume of TDA in 2018 as in 2017. This is on top of any continuing projects and additional new projects that may be developed later.

Figure 7
California Waste Tires Used in Civil Engineering: 15-Year Trend



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. All reports are available at http://www.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

Landfill Civil Engineering Applications

About 85 percent of TDA volumes in 2017 was used in civil engineering projects at five landfills, for a total of 5,583 tons (0.6 million PTEs). Based on three recently approved TDA grants, about 4,000 tons per year is expected to be used in landfill civil engineering projects in 2018 and again in 2019, in addition to ongoing and any new projects. While some are currently using low volumes, landfills as a category could potentially be a consistent market for TDA. California landfills generally report using TDA in connection with gas collection systems and leachate drainage channels.

Non-Landfill Civil Engineering Applications

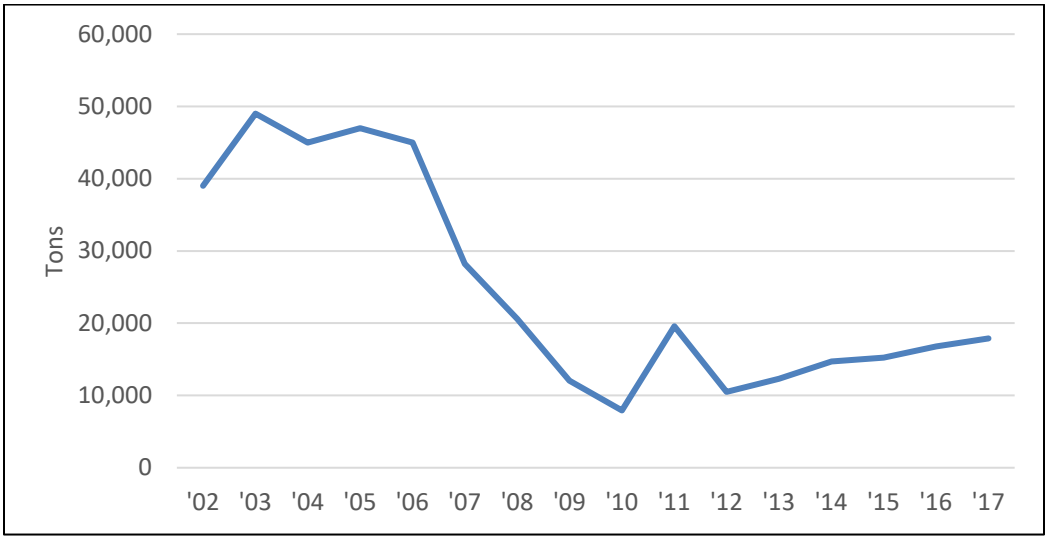
In 2017, 853 tons of TDA were reported to be used in one low-impact development project in Santa Rosa, outside of the grant program. This was the only non-landfill civil engineering project identified for 2017. However, based on five recently approved TDA grants, including four roadway repair projects and one low-impact development project, about 7,385 tons (0.7 million PTEs) are expected to be used in 2018, and 2,961 tons (0.3 million PTEs) in 2019. 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.

Alternative Daily Cover (ADC)

Tire shreds are used as ADC at some landfills to cover disposed waste at the end of each day. In 2017, four landfills in central or northern California reported combined use of 18,351 tons of tire shreds (1.8 million PTEs) used as ADC, an eight percent increase over the amount used in 2016 as shown in Figure 8. About 243 tons of this was derived from tires imported from out of state and not included in Table 1 above. This amount is expected to decline in 2018 as one of these landfills, which accepted 17 percent of the 2017 total, is slated to close.

