The Flow of Used Tires from California to Mexico and Waste Tire Disposal Issues in Baja California and the Adjacent Area of Sonora

California Department of Resources Recycling and Recovery November 5, 2017

Contractor's Report

Produced Under Contract By:

Institute for Regional Studies of the Californias

San Diego State University

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Publication # DRRR-2017-01620

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Prepared as part of contract number DRR DRR15034 for $296,612.

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Acknowledgements

Paul Ganster, Reynaldo Rojo-Mendoza, and Michael Spitz authored this report. Dr. Efraín Nieblas, of Universidad Autónoma de Baja California (UABC), provided important assistance in organizing the field research and meeting with key informants in local and state government in the study area. Bertha Hernández, M.A., of San Diego State University (SDSU), translated materials for the project, including the final report. Cartographer Harry Johnson, also from SDSU, created the maps for the final report. Dr. Freerk Boedeltje, post-doctoral fellow at Institute of Regional Studies of the Californias (IRSC), provided the analysis of waste tire management in the European Union area and the waste tire trade with Asia. Dr. Candelaria Pelayo Torres, of Universidad Autónoma de Baja California (UABC) Law School and Instituto de la Judicatura del Poder Judicial del Estado de Baja California, and her colleague at the Instituto de la Judicatura, César Holguín Angulo, Ll.M., contributed an important analysis of the legal framework for used and waste tires in Mexico and Baja California. Kenn Morris, CEO of the Crossborder Group, implemented the survey of used tire dealers in the study area. Cristina Saucedo provided the satellite imagery analysis, verification and documentation of tire piles through site visits, and development of the database on waste tire piles in the study area.

Baja California's Secretary for Environmental Protection, Biologist Thelma Castañeda Custodia, was very helpful in identifying key issues for the report and organizing the workshops as was M.C. Saúl Guzman García, the director of planning at the Secretariat for Environmental Protection. Municipal authorities in the study area of the project graciously met with the research team to share information and participated actively in project workshops. Mexican federal representatives from Customs Administration and the Secretariat of Economy graciously supplied background information on international commerce of used tires. The used tire dealers associations of Tijuana and Tecate participated in the workshops and shared useful information on the flow of used tires. La Cámara Nacional de Comercio, Servicios y Turismo de Tijuana (CANACO) was the source of observations and information regarding the used tire sector and they participated actively in the workshops.

The IRSC research team especially appreciated the willingness of CalRecycle staff to share information and data. The perceptive comments on the draft report by CalRecycle experts were very helpful.

Executive Summary

This study analyzes the flow of used tires from California across the international border into Mexico, primarily the state of Baja California and the San Luis Río Colorado region of Sonora. The study updates the August 2009 report The Flow of Used and Waste Tires in the California-Mexico Border Region[1] to understand better the current challenges and opportunities presented by the commerce and movement of used tires from California to Mexico within the context of the dynamic border region. The report also reviews the disposition of waste tires in the region, along with an examination of the physical infrastructure and institutional framework for the management of waste tires. The report concludes with recommendations for addressing problems associated with used and waste tires in the cross-border trade.

The Demand for Used Tires in the Border Region

For the last decade, private companies in California have each year formally exported an average of 750,104 used tires to dealers in Baja California that hold an official import license. In addition, each year from 2007 through 2016 and additional 200,000 used tires were informally imported into Baja California and San Luis Río Colorado, Sonora, without a license from Mexican authorities.[i] The flow of used tires across the border is a valuable export for California businesses, and these tires do not ever have to be disposed of in California.

The strong demand for low-cost used tires in northern Mexico is driven by widespread private ownership of vehicles by people of limited economic means. Low-income residents within this region often need a personal vehicle because residential areas are generally located far from places of work, and public transportation systems are inadequate. Baja California has a vehicle ownership rate of 1 vehicle per 3 people, which is the same rate as California's, and there is a large supply of inexpensive used vehicles available within the border region. Currently, about 1.2 million vehicles are operating in the state of Baja California. New tires in Mexican border towns cost one and a half times more than new tires in San Diego, so many vehicle owners lack the resources to purchase expensive new tires and opt for used tires instead. An estimated market demand for used tires in Baja California and San Luis Río Colorado, Sonora is at least 2 million tires per year.

Although the used tire trade boosts the local economy, used tires wear out sooner than new tires and the region produces waste tires at a rapid rate. The state and local governments of Baja California and Sonora are then left with the responsibility of properly disposing of waste tires generated from their local new tire market as well as from used tires that have been formally and informally imported into their region.

The Flow of Used Tires across the Border

Quantifying the formal flow of tires across the California-Mexico border is necessary for proper management of waste tires in Baja California and Sonora. Accurate Mexican

[i] See Table 6 and petty commerce estimate in Figure 2.

Customs data on used tire imports through the ports of entry in the study area of this project are not consistently available. U.S. Customs export data for used tires from these same ports of entry are available, however, and provide a useful data set to assist in understanding and managing the used and waste tire flows.

The formal flow of used tires depends upon the yearly import quota established by a working group comprised of Mexico's federal Secretariat of Economy, Baja California's Secretariat of Environmental Protection (SPA), and local used tire dealer associations. This quota has averaged slightly over 750,000 tires per year for the last 10 years (2008-2017).

Despite media reports to the contrary, Mexico does not directly or legally import waste tires and there is little evidence to support claims of large numbers of unauthorized used tires flowing across the border. An estimated 5 percent of the permitted used tire import quota enters through informal flows. Additional used tires are imported into Mexico for the retreading industry but are not counted as part of the official quota.

Waste Tire Management in the Border Region

Baja California and San Luis Río Colorado, Sonora, have made important progress on proper disposition of waste tires since the 2009 report. U.S. and Mexican federal, state, and local environmental authorities came together to address the accumulation of the large tire piles under the aegis of Border 2012, the U.S.-Mexico binational border environmental program based on the 1983 La Paz Agreement. In Baja California and in San Luis Río Colorado, the Border 2012 cleanup successfully eliminated the largest and most problematic legacy waste tire piles. CalRecycle has also engaged in addressing the issue of waste tires in Mexico's border region through funding pilot clean-up projects and studies. The State of California has facilitated engagement with Mexico for the waste tire disposal effort through the California-Mexico Border Relations Council and the Solid Waste Working Group.

Baja California's Secretariat for Environmental Protection (SPA) has driven improvements in waste tire management in Baja California. In 2009, the agency opened and managed a collection and transfer center south of Mexicali. SPA also entered into a contract with a company to open a collection and transfer center in Tijuana that functioned from 2013 to 2015. The CEMEX plant in Ensenada is also recognized by SPA as an official disposal site and the plant is scheduled to receive waste tires after a two-year hiatus. SPA's efforts have established basic infrastructure for waste tire disposal in Baja California, although an additional facility is needed for the coastal zone of Tijuana, Rosarito, Tecate, and Ensenada to reduce long-distance hauling of waste tires.

Ongoing Waste Tire Management Challenges in Border Region

While many large legacy tire piles have been cleaned up, and several Mexican state-operated waste tire facilities have opened since 2009, disposal of waste tires remains a challenge in the region. Additional regulatory, administrative, and physical infrastructure is needed for adequate waste tire management in the border area and the waste tire issue needs to be a priority of local, state, and federal government agencies.

Regulation of new tire dealers to require disposal of waste tires they generate would help reduce the regional problem. Finally, development markets for recycled tire products would provide a needed suitable end use for many waste tires in the region.[2]

The regulatory and governmental structures for waste tire management in Baja California present challenges. Although state legislation regarding waste tires has been modernized, the implementing regulations have not yet been enacted. Funding for waste tire disposal is a chronic problem for both state and municipal agencies. Although there is a fee for tire disposal at the official facilities, the monies go into the state's general fund and are not dedicated to waste tire disposal. State and municipal budgets for waste tire management are inadequate. Local and state agencies have many critical issues to address including water and sewage services, solid waste collection, street and road paving, and parks and green areas; agencies find it difficult to prioritize the waste tire problems. There is frequent turnover of elected and high level appointed officials, especially at the municipal level, so providing continuity on topics such as waste tires is difficult. This turnover also hinders long-term relationships with California government counterparts.

At least 2 million waste tires are generated each year in the Baja California-San Luis Río Colorado region, yet only half of the tires collected reached an official collection and transfer facility and are properly disposed. Only about 76 percent of properly disposed tires are diverted to productive end uses, and nearly 90 percent of those tires are processed in cement kilns.

Recommendations to Improve Waste Tire Management in the Border Region

A number of recommendations to improve waste tire management and the expansion of productive waste tire end uses in Mexico emerged from this study, including the need for coordinated actions among CalRecycle, other California agencies, SPA, and Baja California public and private stakeholders.

Collaborative efforts include holding technical workshops in Baja California to provide information and examples of best practices to stakeholders in Baja California and San Luis Río Colorado on the following topics:

- Assistance on developing waste tire management systems that track tire hauler registration and tire manifest systems. Input from industry stakeholders in Baja California and Sonora is desired.
- Rubberized Asphalt Concrete applications and funding options in Mexico.
- Use of waste tires for construction and civil engineering projects, such as Tire-Derived Aggregate (TDA) including California experiences and potential Baja California applications. State and municipal authorities in Baja California could work together to develop technical and engineering standards and building codes, conduct practical training, and provide information regarding the use of waste tires as construction material. This could apply to public works and private construction projects, as well as self-construction uses in newly urbanizing areas.

Collaboration of California and Baja California engineering schools with state and local agencies and the private sector could facilitate development and implementation of appropriate standards.

- Storage of waste tires. Baja California and San Luis Río Colorado could benefit from California's experience with regulation and enforcement of standards for storage of waste tires to reduce fire, health, and safety risks.

CalRecycle could pursue the following initiatives. These include**:**

- Support R&D, business incubator, and market development for tire-derived products that are new and appropriate for the Mexican market. The cooperative effort would center on engineering and business administration divisions of California and Mexican universities.
- Strengthen the California tire tracking system to quantify more precisely the numbers of used tires flowing from California, and from other states through California, into Baja California and the near area of Sonora.
- Work with U.S. Customs to obtain detailed data on California used tire exports to Baja California, including exports of wrecked vehicles for auto dismantlers. Mexican used tire import data are incomplete and better data will provide an important tool for improved used and waste tire management.
- Encourage the State of California to adopt standards for tread depth and casing conditions for used tires that are consistent with other U.S. states and Canada. California law requires used tires to have at least a1/32 inch tread depth while the U.S. federal recommended standard and the requirement of most U.S. states is 2/32 inch. A 2/32 inch standard for California will help address perceptions of some Mexican officials and of numerous media reports that California companies export substandard used tires to Mexico.

Baja California could also pursue a number of useful initiatives. These include:

- SPA and Baja California could encourage establishment of a Mexican national standard for used tires.
- Baja California could develop an environmental fund that would generate stable resources for waste tire management in the state.
- State authorities could conduct a market analysis of current and potential productive end uses of waste tires in the region.
- Municipal authorities could continue to regularize the licensing, monitoring, and enforcement of local new and used tire dealer businesses to ensure proper management and disposal of used and waste tires in the region.

1. Introduction

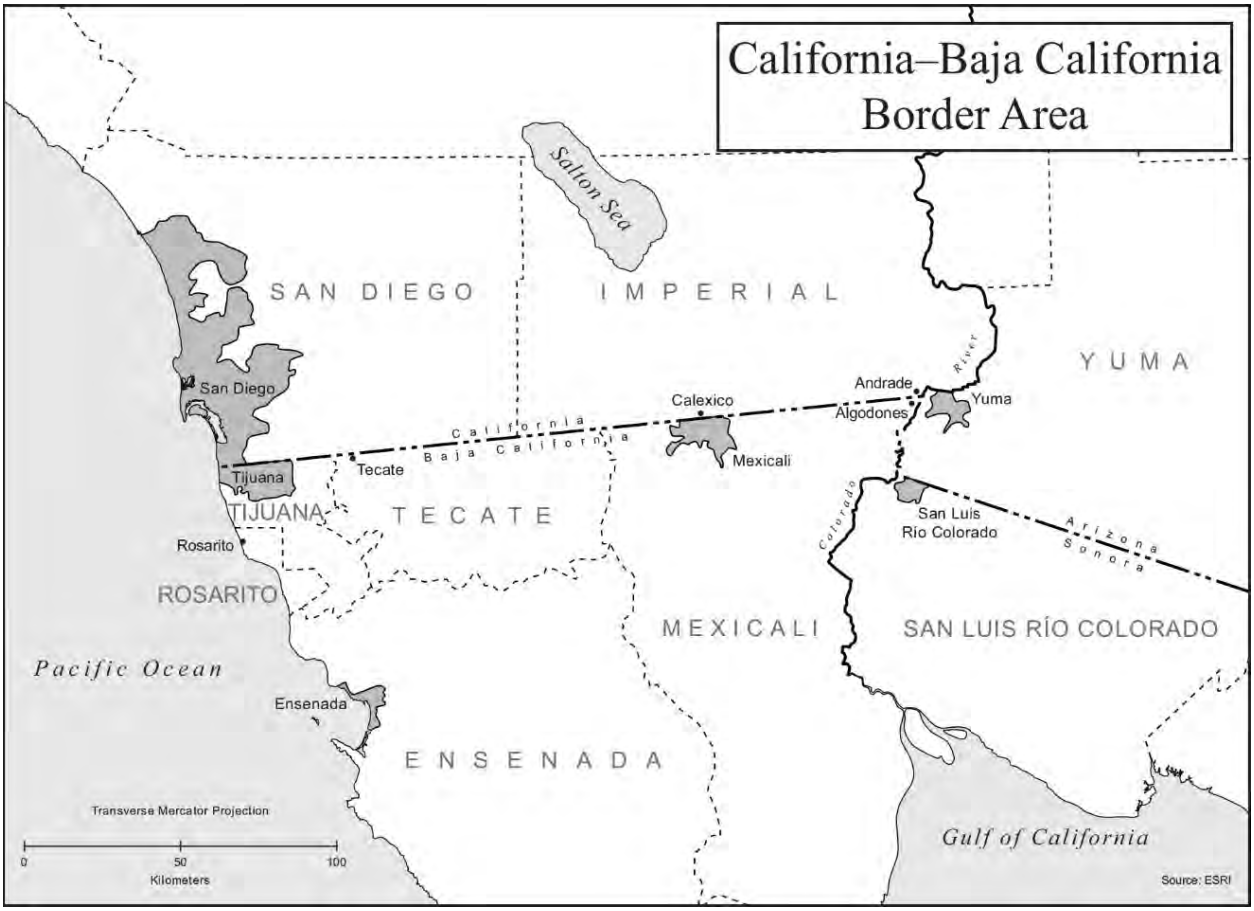
This study analyzes the flow of used tires from California businesses across the international border into the Mexican state of Baja California and the adjacent part of the state of Sonora and discusses the final disposition of waste tires ultimately generated by this commerce. It concludes with recommendations for addressing problems associated with used and waste tires in the cross-border trade. This trade and the challenges it presents to Baja California and part of Sonora is best understood within the dynamic California-Mexico border area.

The U.S.-Mexico Border Region

The border between the United States and Mexico is some 2,000 miles (3,200 km) in length and is characterized by a pattern of densely settled binational urban areas—such as the San Diego-Tijuana metroplex—that are separated by vast expanses of lightly populated deserts and mountains.[3]

The primary focus of this study is the California-Mexico border and the San Luis Río Colorado area of Sonora, which is directly south of Yuma and San Luis, Arizona. For purposes of this study, the California-Mexico border region includes the counties of San

Map 1: The Greater California-Mexico Border Area



Diego and Imperial and the municipalities of Tijuana, Tecate, Ensenada, Playas de Rosarito, and Mexicali in Baja California along with the municipality of San Luis Río Colorado in Sonora. The international boundary is some 140 miles in length between California and Mexico and the border between Arizona and Mexico is about 20 miles along the Colorado River and 8 miles of land border between the sister cities of San Luis Río Colorado and San Luis, Arizona. The border region is the interface between the United States and Mexico and between the developing and developed world. There are great economic differences within the border region as well as differences in culture, language, legal systems, and structures of governance and public administration.