Figure 8
California Waste Tires Used as Landfill Alternative Daily Cover: 15-Year Trend



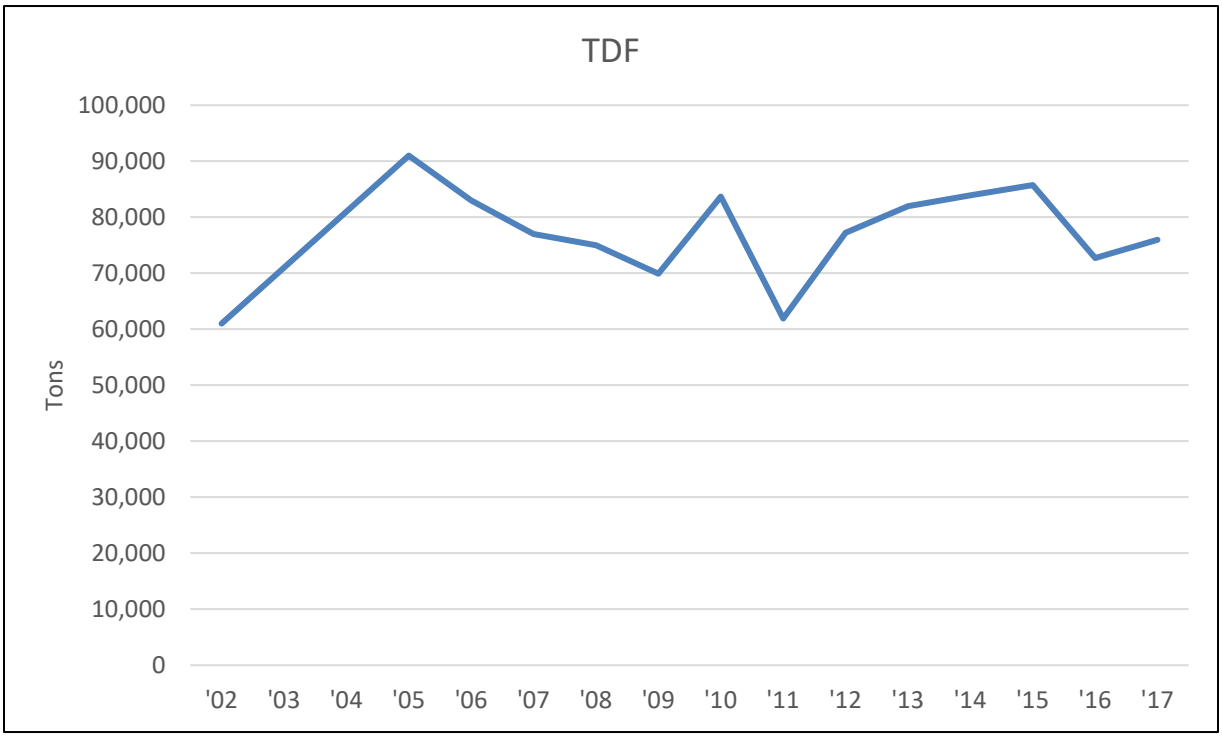
Source: 2002 – 2006 data are from California Waste Tire Generation, Markets, and Disposal Reports prepared by CalRecycle Staff. Data covering 2007 – present are from California Waste Tire Market Reports prepared by CalRecycle contractors. Methodologies may vary year-to-year as discussed in Appendix B.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

Tire-Derived Fuel

Four California cement kilns continue to use significant quantities of size-reduced TDF or waste tires. As shown in Figure 9, these facilities provide a strong, steady market that thrives without government support. (Statute precludes CalRecycle from promoting TDF markets.) In 2017, these plants consumed an estimated 75,989 tons of California-generated waste tires (7.6 million PTEs), including both whole tires and size-reduced TDF, which is five percent more than in 2016. This does not include an additional 11,187 tons of tire fiber produced as a residual product at California crumb rubber production facilities, or 16,899 tons of waste tire TDF (1.7 million PTEs) derived from out-of-state waste tires imported to California processors that shipped TDF to these cement kilns. These cement kilns are already using TDF at or near their maximum

potential based on current operations and permitting restrictions. However, survey responses indicate a slight increase in 2018 is likely.

Figure 9
California Waste Tires Consumed at In-State Cement Kilns: 15-Year Trend



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. All reports are available at http://www.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

Imports and Exports

Used Tires and Casing Imports and Exports

Culled and graded used tires have long been a staple export from California. In 2017, an estimated 7,202 tons of used tires (0.7 million PTEs) were exported, mainly to Mexico but also to several other countries. Based on survey responses and WTMS data, California imported over a million additional used, either as already-culled used tires or as mixed waste tires that were culled here, for resale in California or nearby states, or for export. As described in the reuse section above, Mexico limits imports of used tires from the U.S. via a quota system, typically at a level of around 800,000 tires per year. In 2017, amidst concerns in Mexico over impacts on tire dealer new tire sales and over waste tires accompanying used tire imports, establishment of the quota was delayed until late March, temporarily halting the “formal’ flow of used tire exports into Mexico from California. Also, as shown in Table 2, retreader surveys indicate 2,678 tons

of truck tire casings (0.3 million PTEs) originating out-of-state flowed to and were retread by California facilities.

Waste Tire Imports

In 2017, an estimated 49,906 tons of waste tires (4.9 million PTEs) were imported from out of state and flowed to several California processors. This estimate does not include casings destined for retreading or already-culled used tires imported into California directly for the purpose of sale or export. The processors importing these waste tires, in turn, shipped whole waste, used tires, and 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 amount of imported tires or TDM subtracted from the flows from California processors to each market segment is shown in Table 2.

Table 2
Estimated Market Disposition of Waste Tires Imported to California Processing Facilities (2017)

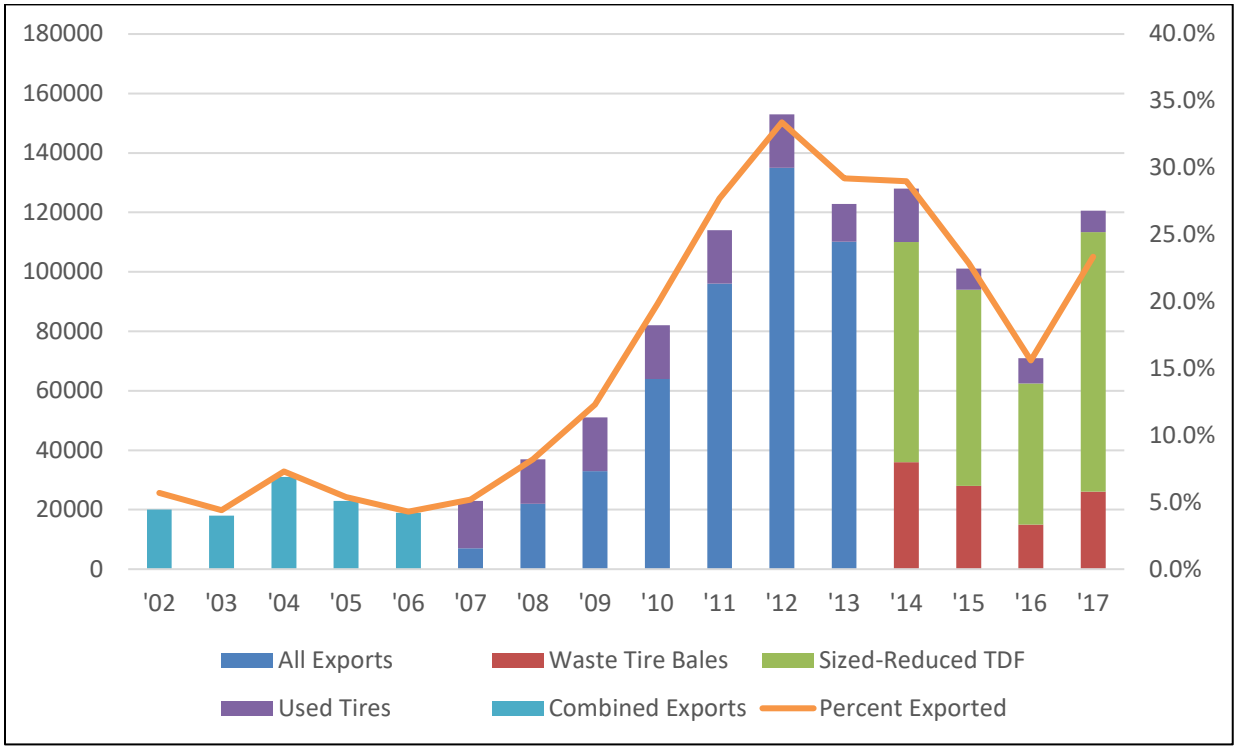
Category	Sub-Category	Adjustments Made to Shipments from California Processors to Account for Imported Tires (Tons)
Reuse	Retread	2,678
	Used Tires (Exported)	2,378
	Used Tires (Domestic)	6,192
	Subtotal	11,247
Crumb Rubber		2,359
Civil Engineering	Landfill Applications	118
	Non-Landfill Applications	0
	Subtotal	118
Other Diversion		0
Alternative Daily Cover		243
Export of TDF	Processed TDF	16,899
	Baled Waste Tires	0
	Subtotal	16,899
Tire-Derived Fuel		16,329
Landfill Disposal		2,709
Total Imports		49,906