Population

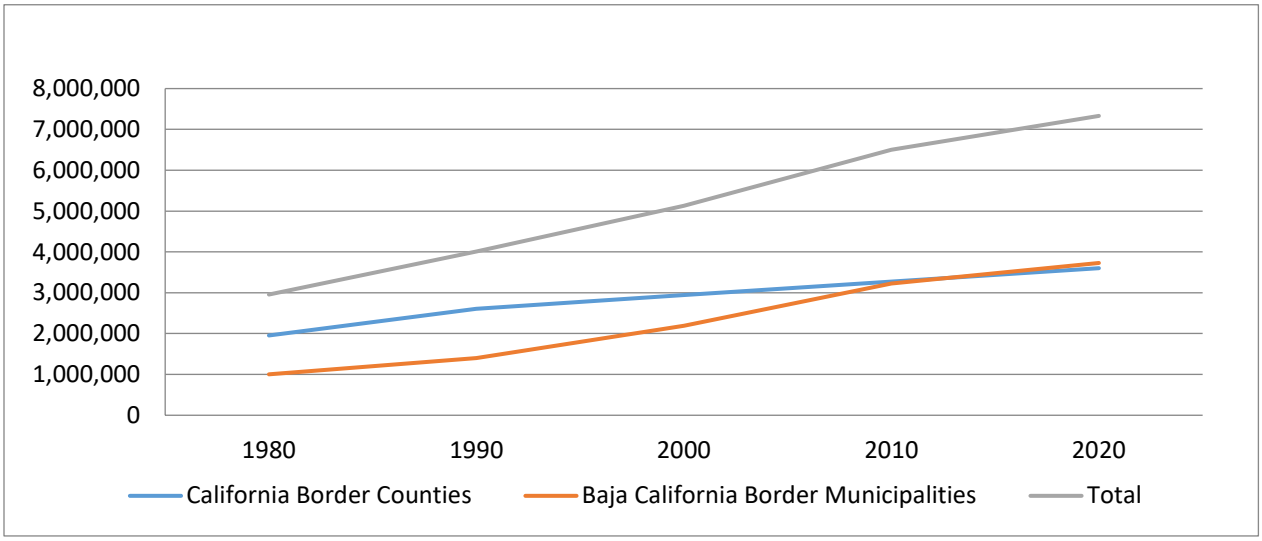
After World War II, the border area was the most dynamic region in both countries. The post-war rapid growth in the Sunbelt of the Southwest United States was mirrored on Mexico's northern border. This demographic dynamism is still seen to this day along the California-Mexico border region (Table 1 and Figure 1).

Table 1. Population Estimates for the California-Baja California Border Region, 1980–2020

Location	1980	1990	2000	2010	2020
California border counties	1,953,956	2,607,319	2,941,502	3,275,636	3,601,666
Baja California border municipalities	1,002,459	1,400,873	2,188,899	3,224,844	3,729,225
Total	2,956,415	4,008,192	5,130,401	6,500,580	7,330,891

Source: See Figure 1.

Figure 1. Population Estimates for the California-Baja California Border Region, 1980–2020



Source: Consejo Nacional de Población, "Baja California proyecciones demográficas, 2010-2030 (www.conapo.gob.mx, accessed 7/22/2017); U.S. Census.

Table 1 and Figure 1 provide population data and projections for the study area, with the exception of San Luis Río Colorado in Sonora, which currently has a population of about 184,000. By 2010, more people lived in the Mexican portion of this border region than north of the international boundary and by 2017 there were nearly 7 million residents in the California-Baja California border region. The rate of population growth in this region has declined in recent decades. San Diego and Imperial counties are now growing at about 1.4 percent per year and Baja California is growing at 1.6 percent yearly. Despite the lower annual increase, Baja California is still adding more than 50,000 residents each year, which will continue to help drive demand for used tires and generation of waste tires.

Trade and Economic Asymmetry

The North American Free Trade Agreement (NAFTA) of 1994 stimulated a significant expansion of flows of investment and goods between Mexico and the United States. Bilateral trade between the two countries was valued at $100 billion in 1994 and by 2016 it had surpassed $500 billion per year. Much of the bilateral trade moved on trucks across land ports of entry. In 2016, high numbers of loaded container trucks traveled northbound across the border region, reflecting the intense cross border trade and the well-developed manufacturing sector in the Mexican border cities adjacent to California (See Table 2).

Table 2. 2016 Northbound Commercial Crossing at Border Ports of Entry

Port of Entry	Trucks	Loaded Truck Containers
Otay Mesa, CA	889,336	675,511
Tecate, CA	52,269	37,265
Calexico East, CA	349,747	199,469
San Luis, AZ	31,338	18,742
All ports of entry	5,802,759	4,066,598

Source: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, based on data from the Department of Homeland Security, U.S. Customs and Border Protection, Office of Field Operations. Report created: Sat Apr 01 11:54:28 EDT 2017.

As trade volumes under the NAFTA regime grew, U.S. and Mexican Customs improved coordination at the ports of entry through development of an electronic manifest system and standardized codes for products. By 2017, the informal movement of goods across the border was reduced with more strict enforcement at the U.S. non-commercial ports of entry and improved regulation and enforcement by Mexican Customs authorities. Individuals in vehicles now entering Mexico through the non-commercial crossings with specific items or quantities of used goods are charged duties or are redirected to the nearest commercial port of entry where they are required to declare the goods to be imported into Mexico and to pay the established duties. When items such as used tires are not eligible to be imported, they are refused entry by Mexican authorities or

sometimes confiscated. Since only permit holders can legally import used tires into Mexico, small, informal imports have declined considerably.[i]

Although the United States' poorest region is its border area, even when including the more prosperous San Diego region,[4] Mexico's northern border is among its most prosperous regions, along with Mexico City, Guadalajara, and Monterrey. Nonetheless, the economic differences between the two countries are significant, particularly along the California-Mexico border. The minimum *hourly* wage in San Diego is roughly equivalent to the minimum *daily* wage in Baja California. The gross regional product of San Diego County is about 6 times larger than that of the Tijuana municipality.[5] In addition, the local government budgets of San Diego County are significantly greater than those of the municipality of Tijuana. As a result, local and state authorities in Mexico have very small budgets to provide services in comparison to budget and staffing levels in counterpart California agencies. For example, the Municipality of Tijuana has only 2 environmental inspectors and one vehicle to cover an urban population of 1.6 million residents.[6]

Public Administration and Governance

Due to the rapidly growing population in the border region, demand for public services has increased as well. As large cross-border metropolitan areas such as San Diego and Tijuana have developed, so have links between U.S. and Mexican economies. Many environmental and social issues also flow in both directions across the border, including:

- Water quality and quantity issues in the Imperial-Mexicali valleys,
- Surface water quality issues in the San Diego-Tijuana area,
- Air quality problems in the shared air basin,
- Binational conservation challenges in the San Diego-Tijuana-Tecate region, and
- Infectious diseases such as tuberculosis and HIV/AIDS.

Border crime, such as auto theft, drug trafficking, arms smuggling, and money laundering, have also increased in this region. These issues are often best addressed through cross-border approaches implemented by California and Mexico government agencies at all levels. However, for a number of reasons, governmental cooperation on border problems is often lacking or inadequate.

Differences between U.S. and Mexican Government Structures

Mexico and the United States are both federal republics, and Mexico is much more centralized with most of its power and wealth concentrated at the federal level. Although Mexico has been in the process of devolving government responsibilities to the state and municipal levels for the past several decades, the process has been slow,

[i] Based on observation of border crossings and interviews with frequent border crossers by the IRSC research team for this study.

especially with regard to government funding.[7] In Baja California, the federal government still provides about 40 percent of local and state government budgets.

Due to rapidly growing cities with unplanned urban expansion, local and state government priorities are to provide basic services of electricity, water, and sewage collection and treatment. Solid waste, including waste tires, has been a lower priority, and only recently have officials turned their attention to collecting solid waste and constructing modern landfills.

Due to differences between U.S. and Mexico governments, California and U.S. government agencies may not have direct counterparts across the border. Mexican state governments are organized on a territorial basis by municipalities, which are governed by a municipal president and council and include both urban and rural areas. Mexican municipalities correspond to California counties and incorporated cities within the boundaries of those counties. In Baja California, water and wastewater services are provided by a state government agency with branches in each of the municipalities; in California, these urban services are provided at both the county and city levels.

For used and waste tires, the Baja California Secretariat of Environmental Protection (SPA) has responsibilities somewhat similar to those of CalRecycle, although Baja California is still hindered in its efforts by an inadequate and incomplete regulatory and legislative framework. The California EPA Border Environmental Program and the SPA have excellent opportunities for cross-border collaboration on matters related to used and waste tires.

The Impact of Institutional Continuity on Collaboration Efforts

In Mexico, federal and state officials are not eligible for re-election and serve one six-year term. Historically, municipal officials served one 3-year term, but recent changes in Mexican law allow officials to stand for re-election. This provides for greater institutional continuity at the local level and the possibility of 6-year local administrations rather than the short 3-year terms of the past. This is particularly important because Mexico's public administration generally does not have the equivalent of long-term civil service that provides for the continuity of technical and administrative staff—and institutional memory—from one elected administration to the next.

Institutional continuity has positive impacts on waste tire management as well. In the Municipality of San Luis Río Colorado, the directors of the departments of Public Works and Services, Property Registry, Urban Development, and Ecology have been in their posts since 2012. This continuity—along with technical assistance funding from the Border Environment Cooperation Commission to establish a collection and transfer station for waste tires—helps explain why the problem of waste tires is minimal in San Luis Río Colorado.[8]

While continuity and institutional memory between administrations is improving with increasing professionalization of the bureaucracy, there are still problems. Turnover of local and state-level elected and politically appointed officials can disrupt and shift priorities for cross-border collaboration. Newly elected and appointed officials often drop viable programs due to different priorities from those of the previous administration.

From the perspective of California elected officials, this turnover presents challenges since working relations have to be established with each new administration. Personal relations are culturally important in Mexican bureaucracies and require at the very least initial and then periodic face-to-face meetings.

Limited resources and funds complicate effective cross-border cooperation. As previously mentioned, Mexico's local government agencies have very small annual budgets relative to counterpart agencies across the border. Thus, Mexico's local governments are limited in their ability to fund and implement activities. While a California local agency might expect, for example, a regular inspection program of waste tire generators, implementation of a similar program in Mexico might simply be too expensive due to lack of personnel, equipment, and the appropriate legal and regulatory framework.

Challenges Specific to California

Although federal, state, and local agencies in California have permanent professional staffs, they also encounter barriers to effective and ongoing binational cooperation. Like their Mexican counterparts, California state and local turnover of elected and politically appointed officials can change priorities for cross-border collaboration. The lack of effective binational institutionalized mechanisms also hinders cross-border collaboration in the California-Mexico border region.[9] State, local, and federal agencies in California are usually unable to transfer funds to Mexico for cooperative programs that would otherwise be cost-effective and have positive impacts on California and its residents. State of California staff members regularly face difficulties in obtaining timely travel authorization for meetings and site visits in Baja California. Since Mexican agencies customarily set meetings with little advanced notice, State of California employees frequently do not have enough time to follow the state's complex travel procedures.

Development of mechanisms for funding binational border projects has been more successful at the federal level. The U.S. EPA has been able to use congressionally appropriated funds for water and wastewater infrastructure projects in Mexico through transfer of the funds to the U.S. section of the International Boundary and Water Commission, which is a binational agency established by treaty in 1944 for U.S.-Mexico border boundary, water, and sanitation work. In addition, by working through the North American Development Bank and the Border Environment Cooperation Commission (NADB/BECC), U.S. EPA has been able to fund infrastructure projects as well as the small grants program under the Border 2020 Program. Since NADB/BECC is a binational agency, it works seamlessly on both sides of the international border. NADB/BECC has important experience with solid waste issues and waste tire disposal in the border region. It has funded a number of studies and supported solid waste and waste tire projects in Mexican border municipalities.[10]

Border Trade

A sizable portion of the California-Mexico border region population interacts on both sides of the border.[11] They may work on one side of the border, but they also regularly purchase goods and services in both countries. Border consumers are a perceptive group. As exchange rates fluctuate and pricing policies evolve, border consumers move

back and forth to purchase goods and services at the best prices. Prices for goods like pharmaceuticals vary according to officially established prices in Mexico and to fluctuations in the peso-dollar exchange rate. For example, in 2008, gasoline and diesel became less expensive in Tijuana than in San Diego, so consumers flocked to gas stations south of the border; when related fuel prices dropped in California as in early 2017, the flow of consumers reversed.

Historically, there has been a strong demand by Baja California and some Sonora consumers for low-cost used goods from Southern California. This has included used building materials for self-constructed housing, which is ubiquitous in Tijuana, Tecate, Mexicali, San Luis Río Colorado, Ensenada, and other urban areas in the border region. Large amounts of used clothing, appliances, and automobiles have also flowed across the border to Baja California and beyond. Used tires have always been a component of this flow of used goods in the border region. Mexican authorities widely permitted the flow of used goods since they recognized that serviceable low-cost goods met an important social need for millions of low-income, northern border residents.

Until recently, the flow of used goods that included tires was relatively unimpeded. Baja California and Baja California Sur and San Luis Río Colorado in Sonora were so isolated from central Mexico and the country's economy that for many decades the peninsula was part of an economic free zone that allowed a relatively unrestricted flow of goods from the United States. With the implementation of the North American Free Trade Agreement beginning in 1995, Mexico's authorities began to impose restrictions on the flow of new and used goods across the border through the noncommercial ports of entry. However, among Baja California consumers, the pattern of buying and importing used goods from California continues at high levels. Although now regulated by official quotas and other requirements, the flow of used tires from California to Baja California and the adjacent area of Sonora is an ongoing activity that presents challenges to state and local authorities.

2. The Flow of Used Tires from California into Baja California and the Near Area of Sonora

This chapter discusses the flow of used tires from California across the international border to Baja California and San Luis Río Colorado, Sonora. Detailed information about the flow of used tires is found in the 2009 Tire Flow Study, *The Flow of Used and Waste Tires in the California-Mexico Border Region* published by the California Integrated Waste Management Board.[12] This and recent investigations by the research team provide the basis for an updated analysis of the flow of used tires into Mexico.

The trade in used tires from California into Mexico is many decades old and is part of the complex linkages across the border that have changed and evolved over the years. The trade depends on the ready supply of used tires available primarily from California, but also from other neighboring U.S. states and even from Canada. The demand has remained strong and even intensified in Baja California, one of the most dynamic regions of Mexico in terms of population growth and economic development.[13] Formal and informal practices regulate this flow, and Mexico's formal control of the trade has increased in recent years.

Overview of the Tire Flow

The tire cycle begins with the purchase of a new tire in California and continues with this tire moving across the U.S.-Mexico border as a used tire to Baja California, where its final disposal takes place. This process has been discussed in detail in previous studies, including the 2009 *Flow of Used and Waste Tires* and the 2012 *Methodology for the Development of a Model Integrated Waste Tire Management Plan Framework for Baja California*.[14] The process involves many steps with some variations. At each point, including the final disposition, the used tires generate revenue of some sort for different stakeholders. The steps listed represent the way in which most used tires flow from California to the adjacent Mexican border region.

- When a new tire is purchased in California, the dealer charges the consumer a $1.75 California Tire Fee, which is remitted to the State of California. The dealer might charge the customer an additional take-off tire disposal fee of approximately $2 to $3 per tire. This additional fee is not state-mandated, and the retailer retains the fee.
- The tire dealer accumulates used tires until a contracted tire hauler and/or recycler collects them and transports them to the company's facility where tires are culled and graded for sale.
- The tire recycler sells truckloads of used tires to Mexican tire dealers who have an import quota and permit. Tire shops without an import quota and permit occasionally purchase used tires from U.S. recyclers.[15]

- The Mexican used tire importer hires a customs broker to prepare the paperwork for U.S. Customs for export and for Mexican Customs for import into Mexico. Mexican Customs randomly inspects loads entering Mexico, primarily to detect used tires not manufactured in the NAFTA region; these tires are subject to an import duty of 15 percent in addition to the 16 percent value added tax (IVA in Mexico) to which all imported used tires are subject. For tax purposes, the value of a load is calculated by adding the cost of the tires plus the cost of shipping.
- The imported load of tires is then taken to the Mexican importer's business site where they are unloaded for retail sale and for wholesale resale to tire shops that do not have an import permit.

Table 3 on the following page lists the steps from new tire sale in California to final disposition in Baja California.