Export of Size-reduced TDF and Baled Waste Tires

As shown in Figure 10, after peaking in 2012 at 135,000 tons (13.5 million PTEs), export of size-reduced TDF and baled waste tires dropped steadily to 62,476 tons (6.3 million PTEs) in 2016, and then rebounded sharply in 2017 to 113,405 tons (11.3 million PTEs). In 2017, the amount of size-reduced TDF exported (primarily to Japan and Korea) was 87,317 tons (8.7 million PTEs), and the amount of baled waste tires exported (primarily to Vietnam) was 26,089 tons (2.6 million PTEs). An additional 16,899 tons of waste tires (1.7 million PTE) originating out-of-state were also used by

California-based TDM producers to produce size-reduced TDF for export. Increasing prices for competing fuels, especially petroleum, was cited as a key driver for exported size-reduced TDF. Reportedly, landfill tip fee increases in Southern California may be contributing to an uptick in baler activity in that region. Exports appear to continue to be strong thus far in 2018 and could increase even further.

Figure 10
Export of TDF, Baled Waste Tires, and Used Tires: 15-Year Trend



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. All reports are available at http://www.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

Crumb Rubber and TDP Imports and Exports

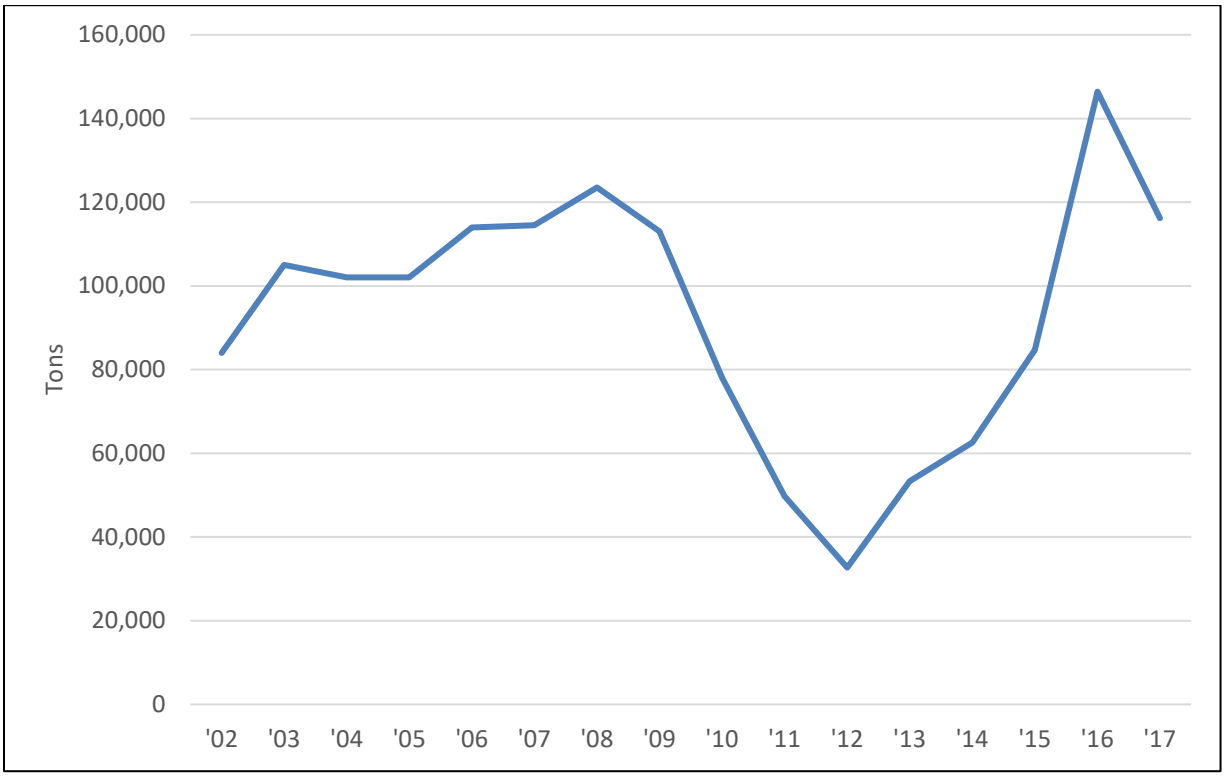
According to some California producers, in 2017 crumb rubber from other states and Canadian provinces continued to be sold in California at competitive prices, despite transportation costs. They attribute this to large incentive payment subsidies and favorable operating conditions in some of these jurisdictions (i.e., lower operating costs).

Disposal

As shown in Figure 11, disposal of California-generated waste tires has varied widely in recent years. After hitting an all-time low in 2012 of 32,668 tons (3.3 million PTEs), largely due to rapid increases in exports, disposal increased in four consecutive years

as exports and crumb markets declined, rebounding to 146,429 tons (1.5 million PTEs) in 2016. However, in 2017, the trend reversed again, with disposal declining by 21 percent to 116,214 tons (11.6 million PTEs) again largely due to an increase in exports. Some processors continue to report that in some cases landfill disposal is their most profitable market outlet and that much stronger, more sustained recycling market demand and pricing is needed to sustain lower disposal levels over the long-term.

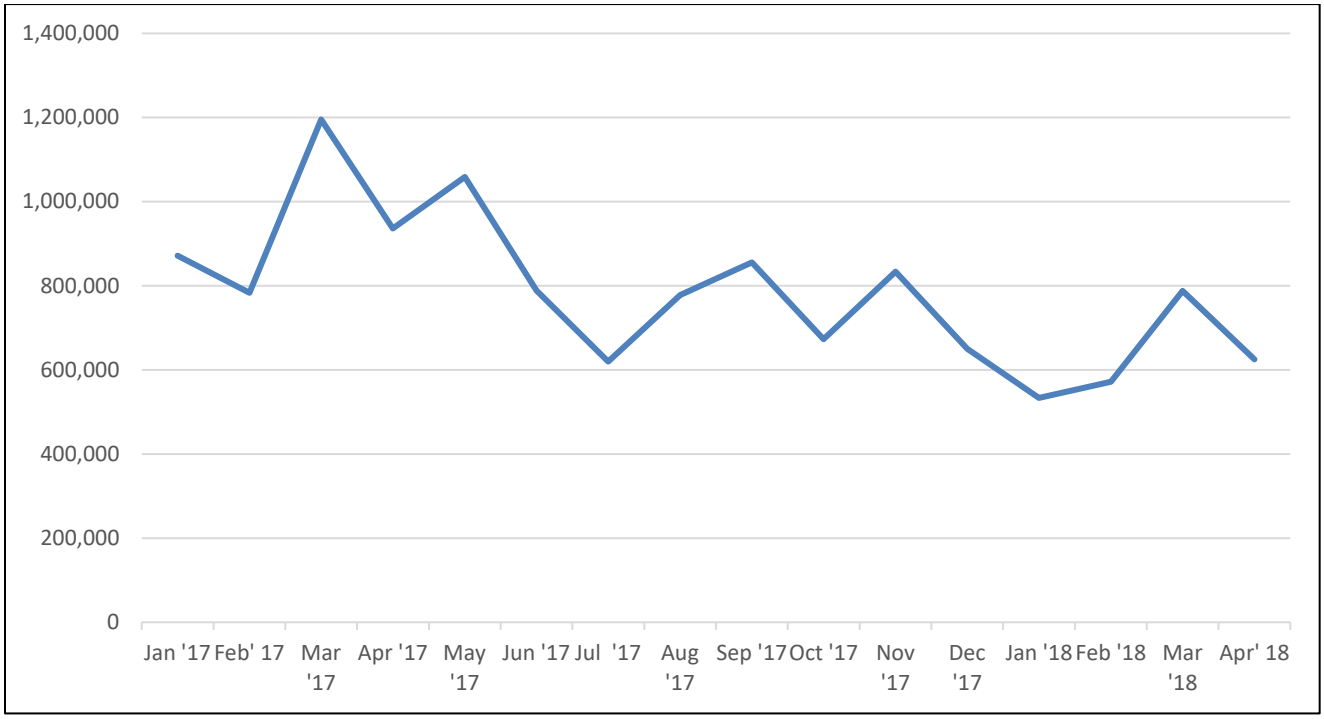
Figure 11
California Waste Tire Disposal: 15-Year Trend