Authorized used tire importers collect waste tires in sufficient numbers to satisfy the requirements of their tire quota. These come from waste tires left by retail customers or tires collected from wholesale customers who have small tire shops. The waste tires collected are then taken for final disposal to a government authorized site, most commonly to the Authorized Temporary Collection Center for Waste Tires (CATANED I) in Mexicali. The tire dealer must pay a fee to the State of Baja California treasury prior to dropping off the tires at CATENED I, where a receipt is provided that enables the dealer to demonstrate that proper disposition requirements are being met. Tires may also be disposed through the engineering firm Yantek, which uses waste tires for engineered retaining walls and other purposes approved by SPA. In addition, the CEMEX plant in Ensenada, which shreds waste tires for tire-derived fuel, is scheduled to again receive tires in 2017 with the approval of SPA.

Supply of Used Tires in California and Elsewhere

Most of the used tires imported into Baja California and San Luis Río Colorado originate in California, although there is anecdotal information that some are imported from U.S. states adjacent to California or from Canada. Those tires are not tracked by California's manifest system since they ostensibly are shipped *through* the state and not unloaded *within* the state. For example, a trucking container of used tires originating in Nevada that is driven directly to the Calexico port of entry or another California border location and then into Mexico would not appear in California data. Shipments that originate out of California and are offloaded in Calexico, California for transport to Mexico would probably not appear in California data, although if the shipment technically ends in Calexico it should.

The California Waste Tire Market Report 2015 noted that in 2014 more than a million used tires were shipped to California from other states either for sale or directly to ports for export to Mexico.[16] The Market Report, citing U.S. Census trade data, also notes that in 2014 some 1,038,633 used tire units were exported from California ports, with 871,700 of these to Mexico and 166,933 units to other countries.[17] From these sources, the number of used tires exported from California ports to Mexico can be determined, but the portion of those tires originating in California cannot. Due to these gaps in data

Table 3. Flow of Used Tires from California to Final Disposition in Mexico

#	Step	$	Notes
1	New tire purchase in CA	$1.75 disposal fee	Fee paid to State of CA
2	Leave take-off tire at tire business	$2.00 disposal fee	Retained by tire dealer
2a	Customer keeps used tire; takes to Mexico	Sale or use in Mexico	*Tráfico hormiga* or petty smuggling
2b	Tire dealer employee takes good used tire to sell in Mexico	Sale or use in Mexico	*Tráfico hormiga* or petty smuggling
3	CA tire hauler company picks up used and waste tires from dealer	Tire dealer pays hauler to collect waste tires	Tire hauler sorts used tires to sell
4	CA tire hauler sends load to border port of entry	Hauler fees	Retained by tire hauler
4a	CA tire hauler sells load to Mexican tire importer or transporter	Sale of tire including cost of shipping	Paid by Mexican tire importer
4	Customs broker hired to export from U.S. and import to Mexico	Brokerage and paperwork fees	Paid by Mexican tire importer
5	Mexican Customs import fees	NAFTA tires pay 16% IVA (Value Added Tax) on tire+freight+insurance	Non-NAFTA origin tires pay additional15%; all fees paid to Mexican federal treasury
6	Mexican importer sells to retail customer	Profit or markup	Collects waste tires to dispose for receipt required by quota authorization
6a	Mexican importer sells tires wholesale to tire shops	Profit or markup	
7	Tire importer hauls waste tires and pays fee to dispose; obtains receipt to import tires under quota	Disposal fee paid to Mexican state government treasury	Waste tire collection center

coverage, there is no systematic information available on the numbers of used tires originating outside of California that flow *through California* into Mexico.

California, with a growing population and increasing vehicle fleet, will likely continue to be an adequate source of used tires for export to Mexico, although there are several factors that might disrupt that source slightly. First, if sales of inexpensive new tires from China and elsewhere grow significantly in California and other U.S. states, fewer suitable used tires will be produced from these low quality new tires.[18] Not only do Chinese and other Asian tires have a negative reputation among Mexican dealers and

consumers, they must pay an additional 15 percent tax when imported into Mexico since they are not manufactured in the NAFTA area. These Asian used tires, then, are less competitive in terms of price and perceived quality. Second, renegotiation of NAFTA could result in new or higher tariffs that could make California used tires less competitive in the Mexican market. Third, introduction of standards by Mexico to improve the quality of imported and Mexican-origin used tires could reduce the number of California tires eligible for resale in the Mexican market.

Demand for Used Tires in Baja California and San Luis Río Colorado

For many decades, there has been a strong demand in Baja California and the near area of Sonora for used tires imported mainly from California. This demand is the result of basic economic forces in northern Mexico and in California. Baja California has a high rate of automobile ownership that is related to the spatial configuration of border cities and inadequate public transportation systems in the major urban areas. The cities are sprawling and workers have to commute long distances from home to their places of employment. Affordable housing in Mexican border cities is on the fringes of the urban settlements where housing projects of INFONAVIT (Instituto del Fondo Nacional de la Vivienda), the government housing authority that includes worker and private sector participation, are located. In addition, these peripheral areas are where individuals can acquire housing lots at no or low cost for self-constructed housing. Historically, these *colonias* and informal settlements have met most of the housing needs in Mexico's fast growing border cities and these areas eventually acquire a full array of urban services.

High Rates of Vehicle Ownership

However, urban public transportation in Tijuana, Ensenada, and Mexicali is inefficient and expensive. Even the smaller and more compact cities of San Luis Río Colorado, Tecate, and Rosarito lack adequate public transportation and also have high levels of private vehicle ownership. In Tijuana, a typical public transportation commute from an outlying *colonia* to a factory job will often require an hour and a half in each direction and include several transfers. The home to work trip in a private vehicle would require less than half of that time. Many large employers, including *maquiladoras*, or assembly plants, frequently contract with bus companies to provide transportation to and from work in order to ensure that workers show up on time.

Many border Mexican workers, perhaps as much as 8 percent of the local labor force, are actually employed formally or informally in the United States and commute across the border on a daily or weekly basis.[19] For these individuals, public transportation difficulties and bottlenecks for pedestrians crossing the border make public transportation onerous. For most of these workers, private vehicles provide the best, and most feasible, transportation option.

The high rate of automobile ownership in the Mexican border is also due to the plentiful supply of inexpensive used vehicles in California that are imported formally or informally for service in Baja California. It has long been a practice for Mexican consumers to purchase used vehicles from dealers or private parties in nearby U.S. cities, including the greater Los Angeles metropolitan area. One source of inexpensive automobiles in the border region is from auction lots in border communities like Otay Mesa, which are

supplied with vehicles donated to Southern California charities. In recent years, Mexican prohibitions on older, higher-polluting vehicles and more rigorous enforcement of regulations has reduced the supply and increased the cost of imported used vehicles, but the flow of used vehicles continues at a high level.[20]

Low-Income Residents Buy Used Tires

Low per capita incomes of Mexican border residents are another factor in the high demand for used tires. New tires are expensive, with retail prices equivalent or higher to those in California, and credit is costly or not available to individuals or families with low incomes. Therefore, outright purchase of new tires is not an option for many low-income consumers. Information and studies from the 1990s suggested that at least half of passenger vehicle tires purchased in Baja California were used tires.[21] While there are no reliable data on the Baja California used and new tire market, the research team assumes that strong demand for used tires continues, comprising up to half of annual sales. Although the used tires wear out sooner, consumers are able to afford the cash outlay for acquiring the used tires. Table 4 provides comparative prices for new and used tires in San Diego and Tijuana. Pricing of new tires in the Imperial Valley and in Mexicali is similar since large retail chains such as Costco are present in these U.S. and Mexican border cities, and it is relatively easy for binational consumers to determine new tire prices in the region.

Table 4. Cost of New and Used U.S.-Made Tires in San Diego and Tijuana

Size	San Diego New	San Diego Used (8-9/32)	Tijuana New	Tijuana Used
R14 185/65	$64	n/a	$70	300 to 500 pesos (USD$17 to $28) for all sizes
R15 195/65	$95	$51	$85	
R16 235/70	$109	$80	$146	
R17 265/70	$149	$86	$197	
R18 235/50	$176	$78	$258	

Sources: San Diego new prices are Goodyear tires from Walmart; Tijuana new prices are U.S. made tires from Walmart Mexico. San Diego used prices are from used tire shops in San Diego. Tijuana used tire prices are from discussions with the Tijuana Tire Dealers Association, August 28, 2017.

Baja California Vehicle Fleet Size

Annual demand for both new and used tires is based on the size of the vehicle fleet in Baja California and usable life of the tires. Tire life is related to the number of miles travelled, condition of road surfaces, and condition of vehicles that also includes tire loading, tire pressure, alignment, shocks, and other mechanical and maintenance aspects.

The vehicle fleet in Baja California includes formally registered vehicles as well as vehicles that circulate with valid or expired license plates from the U.S. or another Mexican state. In 2017, there were 1,078,000 officially registered vehicles in Baja California.[22] About 77 percent of the vehicle fleet is 10 years of age or older and about 60 percent of the registered vehicles that have been imported legally originated in the U.S. In addition to the formally registered vehicles, other categories of vehicles are part of the vehicle fleet in Baja California. For example, commuter workers who live in Baja California and work in the United States are about 8 percent of the state's economically active population.[23] In 2017, there were about 96,000 commuter workers in Baja California and many relied on California registered vehicles for movement across the border to their places of employment. In addition, the vehicle fleet includes *vehículos chocolate,* or chocolate vehicles, which are not legally imported or registered but have a legal order of protection (*amparo*) that is issued by organizations that work to protect the rights of citizens to not pay the costs of importation and license plates in Baja California. In 2017, *vehículos chocolate* numbered about 100,000 vehicles.[24] The combination of legally registered vehicles, chocolate vehicles, and commuter worker vehicles totals about 1.2 million vehicles. With a total state population of about 3.6 million persons, Baja California has 1 vehicle for every 3 people, a ratio similar to that of California.

The population of Baja California and the size of the vehicle fleet have grown considerably over the past several decades. However, the import quota for used tires has lagged behind the growth of population and the increase in the number of registered vehicles in Baja California. For example, in 2000, the authorized quota would have provided 2.28 used tires for each vehicle registered in Baja California. For 2004, the number of authorized used tires per registered vehicles had declined to 0.64 and in 2008 the figure was 0.65.[25] By 2017, the number of used tires in the quota per registered vehicle was 0.74, a slight apparent increase from 2008, which may reflect inconsistencies in data collection and reporting by Baja California. Clearly, the supply of legally imported used tires has not kept pace with the growth in the numbers of registered vehicles in the state. Table 5 details how population and number of registered vehicles in Baja California have grown much faster than the used tire import quota.

Table 5. Population, Registered Vehicles, and Tire Quota in Baja California, 1991–2017

Year	Population	Registered Vehicles	Used Tire Quota for Baja California
1991	1,733,946	n/a	500,000
1995	2,112,140	n/a	320,000

Year	Population	Registered Vehicles	Used Tire Quota for Baja California
2000	2,487,367	293,997	670,000
2001	2,554,775	446,333	500,000
2002	2,624,009	564,881	500,000
2003	2,695,120	671,745	500,000
2004	2,769,158	786,447	500,000
2005	2,844,469	894,079	500,000
2006	2,907,896	998,611	750,000
2007	2,993,009	1,096,616	750,000
2008	3,079,363	1,154,535	750,000
2009	n/a	1,475,939	770,000
2010	3,115,070	887,957	585,300
2011	n/a	917,710	750,000
2012	n/a	1,017,115	704,000
2013	3,381,080	1,072,880	780,000
2014	3,432,944	1,100,840	785,000
2015	3,315,766	1,123,118	800,000
2016	n/a	n/a	786,090
2017	3,584,605	*1,078,000	800,000

*Interview with Ingresos del Estado, Mexicali, 6/29/2017.
Sources: Instituto Nacional de Geografía, Estadística e Informática, Consejo Nacional de Población, Consejo Estatal de Población, Secretaría de Protección al Ambiente de Baja California, Secretaría de Economía.

Formal Flow

Demand for used tires in Baja California has been strong for many decades and, until the 1990s, importation of used tires from California was largely unregulated. This was in keeping with the special status accorded the northern border zone within Mexican national policy. For more than a century and a half, federal authorities have recognized that Mexican cities along the border with the U.S. had weak economic linkages with the center of Mexico and a wide range of goods were available just across the border in U.S. cities. With a well-developed rail and highway system, U.S. border merchants could provide a greater selection and lower prices for goods than could their counterparts across the border. Transportation from the industrial heartland in central Mexico to isolated Tijuana or Mexicali was just too expensive and Mexican authorities acknowledged the difficulty controlling importation of goods from the United States.

It made more sense to permit free trade between Mexican border communities and the U.S. and impose import tariffs on the rest of the country by establishing checkpoints and customs houses on the major transportation routes between the border cities and the heartland of Mexico. After establishment of a free zone for trade in Tamaulipas on the eastern end of the border in 1858, the entire northern border was declared a free zone

in 1885.[26] This stimulated local trade and economic growth of the border communities and established firm traditions of wholesale and retail trade across the border. Mexican authorities have adjusted the free zone policies for the northern border over the years, including reducing elements of free trade and tightening enforcement at the northern border.

Mexican Used Tire Import Quotas

In 1994, NAFTA brought greater Mexican Customs regulation enforcement at the border and a reduction in uncontrolled local movement of new and used goods into Mexico. NAFTA was not created to remove barriers on local border trade; actually, NAFTA increased controls on border trade. In 1988 ecological waybills (*guías ecológicas*) initially controlled used tire imports and established import quotas, which were agreed upon by federal authorities in consultation with state officials in Baja California.[27] By 1996, the current system of yearly import quotas for Mexico's northern border emerged with the annual numbers determined by the federal Secretariat of Economy in Mexico City. Officials treated Baja California and Sonora as one region for the import quota. The import permits required documentation of proper disposal of some portion of the quota. Baja California state environmental authorities acted as an intermediary between tire importers and the state and federal authorities in Baja California.[28] Table 6 provides data on the yearly import quota established under this process.

Table 6. Used Tire Import Quotas and Used Tire Imports, 1991-2017

Year	Baja California	Partial Zone of Sonora	Total Quota	Used Tire Exports from California to Baja California*
1991	n/a	n/a	500,000	n/a
1992	n/a	n/a	700,000	n/a
1993	n/a	n/a	750,000	n/a
1994	n/a	n/a	850,000	n/a
1995	320,000	30,000	350,000	272,000
1996	670,000	60,000	730,000	596,500
1997	670,000	60,000	730,000	596,500
1998	670,000	60,000	730,000	596,500
1999	670,000	60,000	730,000	596,500
2000	670,000	60,000	730,000	596,500
2001	500,000	50,000	550,000	402,155
2002	500,000	50,000	550,000	425,000
2003	500,000	50,000	550,000	425,000
2004	500,000	50,000	550,000	425,000
2005	500,000	50,000	550,000	425,000
2006	750,000	62,000	812,000	637,500
2007	750,000	70,000	820,000	676,350

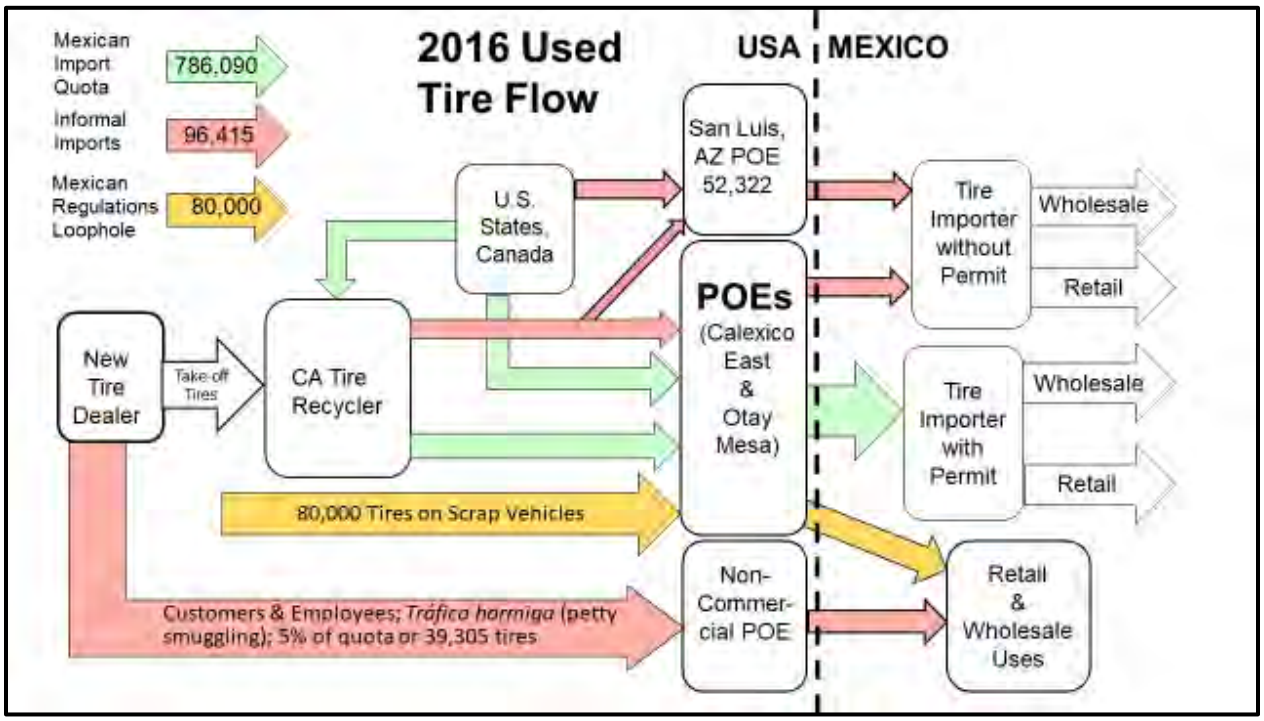
Year	Baja California	Partial Zone of Sonora	Total Quota	Used Tire Exports from California to Baja California*
2008	750,000	n/a	750,000	637,500
2009	n/a	n/a	770,000	709,398
2010	n/a	n/a	585,300	760,885
2011	n/a	n/a	750,000	886,121
2012	n/a	n/a	704,000	1,164,500
2013	n/a	n/a	780,000	1,421,380
2014	n/a	n/a	785,000	1,140,478
2015	n/a	n/a	800,000	872,949
2016	n/a	n/a	786,090	868,878
2017	n/a	n/a	800,000	n/a

*USA Trade; federal data on exports through California ports of entry. HS 4012200000
n/a = not available.
Source: For 1991-1994, Secretaría de Comercio y Fomento Industrial*, Importación de Llantas Usadas en Baja California,* 1995; for 1995-2008, Secretaría de Economía, Delegación Federal en Baja California; Secretaría de Protección al Medio Ambiente y Recursos Naturales, Delegación Federal en Baja California: for 2009-2016, SPA, 9/16/2016, e-mail communication; 2017 data, "Liberan cuota de importación de llantas usadas para BC,"19 March 2017: Unimexicali.com: http://www.unimexicali.com/noticias/bajacalifornia/470909/liberan-cuota-de-importacion-de-llantas-usadas-para-bc.html (accessed 7/27/2017).