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. All reports are available at http://www.calrecycle.ca.gov/publications/PublicationsByCategory.aspx?CategoryID=25.

With potential increases in crumb rubber and civil engineering volumes, as well as apparently sustained and steady growth in TDF and bale export markets, 2018 disposal may decline again somewhat, leading to a modest uptick in recycling and diversion rates. Based on Waste Tire Manifest System data, and as shown in Figure 12, disposal in the first third of 2018 is down by 25 percent through March, compared to the 2017 pace.

Figure 12
15-Month Disposal Trend at Top 10 California Landfills Disposing Waste Tires

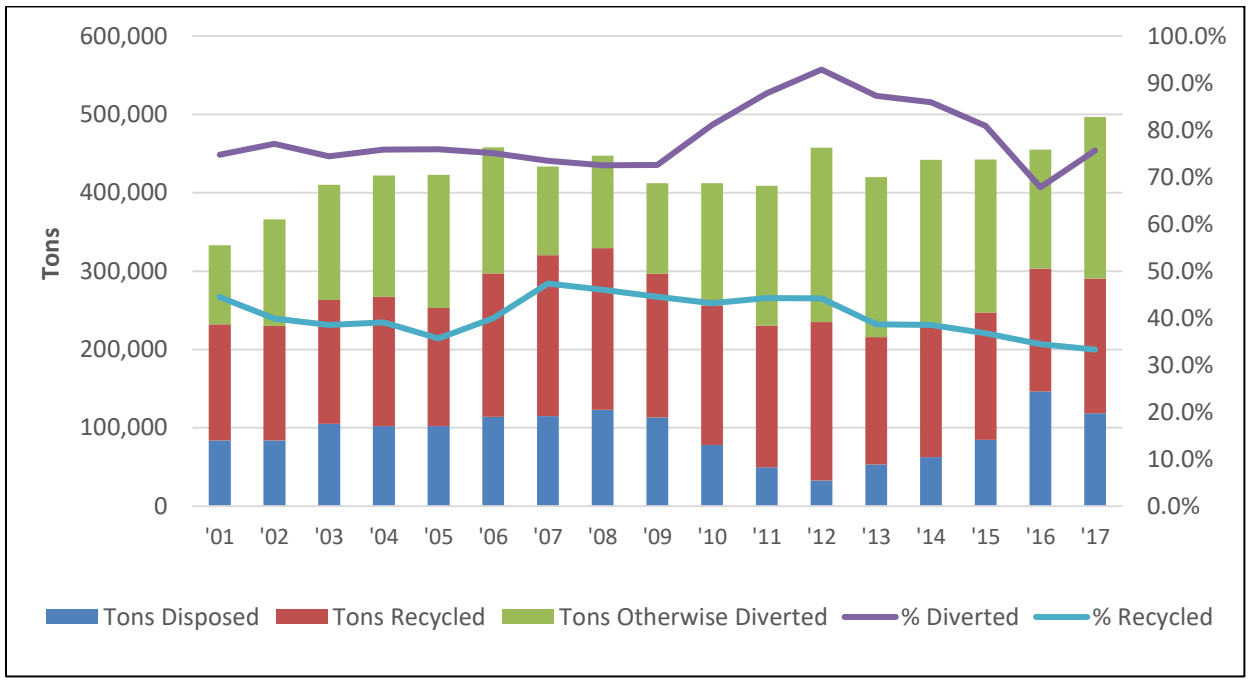


5. Diversion and Recycling Outlook

This section summarizes the outlook for increasing waste tire recycling and diversion in California, based on survey responses and other information gathered.