Figure 2, on the next page, depicts the flow of used tires into Baja California for one year by permitted and informal pathways. As seen in Figure 2, the official 2016 quota for imported used tires into Baja California and the near area of Sonora was 786,090. U.S. Customs export data for 2016 indicate that 868,878 used tires were exported to Mexico from San Diego and Imperial District ports of entry. Some 479,983 used tires were exported through Calexico East and 370,895 through Otay Mesa. Records show an additional 52,322 tires exported from the port of San Luis, Arizona, to San Luis Río Colorado, Sonora. We calculate that 5 percent of the official quota, or 39,305 used tires, entered through the non-commercial lanes in the San Diego-Imperial District as petty smuggling, or *tráfico hormiga*. Finally, we estimate that 80,000 used tires entered Mexico from the San Diego-Imperial District with scrap vehicles legally through a loophole in Mexican regulations. Other than the annual import quota figure, we rely on U.S. export data as official Mexican import data by port of entry and product are not publically available.

In 2001, the Secretariat of Environment's (SEMARNAT) National Institute of Ecology eliminated used tires from the list of materials requiring the ecological waybills. The 2001 agreement that formed part of the annual quota arrangement gave the Baja California state government the responsibility of implementing a system to track importation and proper disposal of used tires by importers.[29] From 2001 to 2017, the

Figure 2. Flow of Used Tires into Baja California and Near Area of Sonora 2016



Source: IRSC research team and tables 7 and 8.

Mexican federal government, in consultation with state authorities and business organizations in Baja California, authorized the importation of used tires at an average number of 695,547 per year. Not all of the authorized used tires in the yearly quota were actually imported into Baja California or the partial zone of Sonora. Authorities in Mexico establish this quota as a limit to the number of used tires that can be legally imported by authorized used tire dealers. Some years, the official quota might not be released until several months into the new year and then bureaucratic delays could delay the necessary paperwork for imports for additional time. Based on available data, the 2009 Tire Flow Study estimated that, on average, only 85 percent of the annual quota was fulfilled.[30]

Stakeholder Perspectives on Mexican Import Quotas

It is also worth noting that a separate annual quota of used tires is authorized specifically for retreading purposes and, thus, is not included in these estimates.[31] In 2007, the Secretariat of Economy authorized the importation of 33,980 tires for retreading purposes only.[32] Additionally, tires enter Mexico attached to vehicles imported for dismantling. Federal officials estimated in 2008 that 67,000 vehicles for dismantling flowed from California into Baja California every year, each with used or waste tires.[33] At that same time, Baja California's Secretariat of Environmental Protection estimated that the importation of the waste vehicles resulted in 80,000 additional used tires imported, but this figure may be low. Used and waste tires that

enter Baja California affixed to vehicles for dismantling do so through a gap in the regulations and are not included by Mexican officials in the used tire import quotas.

Federal policy regarding used tire imports for Baja California and the adjacent area of Sonora has been somewhat ambivalent since implementation of the used tire import quotas in 1991. Federal environmental authorities regularly raise concerns about the environmental impact of used tires that produce waste tires at a more rapid rate than new tires. Ministry of Economy officials are concerned that importation of used tires negatively impacts sales of new tires manufactured in Mexico. The national and local chambers for rubber manufacturers and for new tire dealers (Asociación Nacional de Distribuidores de Llantas) in Mexico regularly lobby against authorization of the used tire import quotas, citing economic, public safety, and environmental concerns.[34] Mexican production of new tires does not meet the national demand—more than 9 million net (imports minus exports) new tires were imported in 2012—so it is unlikely that used tire imports will be eliminated on strictly economic terms.[35] In Mexico, government authorities, some business groups, and consumers characterize the availability of used tires for low-income residents as meeting a widespread social need. This suggests that eliminating or severely curtailing the import of used tires would provoke a strong popular response with political impacts.

While the continuation of used tire quotas for Baja California and the adjacent part of Sonora is likely for the foreseeable future, the critical decisions are ultimately made by Mexican federal authorities. There is a long history of federal decisions having significant effects in the border region. Over the past century, the Mexican federal government arbitrarily imposed or eliminated free zone status along different areas of the border—often without local input or agreement and often with unintended consequences.[36] For example, in 2014 Mexico eliminated the lower value added tax of 11 percent of the border zone and made it equal to the national rate of 16 percent.[37] The lower rate had been in effect as recognition of the special status of the border economic zone and to improve competitiveness with the retail sector across the border in the United States, where sales tax rates were much lower, usually around 8 percent. Thus, the federal government is certainly willing to take measures in the border region that have local negative economic impacts. It is conceivable that the Mexican government may take actions such as elimination of the used tire quota despite economic and social impacts in the region. As NAFTA renegotiations by the United States, Mexico, and Canada proceed, it is possible that trade barriers of many sorts will be erected. A tariff imposed by Mexico on imported used tires would have economic consequences for both California and for Baja California.

In 2009, the largest used tire wholesalers in Baja California each usually received authorization to import between 15,000 and 20,000 tires per year. Approximately 50 to 60 percent of these imports were retailed in the tire shops of the importers; the rest were wholesaled to smaller used tire businesses that are not authorized used tire importers. Other used tire importers are authorized to import smaller quantities, usually between 1,500 and 2,000 used tires per year.[38] According to the 2016 IRSC Tire Dealers Survey, this system has continued with quotas for individual dealers ranging from 50 to 15,000 used tires.[39] For at least the last decade, authorized used tire dealers

have advocated that that the yearly used tire quota be increased to at least 1 million tires per year. They feel that a larger quota would more sufficiently meet the demand for used tires and would reduce the informal flow of used tires into Baja California.[40]

However, small used tire dealers in Baja California that are not authorized importers do not necessarily share this view. Survey information collected in 2006 and 2016 indicates that these small dealers buy from the major authorized used tire importers in Baja California, but these wholesalers often limit the number, quality, and condition of tires involved. Some small used tire dealers said that they are required to buy mixed loads of about 30 tires, which include five to six tires of each tire size as wholesalers do not allow them to choose the size or the quality of the used tires they purchase. The 2016 survey of tire dealers indicates that tire shops buy an average of 126 used tires per month from both used tire importers and from new tire businesses in Mexico.[41] In addition, some Tijuana tire dealers mentioned that the quality of the used tires they buy from the authorized importers and retailers is poor, with minimal tread depths, and other problems. Other small tire shops report that the quality of used tires purchased from large importers is good and they rarely encounter unusable tires in a small lot.[42] In some cases, wholesalers and retailers even re-groove used tires to give the appearance that the tires still have adequate tread depth. Other shops report they regularly repair sidewall punctures, defects that would classify them as waste tires in California, but not in Mexico.[43] Small tire shops suggest that the used tires that the wholesalers sell them are those that the wholesalers cannot sell in their own shops.[44] Some small tire shops in Baja California report that they supplement their purchases from the large authorized importers with other sources. They buy used tires in the sizes and quantities they need from businesses that bring a selection of informally imported used tires to their shops.

Opposition to Used Tire Imports

Mexican tire manufacturers and new tire dealers have expressed dissatisfaction about used tires being formally and informally imported into Mexico from the United States. In Baja California, used tires sell for about one-third of the price of new tires.[45] The availability of the cheaper option is beneficial for many, but diverts business and revenue from new tire dealers and manufacturers. In addition to raising safety, environmental, and economic concerns about the used tire imports, Mexican tire trade and manufacturing groups regularly make exaggerated claims as to the size of the informal flow of used tires. They vehemently oppose the importation of used tires since it affects their businesses and, consequently, the livelihoods of many families.

The National Chamber of Rubber Industries, the Mexican Association of Tire Distributors and Renewal Plants (ANDELLAC), and the Coalition of Tire Industry Unions argue that new tire retailers suffer from unfair competition from the authorized and unauthorized used tires that flow into Mexico. They also argue consistently that importing used tires presents a safety hazard and that waste tires have negative environmental impacts.[46] In 2006, a prominent member of the Chamber of Rubber Industries estimated that for each authorized used tire imported, four used tires enter Mexico illegally because it is extremely difficult for U.S. and Mexican authorities to control the flow of goods across the 2,000-mile-long border.[47]

The president of the tire distributors' association (ANDELLAC) claims that used tires flowing legally from the United States are not thoroughly inspected at the border and most of them are of very low quality.[48] In addition, he argues that imported used tires have been found in Mexico as far south as the Yucatan Peninsula, even when the initial purpose of the used tire quota was to provide economic assistance to residents of the border region.

The research for the 2009 report did find examples of informal flow that included offloading of container trucks into vans and pickups near the border to enter Mexico through the noncommercial lanes as well as numerous references to petty smuggling. By 2017, however, the research team found no evidence to indicate that substantial numbers of unauthorized used tires were entering Mexico from California.

The Used Tire Quality Issue

Opponents of used tire importation have raised questions regarding the quality, safety, and suitability of the used tires that flow into Baja California from California and elsewhere.[49] The California Vehicle Code requires that the tread depth be 1/32" for tires on non-steering axles and 4/32" for tires on steering axles. If these conditions are met on all but one axle, State law will permit lesser tread depth on the remaining axle.[50] Other U.S. states do not consider this adequate and require 3/32" tread depth at a minimum. These states point to the evolving driving conditions within the United States since the 1/32" requirement was established. They suggest that high speed freeway driving requires more tread depth. The National Highway Transportation Safety Administration recommends that tires be replaced when worn down to 2/32".[51] The 2015 California Waste Tire Market Report suggests the lesser California standard may be one reason that explains why used tires are shipped from other states into California where they may still be sold legally as used tires.[52]

It is assumed that California companies that sell used tires to Mexico are exporting only tires that qualify under California law as used tires suitable for reuse. Self-regulation by California companies that export to Mexico is the primary guarantee that only tires that meet California standards are sold to Mexican users. Baja California and San Luis Río Colorado used tire dealers report very few problems with the quality of tires imported from California.

Mexico's definitions of minimum safety standards for used tires are not precise. For example, the 2008 agreement that authorized the importation of used tires into Baja California defines them simply as "tires suitable for reuse in passenger or freight vehicles," which is subjective and dependent upon who is inspecting the tires.[53] Mexican federal customs inspections of tires is limited to reviewing their country origin; inspectors do not examine the quality of used tires. Moreover, there is no state or municipal inspection of the quality of used tires at outlets in Baja California. Road conditions in Baja California are problematic and include worn and deteriorated surfaces; narrow, unpaved, or rough shoulders; potholes; debris; gravel roads; and dirt roads. Used tires with minimum tread depth and other defects may not have adequate puncture resistance and/or traction to be safe under these conditions. To our

knowledge, there are no empirical studies regarding the safety of used tires in Baja California.

Representatives of the Mexican tire manufacturers regularly argue that the United States exports low-quality and unsafe tires to Mexico and these charges regularly appear in the Mexican press.[54] However, there is no evidence to indicate that tires exported to Baja California from California are less safe than used tires sold in California or are less safe than used tires generated in Baja California or elsewhere in Mexico. In the field research for this project, tire resellers in Baja California occasionally mentioned loads of tires from California that included some poor quality or waste tires. However, the research team found no clear indication of persistent problems of waste tires being included in loads of imported used tires. Informants in California and Baja California indicate that tire haulers who regularly included numbers of waste tires with shipments of used tires would quickly lose market share since the used tire export industry is quite competitive and, more importantly, used tire importers are savvy business people. Importers who had received poor quality tires from one tire hauler would simply move their business to another.

When loads of tires are imported into Mexico, they are subjected to random inspection by Mexican Customs.[55] When a load is selected for inspection, all the tires are removed from the container, but the intent is to make sure that the load contents are accurately reflected in the manifest. Of particular concern are tires not originally manufactured in the NAFTA region—Mexico, the United States, or Canada. Tires manufactured elsewhere, most commonly China, are required to pay additional duties of 15 percent. The inspection is not geared toward whether or not the tires are roadworthy.

Informal Flow

The information about the number of tires in the informal flow from California to Baja California is sketchy at best. There is little empirical data for the estimates that have been made and are regularly reported in discussions about used and waste tires in the U.S.-Mexican border region. After a review of the issue in 2009, the research team for this study concluded that no more than 10 percent of the quota number are part of the informal flow of tires. By 2017, it is probable that the flow of unauthorized used tires has been reduced even more, to no more than 5 percent of the official quota.

The informal flow of tires from California into Baja California and the San Luis Río Colorado area of Sonora consists of several components. First, and most important, is petty smuggling. Second, there are the used tires on vehicles imported for salvage purposes. Finally, there are discrepancies in the data for numbers of used tires exported from California and imported into Mexico, which may indicate informal flows.[56]

Petty smuggling, or tráfico hormiga*,* accounts for most of the informal flow of used tires into Baja California and the near area of Sonora. In previous decades, this consisted of private individuals and businesses that moved small loads of tires in passenger cars, vans, or pickups with camper shells across the non-commercial lanes into Mexico. The 2009 study documented a few cases of loads up to 30 or so tires that were transported in this way.[57] Since 2009, however, Mexican Customs enforcement at the commercial and non-commercial lanes at the ports of entry has been tightened considerably. This is

partly the result of the smuggling of illegal arms and cash into Mexico, which is a national security concern, partly a response to the tightening of security procedures at the border by the United States, and partly from improved public administration efforts in Mexico. For example, reforms in Mexican Customs personnel and improved training mean that even petty smuggling of used and new goods has decreased. In 2017, a vehicle entering Mexico at a non-commercial lane that is found to include taxable or prohibited merchandise is stopped and prevented from entering the country. In the case of taxable items, a vehicle at San Ysidro/Puerta México would be redirected to Otay Mesa to pay the required taxes. Illegal articles would be confiscated on the spot and the vehicle could be impounded.[58] Based on multiple sources, the study researchers estimated in 2009 that the informal flow was about 10 percent of the number of tires imported legally. By 2017, our estimate is that the irregular flow had been reduced even more, to approximately 5 percent.

In March 2008, Baja California's environmental secretariat estimated that the annual flow of unauthorized tires into the state was 20,000 tires, with another 80,000 generated by the imports of junk cars for dismantling.[59] Importation of junk cars continues in 2017, but no specific numbers are available. Although the tires on imported junk cars are imported legally they represent an additional informal flow of used tires from California that is not part of the used tire quota.