In 2017, waste tire diversion increased while recycling decreased. As detailed in Section 1, California has a goal of achieving a 75 percent recycling rate for all waste materials including tires by 2020 per AB 341 (Chesbro, Chapter 476, Statutes of 2011) and, although not codified in statute, CalRecycle has also adopted this goal specifically for waste tires. The recycling-based measurement is defined in this report to exclude ADC and TDF (including TDF consumed by in-state cement kilns as well as exported size-reduced TDF and waste tire bales) assumed to ultimately be used as fuel. By this definition, as shown in Figure 13, the California waste tire recycling rate fell by one percent from 2016 to 33 percent, the fifth year of recycling rate reductions in a row. Despite the recycling rate decrease, recycling volumes did increase, including a 10 percent increase in reuse and a six percent increase in crumb rubber. However, these gains were out-weighed by a seven percent across-the-board increase in the amount of waste tires managed in 2017. This increase was partly due to high inventories for at least one processor, as well as continued cleanup of a facility that closed in 2016, which involved disposal of accumulated waste tires.

Figure 13
Waste Tire Diversion and Disposal Trends



The diversion rate is defined as including all uses other than landfill disposal (including ADC and TDF both in-state and exported). By this measure, after falling for five straight years from its all-time high of 93 percent in 2012, in 2016 diversion hit 68 percent, the lowest level in the past 17 years. However, in 2017 the diversion rate increased again to 76 percent. While influenced by the recycling markets described above, the diversion trend has been mostly influenced by changes in the export of size-reduced TDF and baled waste tires.

A number of important barriers are slowing or restricting growth in California's waste tire recycling rate, including:

- Low demand in crumb and civil engineering segments.
- Relatively low profitability as seen by some TDM producers.
- Competition from out-of-state TDP or conventional product producers.
- A host of challenges related to developing new TDPs or implementing feedstock conversion (i.e., shifting feedstocks to recycled tire rubber in established products).

Drawing on specific information gleaned during research for this report, Table 3 summarizes projections for short- and long-term recycling and diversion of California waste tires. In the short term, the recycling rate is expected to increase modestly in 2018, driven by anticipated modest gains in paving, molded, and "other" products as well as an uptick in civil engineering projects. Similarly, the diversion rate is expected to rise moderately as a result of these trends and continued strength in exports. The potential for substantial, long-term growth in recycling volumes rests mainly on whether there are large increases in customer demand for existing and new products made with crumb rubber and TDA, and whether California based TDM producers can fully take advantage of such market opportunities.

In the long term, given the diversity of diversion markets and their proven ability to sustain large volumes, it appears likely that diversion levels will continue to be relatively high, perhaps in the 65 to 90 percent range, fluctuating with market conditions, such as inevitable changes in exports of size-reduced TDF and waste tire bales.