Petty smuggling of used tires into Mexico takes a number of forms. Residents of Baja California who buy new or used tires in San Diego or the Imperial Valley tend to keep their take-off tires for several reasons. First, they are unwilling to pay the dealer the disposal fees for the old tires. Second, their old tires may have enough tread remaining to serve as spares or to give to a friend or relative.[60] Some individuals may cross the Mexican border to sell the used tires to individuals or dealers. Although these individuals might not haul more than a few used tires per trip, this creates a small but steady flow of used tires into Mexico.

Approximately 96,000 commuter workers live in Baja California and travel north across the border daily or regularly for employment.[61] Some live in Baja California and work legally in Southern California—U.S. citizens, permanent U.S. residents, and holders of work visas for the United States. These commuter workers are employed in all sectors in California, including tire dealers and auto repair shops. Others are Mexican residents and citizens and cross the border ostensibly to shop, purchase services, visit family members or friends, or for tourism purposes, but many of these actually work in the informal sector without a U.S. work visa.

The scale of the number of crossings is impressive. In calendar year 2016, there were 3.1 million northbound personal vehicle crossings into California and into Arizona from San Luis Río Colorado, which is on the eastern edge of the Mexicali Valley in Sonora.[62] The daily average of northbound personal vehicle crossings along this section of the border was 8,529. About 60 percent of all northbound non-commercial vehicular crossings, or 5,117, are by Mexicans, constituting a large number of individuals who potentially bring used tires back with them into Mexico. If 10 percent of southbound personal vehicles each brought two used tires that would total 18,615 tires per year.

This hypothetical example illustrates the possible scale of petty smuggling activities over the course of a year.

Many small merchants also buy used items in San Diego, the Los Angeles area, and the Imperial Valley for resale in Mexico. These people acquire goods of all kinds, including used tires, at garage sales, swap meets, and thrift stores for resale in Mexico. Since 2009, with tightened enforcement at the border by Mexican Customs, most of these small merchants are required to pay duties on the quantities of materials they import. Since used tire imports are prohibited without a permit, it is unlikely that many used tires enter Mexico with these loads of mixed goods for resale.

According to the president of the Tijuana Tire Dealers Association, the informal flow of used tires directly affects formal importers since it amounts to unfair and illegal competition in the used tire market. Survey data from a Tijuana tire dealers meeting indicate strong support from members to implement a comprehensive tire tracking system complete with a government imposed tire fee to develop recycling programs. Tijuana Tire Dealers Association leaders estimate that there are approximately 1,800 used tire dealers in the state of Baja California. Of this total, 80 are in compliance with the importation and disposal requirements as well as with city land use regulations, while the rest are not. These informal retailers do not have access to the authorized used tire quota and thus resort to illegally imported used tires.[63]

Used tire dealers interviewed in Tijuana who do not have import permits claim that, in addition to buying tires from the major authorized used tire importers, they have access to an “informal” source of used tires. The 2009 Tire Flow Study reported the existence of groups of individuals operating out of trucks and vans who approach tire shops with good quality used tires brought in from California via petty smuggling. These so-called "informals" carry around 30 to 40 used tires in their trucks and, unlike importers, allow tire shops to choose the number and size of tires needed for their business. Tire shops in Tijuana, for instance, reported buying between 10 to 30 used tires per month from these sources and claim to do so exclusively when necessary to restock a specific tire size.

Data from the 2016 Tire Dealer Survey reinforces this narrative. When used tire shops were asked if they import used tires from the Unites States when used tires are "scarce" in the local market, 13 of 111 interviewed used tire shops (11.7 percent) answered in the affirmative. These tire shops, which are not authorized importers, claim to bring in between 50 to 500 used tires per year from California to complement what they buy from authorized importers and from the local used tire market.[64] Taken together, these accounts reinforce the notion of an informal flow operating parallel to the formal imports of used tires. Nevertheless, the reported amounts are small relative to the claims of "hundreds of thousands" of unauthorized used tires flowing from California into Mexico.

The formal and informal flow of used tires also reaches as far south as Baja California Sur. Used tire retailers there have not been allocated a used tire quota since approximately 1995.[65] A report of waste tire generation and disposal in Baja California Sur developed for the 2009 Tire Flow Study indicates that many tires in municipal landfills and other tire dumpsites come from the United States. Tire shop employees

interviewed in Loreto in 2007 indicated that the owner also had a tire business in San Diego and regularly brought loads of used tires to the Loreto store, which only sold used tires. Interviews in Loreto in 2016 and 2017 confirmed that tire shops in Loreto are still supplied by sources along the northern border.[66]

It is important to note that much of the discussion regarding the waste tire disposal problems in the border region of Baja California, Sonora, and Baja California Sur centers on the flow of used tires from California as the source of the problem. However, at least half of the waste tires generated in Baja California originate from take-off tires at new tire dealers in the state. New tire dealers in Baja California have no responsibilities for disposition of waste tires. Therefore, even without the faster accumulation of waste tires due to importation of used California tires, Baja California still would have a problem with proper disposal of waste tires due to local generation.

Tire Flow across the Entire U.S.-Mexico Border

Tires are exported from other U.S. border states into Mexico, although the largest numbers are sent from California. Table 7 provides data on exports from U.S. border.

Table 7. Used Tire Exports from U.S. States to Mexico, District Level Data, 2009-2016

State and Trade District	2009	2010	2011	2012	2013	2014	2015	2016
California								
Los Angeles District	0	0	0	0	1,240	0	0	0
San Diego and Imperial District	709,398	760,885	886,121	1,164,500	1,420,140	1,140,478	872,949	868,878
California Total	709,398	760,885	886,121	1,164,500	1,421,380	1,140,478	872,949	868,878
Arizona								
Nogales District (excluding San Luis Port)	1,104	321	3,305	1,826	3,850	5,631	5,229	8,789
San Luis Port	894	0	0	102	0	14,940	228,264	54,322
Arizona Total	1,998	321	3,305	1,928	3,850	20,571	233,493	63,111
New Mexico								
Santa Teresa Port	0	153	0	1,149	711	0	0	0
New Mexico Total	0	153	0	1,149	711	0	0	0
Texas								
El Paso District (excluding NM ports)	112,490	83,451	173,696	261,721	122,575	80,950	86,714	90,924
Houston-Galveston District	0	0	0	0	0	0	400	0
Laredo District	364,031	295,987	338,911	391,251	351,636	216,080	64,333	37,641
Texas Total	476,521	379,438	512,607	652,972	474,211	297,030	151,447	128,565
Total	1,187,917	1,140,797	1,402,033	1,820,549	1,900,152	1,458,079	1,257,889	1,060,554

Source: US Census Bureau. Available quantity data for HS Code:4012200000 at the district level. District level data are not available from New Mexico as New Mexico ports are included in other districts. Used tires exported to Mexico via New Mexico ports are listed separately in this table. The Santa Teresa Port is part of the El Paso, Texas Trade District. Export numbers were subtracted from the El Paso Trade District.

states to Mexico from 2009 to 2016. Table 8 has specific used tire exports for the individual ports in the San Diego Trade District, which also includes those in Imperial County. Because of gaps in the California used tire tracking system, it is not known how many tires exported from California were actually first imported from another state into California. It is also not known how many used tires originating in California are exported to Mexico from another U.S. state. For example, it is likely that some of the used tires exported from the San Luis, Arizona, port of entry are tires from California.

Table 8. Used Tire Exports to Mexico: San Diego Trade District Port Level Data, 2009-2016

San Diego Trade District	2009	2010	2011	2012	2013	2014	2015	2016
Andrade Port	0	0	0	0	0	0	0	0
Calexico Port	0	0	0	6,413	15,614	145,922	3,885	0
Calexico-East Port	425,141	438,240	416,829	470,755	717,726	536,074	405,190	497,983
Otay Mesa Port	284,257	322,645	465,127	687,332	686,297	458,482	463,874	370,895
San Diego Port	0	0	0	0	0	0	0	0
San Ysidro Port	0	0	3,707	0	0	0	0	0
Tecate Port	0	0	458	0	503	0	0	0
Total	709,398	760,885	886,121	1,164,500	1,420,140	1,140,478	872,949	868,878

Source: US Census Bureau and IRSC calculations.

Mexico Trade with Asia

Although much less prominent than the flow of used tires from the United States into Mexico, the quantities of used tires imported into Mexico from China have increased over time and equaled 73,000 tires in 2007, growing to 227,853 in 2016.[67] The data are applicable to Mexico as a whole, and cannot be separated into states or regions. Table 9 on the following page provides available data on used tires imported into Mexico from China. The research team found no evidence of used tires arriving by ship from Asia in the peninsular ports of Ensenada or La Paz. Mainland west coast ports, then, were the probable destination for these used tires from China.

Table 9. Used Tire Imports to Mexico from China

Year	# Tires	Year	# Tires
2003	1,587	2010	152,624
2004	16,762	2011	260,141
2005	37,697	2012	281,561
2006	50,206	2013	447,960
2007	73,469	2014	393,425
2008	102,292	2015	229,964
2009	128,864	2016	227,853

Source: United Nations Commodity Trade Statistics Database.
Comtrade:.www.comtrade.org

3. Disposal and Alternative Uses for Waste Tires in Baja California

While much progress has been made by Mexican authorities to control and regulate the final disposition of waste tires in the border region, many challenges remain. Whether a citizen, authorized importer, or tire dealer, the most preferred option for Mexicans continues to be disposing of waste tires when no cost is involved.[68] Due to the significant limitations and gaps still remaining in the physical infrastructure and institutional framework for waste tire management in Baja California, waste tire generators often avoid incurring disposal costs by improperly storing and discarding waste tires. Proper waste tire disposal is further complicated by few incentives or options currently available to divert waste tires for productive end uses.

As previously noted, new and used tire dealers sell more tires than they dispose of legally and with a certificate from SPA. New tire dealers generate substantial numbers of used and waste tires from new tire sales, yet they are not required by law to responsibly dispose of waste tires. Many waste tires, then, remain in the hands of individual customers or accumulate in tire shops and are not disposed of properly. Currently, the ultimate disposal of waste tires is most commonly at authorized waste tire collection centers, in an authorized municipal collection lot, in an authorized landfill, or in an informal dumpsite.

Productive end uses for waste tires in Baja California include tire-derived fuel, formal and informal civil engineering applications, and miscellaneous uses such as artisanal products and other retail goods. Diversion of large numbers of waste tires to these productive end uses, however, remains limited in Mexico due to immature markets, various technological barriers, lack of effective public policies, and lack of designated funding, subsidies, and investment. Of the productive end uses, tire-derived fuel processed in cement kilns remains the most common use of waste tires in Baja California and the near region of Sonora and accounts for some 90 percent of tires diverted to productive end uses. Overall, public initiatives have remained focused on the collection and storage of waste tires generated in the region with little attention to development of markets for productive end uses.

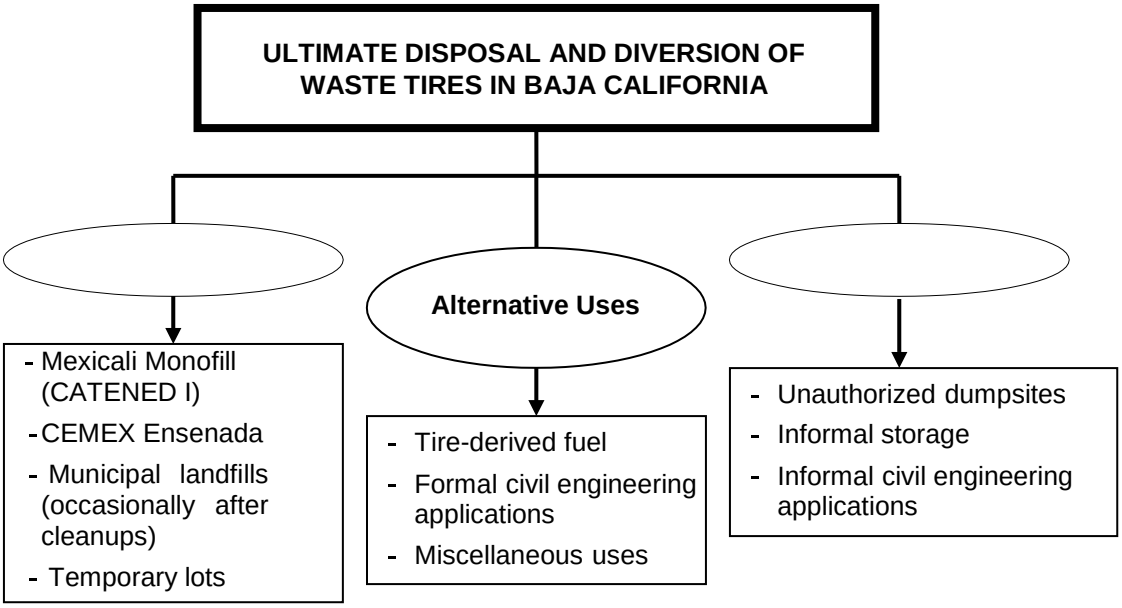
A basic challenge in understanding used and waste tire issues related to disposal is the absence of reliable data. Detailed market data quantifying the number of new and used tires sold in Baja California is not available from industry or government sources. The number of vehicle owners from Baja California who purchase new tires in the United States is unknown. However, a reasonable estimate is that sales of Mexican or foreign manufactured new tires in Baja California, and purchases of new tires in the United States by Baja Californians, account for approximately half of all additional new and used tires added to the vehicle fleet in the state each year.[69]

In 2015, Baja California had a registered fleet of 1,123,118 vehicles according to federal authorities.[70] In 2017, the registered fleet, according to state officials, was 1,078,000.[71] While the number of unregistered and irregular vehicles (meaning vehicles with foreign license plates such as those from California) is also unknown, government officials and

the Tijuana Chamber of Commerce estimate there are anywhere between 200,000 and 800,000 additional vehicles operating in the state.[72] Industry sources estimated that by the end of 2010, unregistered and illegal vehicles represented at least an additional 20 percent of all of Mexico's registered national vehicle fleet.[73] Baja California has an above average number of legally and illegally imported vehicles when compared to the rest of the country. Tijuana, Tecate, and Mexicali are cited as among the municipalities with the most irregular (unregistered in Baja California or illegal) vehicles.[74] In a recent study of vehicle emissions and vehicle activity in Baja California, around 80 percent of the individuals in the sample reported acquiring a vehicle from the United States.[75]

Taking into account irregular vehicles and the registered vehicle fleet in Baja California and San Luis Río Colorado, Sonora, an estimated market demand for replacement tires is at least 2 million tires per year.[76]

Figure 3. Waste Tire Disposal and Diversion in Baja California



In 2016, the National Association of Tire Distributors (ANDELLAC) reported that Mexico produced 29.8 million new tires, of which 14.3 million were exported. The estimated national market demand was 39.4 million tires, an increase of about 48 percent from 2009. About 24 million new tires were imported to meet the market demand. Industry sources did not report on used tire sales. ANDELLAC claims that the importation of large quantities of used tires from the U.S., as well as the importation of low quality tires from China and South Korea, has complicated and blurred the domestic replacement tire picture. [77]

Table 10. Mexico New Tire Market Indicators, 2009-2014

Indicator	2009	2010	2011	2012	2013	2014
National Production	13,848,000	17,094,496	20,190,038	25,687,221	25,115,779	25,001,748
Imports	13,886,000	17,972,824	17,932,278	19,175,298	19,947,448	24,801,240
Exports	4,606,000	5,313,162	8,677,183	11,672,303	11,544,339	12,021,111
Tire Market	23,128,000	29,754,158	29,445,133	33,190,216	33,468,888	37,781,877
Replacement Sales	20,426,000	23,706,415	23,959,385	26,441,337	26,553,176	30,340,854
Original Equipment Sales	3,577,000	5,605,497	5,345,917	5,885,291	6,006,031	6,817,412

Source: ANDELLAC.

Baja California and the near region of Sonora generate a substantial number of used and waste tires locally. Inevitably, some of the new tires sold in the region wear out each year and become waste tires, while others that are partially worn are sold as tires suitable for reuse. Contributing to the rapid generation of waste tires in Baja California and Sonora, however, are a number of factors, including the importation of used tires from the United States into the border region. As described earlier in this report, imported used tires enter the Mexican tire market with less service life than an equivalent new tire.[78] The useful life of tires in Baja California is further reduced by road conditions throughout the state. Mexican officials estimate that the average service life of a tire in Mexico is around 46 months, a figure markedly below the average service life of tires in many industrialized countries.[79] Unpaved roads, deteriorated paving, worn asphalt, obstacles in the road, and other factors mean that waste tires accumulate proportionally faster in Baja California than in California. Despite media perceptions, waste tires are not directly or legally imported into Mexico. Occasionally they do slip in with used tire imports as well as with imports of used or waste vehicles from the United States, but the research team believes this quantity to be minimal.[80] The widespread availability of used tires in the border region, their relatively low cost, and the fact that used tires have a reduced service life help explain the generation of large volumes of waste tires. Many of these waste ties are not disposed of properly and have accumulated in various locations scattered across border municipalities.[81]

Estimating Waste Tire Generation in Baja California

Estimating the number of waste tires generated in Baja California is an important aspect of developing an integrated and sustainable solid waste management plan. Given the limitations of available data for the Mexican tire market, however, there is no standardized method to quantify the number of waste tires generated in Mexico each

year. Nonetheless, several conventions do exist for making reasonable estimations. Industry sources in the United States report that in 2016 tire replacement was a $38.1 billion industry with a replacement tire market share of about 254.4 million units of passenger, light truck, and medium/heavy truck tires.[82] The number of registered vehicles in the United States in 2016 was about 261 million.[83] Thus, the ratio of new replacement tires sales to the U.S. vehicle fleet size is about 0.98 tires per vehicle per year. The ratio of new replacement tire sales in Mexico in 2014 to the registered vehicle fleet of that year is 0.8.[84] When considering the sale of new and used tires and the number of used tires imported into Baja California, the state generates—and is faced with the annual disposal of—between 2 and 3.5 million waste tires depending on the estimation method.

The first estimate uses available used tire export and vehicle fleet data as the baseline. In 2016, the number of used tires exported from the United States into Baja California via California ports was reported to be 868,878, excluding tires for retreading.[85] If it is assumed that an additional 5 percent over the authorized imports was informally imported, and at least 80,000 more used tires came into the state on vehicles to be dismantled, then in 2016 around 1 million used tires came into the state of Baja California. If the ratio of new replacement tire sales to vehicle fleet size is extrapolated to Baja California, the state's registered vehicle fleet of around 1.1 million vehicles generates an estimated new tire market of about 900,000 units. According to industry stakeholders in Mexico, new tire sales are roughly equivalent to the number of used tires introduced into the state, making this estimate reasonable.[86] Given this information, around 2 million new and used tires are estimated to be purchased each year for use by the vehicle fleet in Baja California, generating a similar number of waste tires. This number seems appropriate given that SPA officials have estimated that Baja California generates at least 2 million waste tires annually.[87]

An alternative, and generally accepted, method of estimating waste tire generation in industrialized countries is to count one waste tire per resident per year.[88] The actual number of waste tire generation in the border region, however, is perhaps slightly lower. A study conducted in the Chihuahua border region estimated that about 0.69 waste tires were generated per resident per year.[89] Due to the similarities of the population of that study with the Baja California border region, the research team feels that extrapolating this ratio for the estimation of waste tire generation in Baja California is appropriate. Employing this method of estimation, the five municipalities of Baja California and the municipality of San Luis Río Colorado, Sonora potentially generate around 2.4 million waste tires annually, with an upper range of 3.5 million waste tires.

In addition to estimating regional waste tire generation, it is useful to calculate waste tire generation at the used tire dealer level. The 2016 IRSC Tire Dealer Survey asked a sample of 36 used tire importers and 111 small tire shops in Baja California and San Luis Río Colorado about the number of waste tires they generate every month. To avoid direct questioning such as "how many waste tires does your business generate each month," the survey asked if they generated "at least 200, over 100 but less than 200, over 50 but less than 100, or less than 50" waste tires. Among used tire importers, over

Table 11. Waste Tire Generation Estimates for Baja California and San Luis Río Colorado, Sonora, by Population

Municipality	2010 Population	Estimate #1	Estimate #2	2015 Population	Estimate #1	Estimate #2
Ensenada	466,814	466,814	322,102	486,639	486,639	335,781
Playas de Rosarito	90,668	90,668	62,561	96,734	96,734	66,746
Tijuana	1,559,683	1,559,683	1,076,181	1,641,570	1,641,570	1,132,683
Tecate	101,079	101,079	69,745	102,406	102,406	70,660
Mexicali	936,826	936,826	646,410	988,417	988,417	682,008
San Luis Río Colorado	178,380	178,380	123,082	192,739	192,739	132,990
Total	3,333,450	3,333,450	2,300,081	3,508,505	3,508,505	2,420,868

Population source: INEGI.
Note: Estimate #1: 1 waste tire generated per resident per year; Estimate #2: 0.69 waste tires generated per resident per year

40 percent reported generating at least 200 waste tires every month and almost 20 percent reported monthly waste tire generation of between 100 and 200 waste tires. Conversely, 46 percent of used tire shops that are not used tire importers report generating less than 50 waste tires and 27 percent between 50 and 100 per month. Only 10 percent of tire shops said they generated at least 200 tires per month.

Table 12. Monthly Waste Tire Generation by Importers and Non-importers

Amount	Importers %	Non-Importers %	Full Sample %
At least 200	41.7	9.9	17.7
Over 100 but less than 200	19.4	17.1	17.7
Over 50 but less than 100	22.2	27.0	25.9
Less than 50	11.1	46.0	37.4
No response	5.56	-	1.36

N = 147
Source: 2016 IRSC Tire Dealer Survey.

Ultimate Disposal of Waste Tires in Baja California

When considering used tire imports from the United States, new and used tire sales, population statistics, and vehicle fleet size, Baja California is faced with the annual disposal of at least 2 million waste tires with a high estimate of 3.5 million. As a result of initiatives over the last decade that focused attention on the problem of waste tire disposal, the states of Baja California and Sonora have made substantial progress in diverting waste tires from landfills and illegal dumpsites to formal collection centers and productive end uses compared with the rest of Mexico. Mexican officials have estimated that nationally only around 10 percent of waste tires are recycled or diverted to productive end uses each year. Conservative estimates suggest that only 5 percent of waste tires are recycled, 2 percent disposed at formal collection centers, and a similar number used as tire-derived fuel in cement and brick kilns.[90]

By 2017, the large legacy tire piles in Baja California that were so problematic in the first decade of the 21st century had been removed, although there were still remnants of piles and scattered tires at the sites to the west of Mexicali known as INNOR and LLANSET.[91] Municipal authorities working with SPA and the tire dealers associations were cleaning up waste tires in urban areas in Tecate, San Luis Río Colorado, and Playas de Rosarito. Ensenada was challenged to remove abandoned waste tires in the urban zone due to insufficient municipal resources dedicated to the effort. Mexicali and Tijuana (large metropolitan areas with large vehicle fleets) experienced ongoing difficulties in removing waste tires abandoned on streets, vacant lots, and dry watercourses. Several tire piles were present in newly urbanizing areas of Tijuana such as Cañón de las Carretas, where residents were using large numbers of tires for self-constructed housing foundations, retaining walls, and stairways. These areas also tended to have miscellaneous waste tires scattered about or piled on both private and vacant lots, sometimes mixed with other solid waste. Mexicali residents constructing housing had much less use for waste tires due to the flat topography.

The research team for this study conducted a review of tire piles in the municipalities of Baja California and Sonora. The methodology included interviews with local and state officials as well as tire dealers that asked about the location of large tire piles. It also involved a detailed analysis of satellite images through GoogleEarth to identify specific accumulations of tires or likely tire piles. Finally, the team conducted filed visits to the municipal urban areas to verify locations, to take photographs, and to interview local people. Interestingly, in many cases tire piles visible from the satellite images were not visible from the street, even when the exact location was known. Many of the piles are in abandoned buildings or in lots screened by buildings and high fences or walls.

Waste tire accumulations in Baja California and the near area of Sonora can be categorized as follows.

1. Scattered small tire piles, often in newly urbanizing areas with self-constructed housing. These piles are the source of construction materials. As well, waste tires mixed with other solid waste are often found in these areas that do not have well established solid waste collection services.

2. Small piles found throughout the cities in back yards and on roofs of private houses, as well as in vacant lots and abandoned buildings.

3. Waste tire accumulations in the back lots of tire shops, automobile repair shops, vehicle junk yards, and construction company equipment yards. Most often, these piles were controlled with restricted access. The size of these piles ranged widely in numbers, infrequently exceeding 200 or 300 tires.

4. Waste tire piles at municipal transfer stations, controlled lots, or more informal lots. These piles present minimal fire danger at transfer stations or controlled lots. However, the uncontrolled lots are prone to fires.

5. Informal civil engineering uses. Found throughout the urban areas, especially on areas of moderate and steep slopes, are areas characterized by self-constructed houses and businesses. House pads and foundations, stairways, and retaining walls built of waste tires are present. Many of these areas have retaining walls that are recently constructed or have deteriorated and are being repaired. These areas often have numbers of tires scattered about that are left over from construction projects or have eroded out of an older retaining wall.

The field survey made it clear that there are no standard practices for waste tire storage to avoid the dangers of fire or collecting water and forming mosquito habitats. Development and implementation of regulations for indoor and outdoor storage of waste tires would assist in the proper management of waste tires in Baja California. Storage standards would also likely help discourage accumulation of large numbers of waste tires by companies and individuals. Public health authorities have expressed concern about these scattered tires, especially those in close proximity to dwellings, since they pose fire hazards as well as accumulate standing water and thus serve as perfect breeding environments for mosquitos, especially the Aedes aegypti mosquito that is a vector for dengue and zika viruses.[92]

Waste Tire Disposal at the State Level

From 1996 to 2013, Baja California had only one authorized waste tire collection and transfer center, first INNOR from 1996 to 1998, and then LLANSET from about 1998 to about 2005, both located in Mexicali. These sites were largely remediated through the efforts of Border 2012, the U.S.-Mexico binational border environmental program that was active from 2003 to 2012.[i] By 2017, the huge tire pile at El Centinela, located just to the north of INNOR and LLANSET, had been fully cleaned up. After INNOR and LLANSET had been largely cleaned up, remnant piles remained and sporadic dumping of waste tires was still occurring. There were perhaps several thousand waste tires at each site.

[i] The leads for this program were the U.S.E.P.A. and the Mexican federal environmental agency, SEMARNAT. Border 2020 (2013-2020) is the successor border environmental program. www.epa.gov/border2020.

Image 1. LLANSET waste tire collection center to the west of Mexicali in 2006 (left image) and 2016 (right image). Source: GoogleEarth.

In 2013, the state of Baja California entered into contract with a private company to open a new formal collection and transfer center called CATENED II in southern Tijuana. In addition to serving as a state authorized collection and transfer center, the site was to host a pyrolysis plant to remove the oil, metal, and black powder from waste tires and produce alternative fuel. The contract with the state was terminated in 2015 because the company had not made adequate progress with the planned plant installation.[93] Although CATENED II Tijuana received several hundred thousand tires from the surrounding municipalities, the pyrolysis plant never operated beyond the test phase. Upon closure of the site, state authorities began transferring tires from CATENED II Tijuana to the Mexicali transfer station. Yet, as of December 2016 no further transfers had been made from Tijuana and approximately 200,000 tires remain at the closed site. In a research visit to CATENED II Tijuana, on-site staff conveyed that state and municipal authorities were working on plans to establish a new collection and transfer center at another undetermined location in Tijuana to replace the closed facility. Once established, all remaining tires would be transferred to the new site.[94]

With the closure of CATENED II Tijuana in 2015, Mexicali once again became the only municipality with an official waste tire collection and transfer center in the state of Baja California. As a result, waste tire generators in the other municipalities must haul their waste tires or hire a waste tire hauler to transfer waste tires to CATENED I in Mexicali for final disposal. The Mexicali collection center has been open since 2009 and is 120 miles from the center of Tijuana and 180 miles from Ensenada. This location has introduced conflict between the tire dealers of Tijuana and Ensenada and those of Mexicali. As Mexicali dealers continue to dispose of tires nearby, dealers from all other municipalities are burdened with higher hauling costs. The cost of transportation is relatively high and fluctuates according to the price of fuel and other factors. This contributes to the problem of illegal and informal dumping of waste tires.

In the past, as detailed in the 2009 study, the CEMEX facility in the city of Ensenada has served as a state approved disposal facility by storing large numbers of tires on-site while waiting to be processed as tire derived fuel. Yet, as noted above, the CEMEX plant did not accept waste tires from 2015 through the first half of 2017. Yet even with the new CEMEX contract, given that the CEMEX plant will only dispose of 500,000 tires annually, the facility will not be a sufficient final disposition location for all waste tires generated in the region.

In November 2016, there were approximately 200,000 waste tires stored in cells at the CEMEX facility in Ensenada. In addition, by mid-2017, about 350 tires had accumulated on a vacant lot adjacent to an entrance door to the CEMEX facility. Apparently, individuals were dropping waste tires there on the assumption that they would be collected and processed by the cement company.

Mexican environmental authorities have suggested that about one-third of the waste tires generated in Baja California have been used as fuel in the cement kilns of Ensenada and Hermosillo.[95] Yet from 2015 to 2017, the CEMEX plant in Ensenada did not officially accept waste tires from the surrounding municipalities. This caused a significant disruption in the management and ultimate disposal of waste tires in the border region. In May 2017, state authorities announced that a new contract had been negotiated with the CEMEX Ensenada plant to begin disposing of 500,000 tires annually.[96] The actual maximum capacities of these facilities, however, may be much greater. For example, representatives from CANACO maintain that the cement company Apasco could process well over two million waste tires in Hermosillo if profitable and sustainable arrangements were made.[97]

The remainder of waste tires in the region not used for fuel must be diverted for other productive end uses or be disposed in other ways. Baja California continues to face challenges in managing the ultimate disposal of waste tires. The state has limited and inadequate alternatives for productive end uses of waste tires beyond tired derived fuel for cement kilns.

Between 2012 and 2016, 4,475,318 tires were deposited at the official temporary collection and transfer centers in Tijuana, Ensenada, and Mexicali.[98] Using the lower, conservative estimate of 2 million waste tires generated per year, this represents the proper disposal of only around half of Baja California's waste tire generation during this period. Of those tires deposited at the official centers, only 3,421,569, or about 76 percent, were diverted to productive end uses.[99] Most of those tires were processed as tire derived fuel in the cement kilns of Hermosillo and Ensenada. The rest were utilized as material for authorized civil engineering projects in Tijuana and elsewhere. The fate of the rest of the waste tires generated throughout the region is less clear. If only 721,963 waste tires, about 36 percent of the conservative estimate of 2 million waste tires generated annually, were deposited at official collection and transfer centers in 2016, at least 1.2 million tires were disposed in other ways. Some were delivered to municipal collection lots or municipal landfills for storage and eventually disposal. Some were used for miscellaneous productive uses such as sandal soles, belts, mats, and playground equipment. Tires were also used by local residents for self-built construction purposes, including stairways, retaining walls, foundations, and erosion protection along

watercourses. Other tires were burned deliberately to recover the steel to sell or to create more space for tire or mixed tire and trash clandestine dumpsites. Others were used as unauthorized fuel for artisanal brick kilns or heating. Still others were stored in piles at transportation companies, agricultural enterprises, auto mechanics, vehicle junk yards, and other businesses that did not have a convenient way to properly dispose of them. Private individuals, lacking other options, accumulated waste tires on roof tops and in back yards or dumped them in vacant lots, rural areas, canals, canyons, arroyos, and rivers.

Table 13. Disposal of Waste Tires at Official Temporary Collection Centers, 2012-2016

Year	Disposal at Temporary Collection Centers	Used Tire Exports from California into Baja California	Used Tire Import Quota for Baja California
2012	863,480	1,164,500	704,000
2013	1,075,059	1,421,380	780,000
2014	867,875	1,140,478	785,000
2015	964,941	872,949	800,000
2016	721,963	868,878	786,090
Total	4,475,318	5,468,185	3,855,000

Source: SPA; US Census Bureau.

Recent actions by the state government of Baja California have met with some success in efforts to address the waste tire issue. However, it is clear that additional actions and programs will be required to resolve this problem. Particularly important will be efforts to develop sustainable productive uses for waste tires that respond to market demands and to develop mechanisms to provide adequate funding. It will also be necessary to more fully engage private sector stakeholders for long-term solutions and to educate the public on the proper storage of tires and the safe use of tires in civil engineering applications.