Table 3
The Outlook for Diversion and Recycling

Category		2017 Volumes			Short-Term Outlook (2018-2019)	Long-Term Outlook (2020 and Beyond)
		1,000 Tons	Million PTEs	% of Total		
Recycling	Reuse	89,784	9.0	18.5	**Steady or Slight Decline** Mature, stable markets with relatively little growth potential. Possible decline after 12% increase in 2017.	**Flat or Possible Decline** Potentially threatened by competition with, and poor reuse potential of, imported lower-tier Chinese tires.
	Crumb Rubber	68,142	6.8	14.0	**Growth, But Risks** Expected growth in paving and molded/other; steady or modest growth for turf infill and nuggets. Expanding crumb production capacity.	**Uncertain, But Potential for Significant Growth** Increased incentives, infrastructure funding, health study findings may catalyze growth. Risks: new funding rejected, weak economy, competitive pressures.
	Civil Engineering	6,436	0.6	1.3	**Growth** Recent grant awards and modest momentum suggest at least modest growth over next two years.	**Increasingly Steady Use with Modest Growth** Signs of growing acceptance; increasing range of applications; sustained CalRecycle funding and new state infrastructure funding could boost TDA use.
	Overall Recycling	161,760	16.2	33.3	**Modest Growth** At least modest growth in crumb and civil engineering should boost recycling rates modestly.	**Potential Growth but Much Higher Demand Needed** If new crumb and civil engineering growth is sustained, could lead to lasting increases. But new demand with strong pricing is needed to greatly increase recycling.
Diversion	ADC	18,108	1.8	3.7	**Slight Decline** One of four ADC-using landfills will close in 2018.	**Steady** Current levels have been sustained for many years.
	TDF (In-State)	75,989	7.6	15.7	**Steady** California cement kilns have sustained use for many years, and are near full capacity.	**Flat** Growth would require new permitting and kiln investments.
	Export of Size-Reduced TDF and Bales	113,405	11.3	23.4	**Slight Growth** After significant growth in 2017, this market remains strong.	**Sustained High Volume; Intermittent Fluctuations** Demand is strong but will likely suffer inevitable interruptions, spikes, and declines.
	Overall Diversion	369,262	36.9	76.1	**Modest Growth** Increasing export, TDA, crumb rubber paving applications should overcome potential declines in other segments.	**Continued High Rates but with Fluctuations** California market diversity and growth potential appears able to sustain relatively high diversion for foreseeable future.

6. Concluding Remarks

California's waste tire diversion rate has increased in each of the past two years, but mainly as a result of increased exports of tire-derived fuel and baled waste tires. Meanwhile, the waste tire recycling rate has dropped for five consecutive years. This report's analysis suggests the recycling rate may have bottomed out, and could be poised for at least modest growth in 2018 and the next couple years, driven by rebounding crumb rubber demand and new production capacity, as well as an uptick in civil engineering.

However, as in recent annual Waste Tire Market Reports, this year's analysis also concludes that new, as-yet unidentified high-volume tire-derived product markets and end uses are needed to achieve significant growth approaching CalRecycle's 75 percent recycling goal. Even with the optimistic projections for rubberized paving markets, and potential steady increases in civil engineering, this will still be the case. Pending Legislation (AB 2908, Frazier), if adopted, would significantly increase funding for waste tire market development and create a new and expanded Tire Recycling Incentive Program. Similar policies in other states and countries have demonstrated the risks inherent in such programs, but also the potential for recycling gains in some circumstances. The fate of this legislative proposal will be known by November 2018 when CalRecycle plans to hold the first stakeholder workshop to gather ideas for the next Five Year California Waste Tire Management Plan, expected to be adopted in Spring 2019.

In the long run, significant increases in California's waste tire recycling rate will depend on how well current and potential new state policies and programs can help industry in their efforts to innovate new ideas, products and marketing strategies.

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
Crumb rubber	Tire-derived material less than ¼ inch in size, free of wire and fiber.
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
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
WTMS	Waste Tire Management System

Appendix B
Methodology

Interpreting Results

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

Findings Quantify Use of California-Generated Waste Tires: The main report findings provided in Table 1 quantify California-generated waste tires flowing into each market segment. 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 reported flows are not estimates of 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 was disposed. However, 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 brand owners, and other knowledgeable stakeholders. The survey response rate has steadily increased over time, and in 2017 was about 80 percent.

Step 2: Compiling and analyzing CalRecycle data from Comprehensive Trip Logs 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 sources.

Step 4: Key data from these sources is entered into a customized spreadsheet model and 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. With the exception of 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.[13] 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 Comprehensive Trip Logs (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. In this year's report a few changes to the categories used to report the main findings in Table 1 were changed:

- Used Tires (Export) was grouped in the reuse category rather than the export category as in previous reports.
- Under crumb rubber, the "Molded and Extruded" and "Other" categories were combined to form the new "Molded and Other" category.
- The Export category was relabeled as "Exported TDF", with two subcategories, "baled waste tires" and "size-reduced TDF."

[13] 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://rma.org/publications/scrap-tire-publications/market-reports