Waste Tire Disposal at the Municipal Level

The number of tires that Baja California generates each year as waste is large. The research team estimates the current figure to be at least 2 million waste tires per year. However, as other accepted methods of estimating waste tire generation mentioned in this study show, the number of waste tires generated annually in the region could potentially be between 2.4 and 3.5 million. Without sufficient state collection and transfer facilities, part of the burden of waste tire management has fallen on municipal governments. This has occurred despite waste tires being classified as “special waste” and thus the ultimate responsibility of the state government of Baja California under

Mexico's waste management regulatory framework. Laws, regulations, and jurisdiction issues will be discussed at length in chapters 4 and 5 of this report.

Under some circumstances, municipal landfills in Baja California that receive urban solid waste also receive waste tires. This occurs mainly through municipal cleanup programs or as a result of daily routine solid waste management operations in the municipalities. Often, these waste tires are stored temporarily for later transfer to either Mexicali or Ensenada.

Despite efforts to control the disposal of special waste, tires continue to be illegally dumped in relatively small amounts on vacant and abandoned lots and in canyons scattered throughout the urban areas of Baja California, especially on the edges of the densely urbanized zones. There are also problems of waste tire dumping on beaches, although winter storm runoff on adjacent canyons and hillsides likely transports waste tires to beaches. These tires are routinely collected and deposited at the local landfills or municipal tire collection sites. Since most municipalities in Baja California lack the adequate infrastructure for waste tire disposal, such as tire shredding machines, proper disposal is often problematic.

In response to the continued accumulation of tire piles, the limitations of municipal landfills, and the need for official collection and transfer centers, municipal governments have created temporary waste tire collection sites. The municipal authorities of Ensenada, Playas de Rosarito, Tecate, and San Luis Río Colorado have all established waste tire collection or transfer sites on municipal properties or in special areas of the municipal landfills. These sites, sometimes undeveloped and not controlled, have quickly filled with large numbers of waste tires collected by municipal environmental, civil protection, and public works employees. The response of the municipalities to the problem of waste tires has been fairly successful at reducing the accumulation of large waste tire piles at illegal dumping locations.

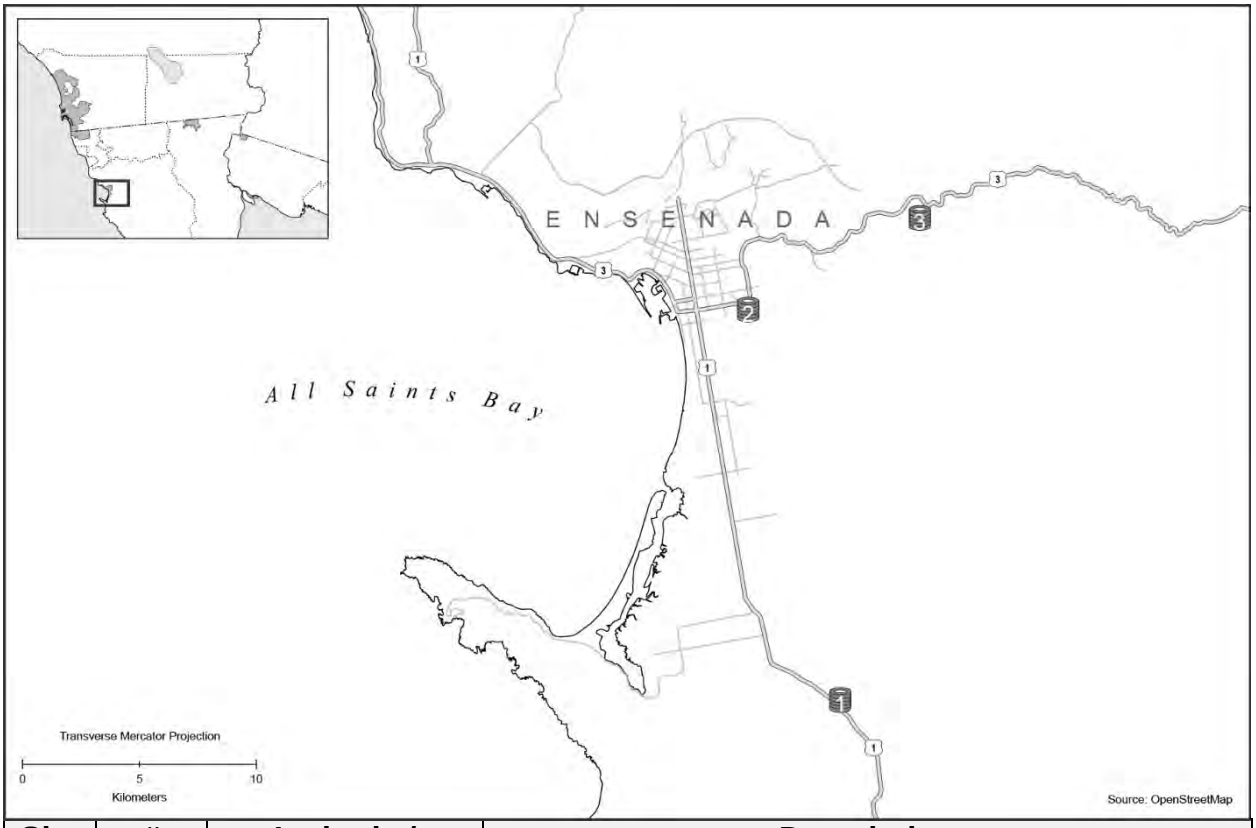
In interviews with municipal stakeholders it was stated that no illegal tire piles numbering over 500 tires were known to be in existence. Rather, officials suggested that smaller tire piles accumulate sporadically and in dispersed areas but are periodically collected by municipal waste management operations and deposited at the temporary municipal collection lots or at the official collection and transfer center in Mexicali. During extensive fieldwork, however, the research team did discover numerous small tire piles scattered throughout all five municipalities of Baja California as well as numerous larger, and improperly stored, accumulations of 200 to 500+ tires. These larger accumulations were located on private properties, within walled-in business lots, and in abandoned buildings used for storage. The continued existence of large, improperly stored accumulations of waste tires highlights the need to educate the public about proper tire storage and disposal as well as the need to provide the public with adequate and reasonable options for disposing discarded tires.

It would also be helpful for the state and municipalities to develop regulations and implementation plans for storage of waste tires in numbers above a threshold such as 200, 300, or 500 tires. While the municipal lots have greatly reduced the accumulation of large tire piles compared to previous years, it is important to note that the municipal

lots remain ad hoc and ultimately inadequate solutions to the problem of ultimate disposal of waste tires in the state of Baja California. The municipal collection lot of San Luis Río Colorado that accumulates waste tires for periodic shredding functions quite well. All municipal officials interviewed during the course of this study expressed the need for the further development of solutions to the problem of waste tire management in the border region.

Ensenada

Map 2. Ensenada Sites with >500 Waste Tires



Site #	# Tires	Latitude / Longitude	Description
1	500+	31°41'34.64"N / 116°32'12.13"W	Junkyard with passenger, truck, and heavy-duty equipment waste tires.
2	500+	31°50'47.24"N / 116°34'46.25"W	CEMEX cement plant; only passenger tires.
3	500+	31°52'55.82"N / 116°29'53.25"W	Waste tires in separate section of GEN Ensenada municipal landfill.

Source: IRSC 2017 Waste Tire Field Survey.

The municipality of Ensenada has solid waste management challenges that include populated urban centers, like the city of Ensenada, as well as many dispersed populations such as San Quintín and the many rural areas to the south. Although the many settlements along the highway south of the city of Ensenada are small in size, a large volume of regular traffic passes through the region on the trans-peninsular

highway and there are numerous tire shops. Thus, waste tires accumulate fairly rapidly, creating disposal problems for these communities.

During the period when the Ensenada CEMEX plant was not accepting waste tires, 2015 to 2017, importers were required to dispose of waste tires at the collection and transfer center in Mexicali. As a result, importers were at a competitive disadvantage compared to those of other municipalities due to long haul distances and increased time and cost of disposal. As noted above, in May 2017 it was announced that importers and waste tire generators would be able to once again dispose of waste tires at the CEMEX facility beginning at some point in 2017. Yet as previously mentioned, the CEMEX contract is only for 500,000 tires per year.

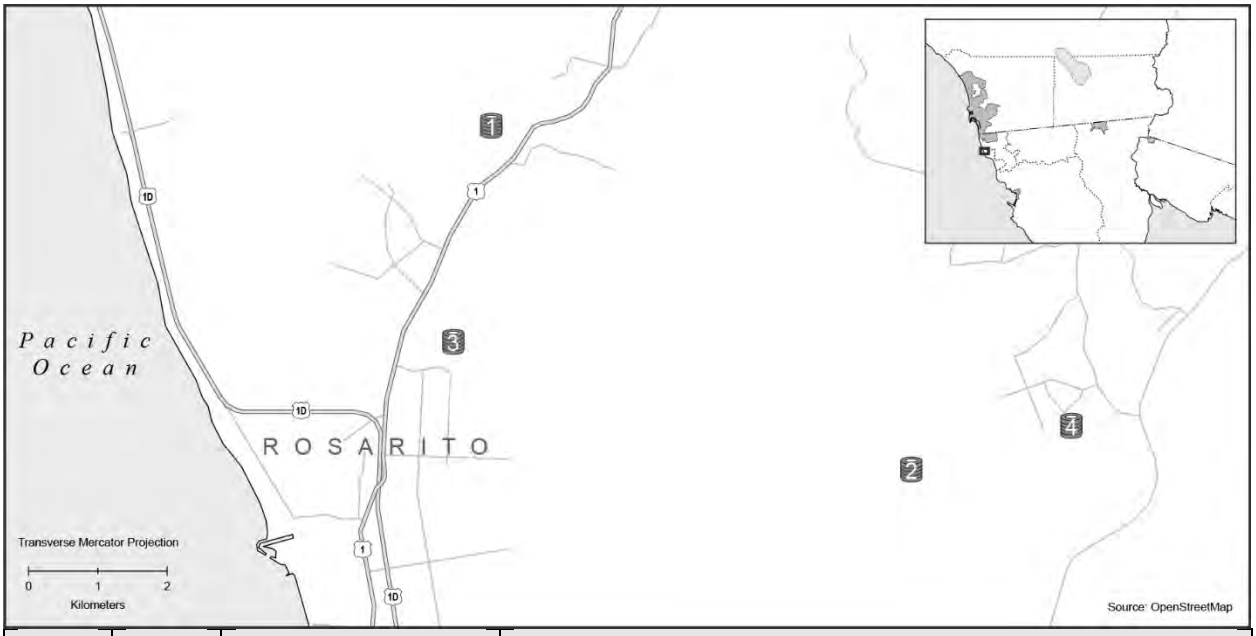
Municipal authorities in Ensenada recognize the proper disposal of waste tires as an urgent problem. Unlike Tijuana and other municipalities, Ensenada does not have an agreement with a private company for its trash and solid waste cleanup. Instead, GEN Industrial only manages the municipal landfill. The municipal department of Public Services is responsible for the collection and management of municipal solid waste. While some tires are disposed at the privately managed municipal landfill located to the east of downtown Ensenada, large quantities of waste tires continue to be informally and illegally discarded throughout the municipality.

During interviews with municipal officials, it was noted that the municipality does not receive adequate support or funding from the state or federal government to properly manage the problem of waste tires.[100] Nonetheless, the Department of Public Services has taken on the additional responsibility of collecting and storing discarded tires. However, no specific effort apart from normal municipal cleanup operations is presently being made. In the past, municipal officials had attempted to institute a community cleanup program to help reduce the illegal dumping of waste tires. The idea was to make promotional materials and conduct a campaign at local schools to request parents and community members to bring waste tires to schools on certain dates for pickup. Yet the program never materialized due to lack of sufficient funds in the budget. Discarded tires are currently collected with other trash in the municipality, are separated, and are then taken to a temporary waste tire disposal site established on vacant municipal property east of the city or separated from other waste at the privately operated municipal landfill. Additionally, a new landfill project was planned for San Quintín, about 100 miles south of Ensenada, but those plans have stalled.

Playas de Rosarito

While the Department for Public Works is ultimately responsible for waste cleanup in the municipality of Playas de Rosarito, a private company, GEN Industrial, is contracted to manage domestic waste cleanup and disposal. The collection of waste tires, however, is not considered part of the responsibility of GEN. As a result, the Public Works department routinely collects discarded waste tires throughout the municipality. The department has three large collection trucks and a small fleet of vehicles. Discarded tires are regularly picked up by Public Works employees and taken to a formerly vacant municipal lot in Colonia Benito Juárez that was converted into a temporary waste tire

Map 3. Playas de Rosarito sites with >500 waste tires



Site #	# Tires	Latitude / Longitude	Description
1	500+	32°25'25.96"N / 117° 2'27.84"W	Passenger, truck, and heavy equipment tires in a private lot adjacent to a house.
2	500+	32°22'42.86"N / 116°58'38.14"W	Passenger, truck, and heavy equipment tires at the PASA municipal landfill
3	500+	32°23'43.43"N / 117° 2'48.60"W	Passenger, truck, and heavy equipment tires at uncontrolled municipal lot
4	500+	32°23'3.60"N / 116°57'10.73"W	Passenger, truck, and heavy duty equipment tires at AMECO construction company

Source: IRSC 2017 Waste Tire Field Survey.

collection site. Discarded tires are often carried by heavy winter rains down the local canyons to the beaches. Once the tires are on the beach they become the responsibility of federal agencies but are often collected by municipal employees, as the beaches are an important part of the local tourist economy.

Local officials estimate that over 30,000 tires have been collected during the past three years by municipal employees. From December 2016 to March 2017, about 3,200 tires were collected and deposited at the temporary municipal collection lot. The municipal government has stressed that the temporary collection site is not an adequate nor long-term solution to the problem of ultimate waste tire disposal. However, it is important to note that municipal collection efforts and the existence of the temporary collection site have eliminated the largest and most conspicuous tire piles generated from informal and illegal dumping in the municipality. Stakeholders, including the local fire department, stated that they were unaware of any large piles numbering over 500 discarded tires. Fieldwork conducted by the research team did locate several large accumulations on private properties and at businesses locations. Many retention walls informally constructed from waste tires were also observed.

With limited staff and funding, the temporary municipal collection lot is not sufficiently maintained. Some employees noted that vegetation often encroaches on the tire piles and that many tires are covered by dirt. In interviews with local officials concerns regarding health, safety, and the environment were expressed in regards to the current management of waste tires in the municipality. Municipal officials also stressed problems of jurisdiction in the management of waste tires. Classified as “special waste,” waste tires are the responsibility of the state government. Municipal employees in Playas de Rosarito, however, must manage the actual day-to-day problem of waste tires being discarded in the municipality. Yet these employees are limited by the lack of available public resources.

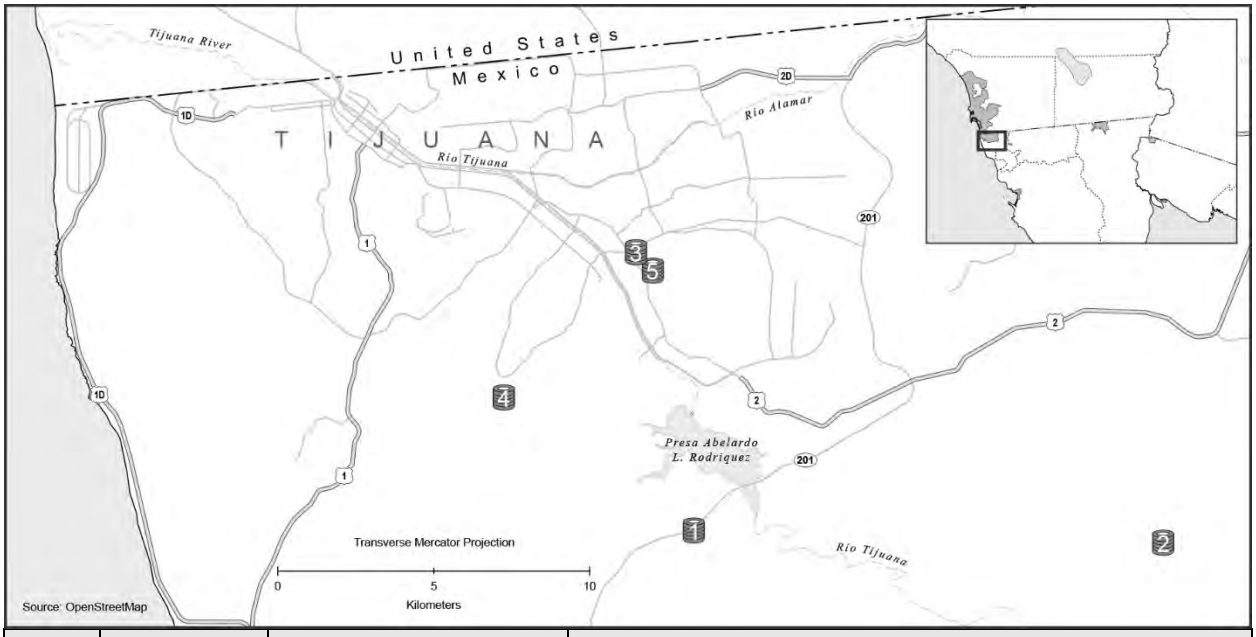
In an effort to minimize illegal dumping, the municipality has increased regulation and enforcement of local tire dealers. Tire dealers are now charged a licensing fee, a flat rate of 1,900 pesos (USD$106).[i] Furthermore, routine inspections are carried out to monitor the operation and compliance of tire businesses. There are around 100 tire dealers in Playas de Rosarito, but only around 3 active dealers with import permits. Therefore, most tire dealers buy used tires from other importers in Tijuana as well as from vehicle junk yards and private sellers. The numerous tire dealers without import permits become problematic for the municipality, because unlike the importers, they are not mandated to dispose waste tires at official, state recognized facilities. Additionally, these tire dealers are often operating without valid registration. When inspected, however, tire dealers have three days to produce paperwork, which according to local officials leads some dealers to falsify documents, while others obtain the necessary permits.

Other problems arise when import permit holders fill the disposition requirements stipulated by the economy secretariat and the environmental protection secretariat and have little incentive to dispose properly of additional waste tires. To make additional profit, tire importers charge a hauling or cleanup fee to used tire dealers in Playas de Rosarito to dispose of their waste tires. Some local officials believe that once tire import recycling quotas are met, several tire importers continue to charge for hauling and cleanup but dump the tires in other locations in order to avoid paying fees at the official collection and transfer center. Officials suggest that it may be reasonable to assume that this practice also occurs in other municipalities of the state.

[i] Throughout this report the peso-dollar value is calculated at 18 pesos per dollar.

Tijuana

Map 4. Tijuana Sites with >500 Waste Tires



Site #	# Tires	Latitude / Longitude	Description
1	200,000	32°24'44.50"N / 116°54'26.63"W	CATANED II, official transfer station, now closed
2	18,000	32°24'31.09"N / 116°44'53.54"W	Municipal landfill managed by GEN; accumulation of waste tires in one section
3	500+	32°29'26.38"N / 116°55'32.53"W	Accumulation on private property; passenger tires
4	500+	32°27'2.17"N / 116°58'18.47"W	Accumulation on private property; passenger tires
5	500+	32°29'20.58"N / 116°55'28.8"W	Accumulation in a building of multiple levels and spaces on private property; passenger and truck tires

Source: IRSC 2017 Waste Tire Field Survey.

Solid waste collection in the municipality of Tijuana is contracted to a private company, GEN Industrial, which operates the landfill in the municipality. Prior to 2013, tire importers hauled waste tires either to the collection and transfer center in Mexicali or to the CEMEX plant in Ensenada for disposal. From 2013 to 2015, however, the municipality of Tijuana had an official collection and transfer center operated by a private company located at kilometer 21 of Boulevard 2000, southwest of the urban center of Tijuana. In addition to collecting waste tires, the site was to host a pyrolysis plant to process waste tires for productive end uses and as alternative fuel. The center closed in 2015 and the plant never made it beyond the test phase. With the closure of the collection and transfer center, and with the CEMEX plant in Ensenada not accepting tires for a period of about two years, used tire importers and other waste tire generators

had to dispose tires at the official center in Mexicali. As a result, tire dealers have incurred increased costs and are more likely to participate in illegal dumping.

The municipality of Tijuana requires tire dealers to obtain municipal business licenses as well as an environmental impact statement from the state. Apart from these requirements, the city environmental department lacks sufficient resources to adequately manage and monitor waste tire collection and disposal in the municipality. For example, the department only has two environmental inspectors and one vehicle for the 1.6 million residents of Tijuana. As a result, the municipal government must rely on the actions of state level officials, private actors like GEN, the cooperation of business chambers and the tire dealers associations, and non-governmental organizations for municipal waste tire cleanup and disposal.

There are many clandestine dumpsites throughout the municipality, mainly on the outskirts of Tijuana where settlement is less dense and there are vacant lots and canyons. Most dumpsites include mixed trash as well as some waste tires. Many large accumulations of tires, numbering between 200 and 500, are located on private properties, within fenced and walled business lots, and in abandoned buildings. Some burning of tires in settlements on the outskirts of the city takes place, mainly at night when the smoke is less visible to authorities. Yet local officials claim that the burning of tires to recover steel is not regarded as a large-scale problem in Tijuana. The metal recycling businesses in Tijuana are not allowed to take steel recovered from tires. The municipality of Tijuana has numerous vehicle junk and waste yards that are a constant source of used and waste tires.

Waste tire management is further complicated by Tijuana's continued urban sprawl. The urban areas, hillsides, and canyons of the municipality continue to see development of informal communities. The makeshift and self-constructed homes in these communities have utilized hundreds of thousands of discarded tires over the last several decades to build house foundations, stairways, and retaining walls.

Tecate

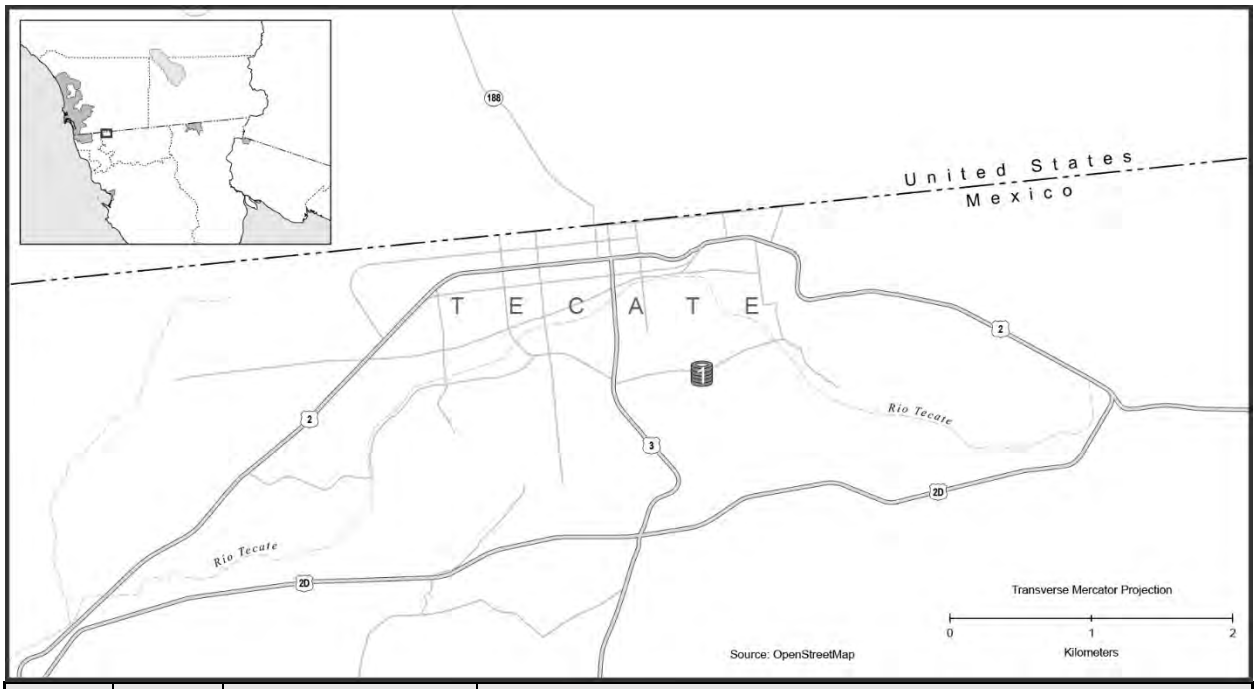
The municipality of Tecate has a sanitary landfill to receive municipal solid waste.[101] The city collects solid waste and separates out waste tires, which are taken to the municipal waste transfer station located within the urban core. Municipal workers also collect waste tires found along streets, in vacant lots, and elsewhere. Private individuals also take waste tires to the transfer site. The city's goal is to proactively collect waste tires so that they are not dumped in and rivers and elsewhere. When a sufficient number of waste tires accumulate, they are hauled by the municipality to the CANTENED I disposal facility in Mexicali. No large unauthorized tire piles are known to be present in Tecate.

The Tecate Dirección de Protección al Ambiente (Directorate for Environmental Protection) was established relatively recently and now municipal regulations support proper disposition of waste ties. The department has 3 environmental inspectors and when problems are found with used tire dealers, the department has the ability to close the businesses temporarily.

Tecate has four authorized tire importers. The local Asociación de Llanteros (Association of Tire Dealers) also maintains a trailer where members of the association drop-off waste tires. When the trailer is full, the Association pays to have it hauled to the state disposal facility in Mexicali.

The members of the Asociación de Llanteros work closely with municipal authorities to address waste tire disposal issues. The llanteros clearly perceive that their business depends upon proper disposal of waste tires and are motivated to find appropriate solutions. Both the municipality and the association members recognize that if disposition of waste tires is easy for local people, that will prevent waste tires being thrown into arroyos and elsewhere. Both also recognize that Baja California needs better options for ultimate proper disposal of waste tires.

Map 5. Tecate Site with >500 Waste Tires



Site #	# Tires	Latitude / Longitude	Description
1	300+	32°33'51.50"N / 116°37'2.48"W	Solid waste transfer center, Municipality of Tecate; about 500 tires per month accumulate here. Passenger, truck, and heavy duty waste tires.

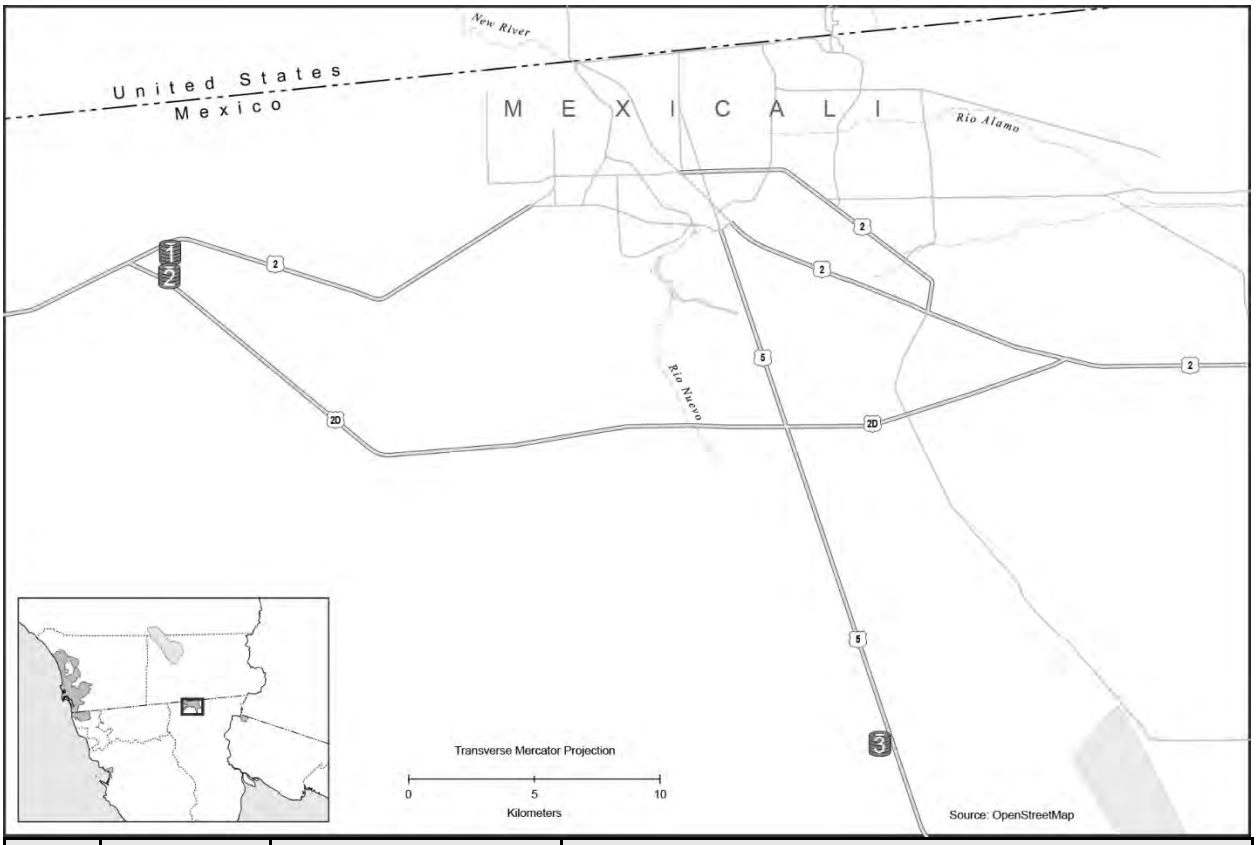
Source: IRSC 2017 Waste Tire Field Survey.

Relative to most other municipalities, Tecate has the problem of waste tires under control. There are few clandestine tire piles or piles of mixed solid waste. Clearly, reducing visible trash and waste tires is a high priority of the municipality and sufficient resources are devoted to the effort. Tecate has been designated as a “Pueblo Mágico,” or “Magical Town,” by the National Secretariat of Tourism to recognize its historic,

cultural, and tourism value, so reducing visible solid waste is a priority for the municipal government. The size of Tecate is also important. With a 2017 population of just over 70,000 and a compact urban footprint, the municipality has been able to maintain adequate urban services, including waste tire removal.

Mexicali

Map 6. Mexicali Sites with >500 Waste Tires



Site #	# Tires	Latitude / Longitude	Description
1	500+	32°35'54.31"N / 115°40'4.74"W	INNOR tire collection site, partially cleaned up but some recent dumping of waste tires
2	500+	32°35'24.21"N / 115°40'6.52"W	LLANSET tire collection site, partially cleaned up but some recent dumping of waste tires.
3	500,000+	32°25'9.98"N / 115°22'18.69"W	CATANED I waste tire collection center for shredding and transfer.

Source: IRSC 2017 Waste Tire Field Survey.

The municipality of Mexicali includes the City of Mexicali and small towns scattered throughout the surrounding rich agricultural Mexicali Valley. The major roads to the east and San Luis Río Colorado, west to Tijuana, and south to San Felipe have numbers of tire shops, auto wrecking yards, and construction yards where waste tires often

accumulate. Although the region is quite flat, settlements dispersed throughout the valley, along with vegetated agricultural drains and scrubland, provide sites for clandestine tire and trash dumps. Tire fires are a fairly frequent occurrence and often set adjacent vegetation on fire.[102] Some of the fires reoccur periodically in the same location, as one fire makes space for additional tires and trash to be dumped. These dispersed fires contribute to the poor air quality of the region and also present problems for Mexicali's fire department. The fire department reports that in addition to an occasional large fire, there are many small fires of a half dozen or so tires that likely are set to recover the scrap steel. These rural fires are troublesome since a local water source is usually not available for firefighting, and the fire requires additional equipment. Burning of tires for steel recovery is not a large problem since the municipal authorities work with the large waste metal dealers to prohibit the purchase of this waste steel.

Mexicali continues to be the only municipality with an official waste tire collection and transfer station managed by state environmental authorities. As a result, Mexicali is the focus of the majority of waste tire collection and management in Baja California and is one of only three locations where used tire importers from the state can obtain required disposal receipts from SPA to meet their quota requirements. The collection and transfer center in Mexicali is responsible for disposal of the vast majority of tires that are currently processed for alternative end uses; the facility processed some 1.2 million tires in 2015 and 2016. Tires are shredded and regularly trucked by Apasco to the cement kiln in Hermosillo, Sonora, in order to be processed as alternative fuel. Until 2012, another private company also shredded and processed tires for alternative use. Using its own shredding equipment, the company shredded and baled waste tires for export to China. The remains of the operation still exist at the collection and transfer facility. Currently around 50 large cubed bales, 3,000 un-shredded tires, and large volumes of shredded tires remain at the center. The volume of shredded tires is variable, but in some sections the height of these remaining piles is around two meters.

San Luis Río Colorado, Sonora

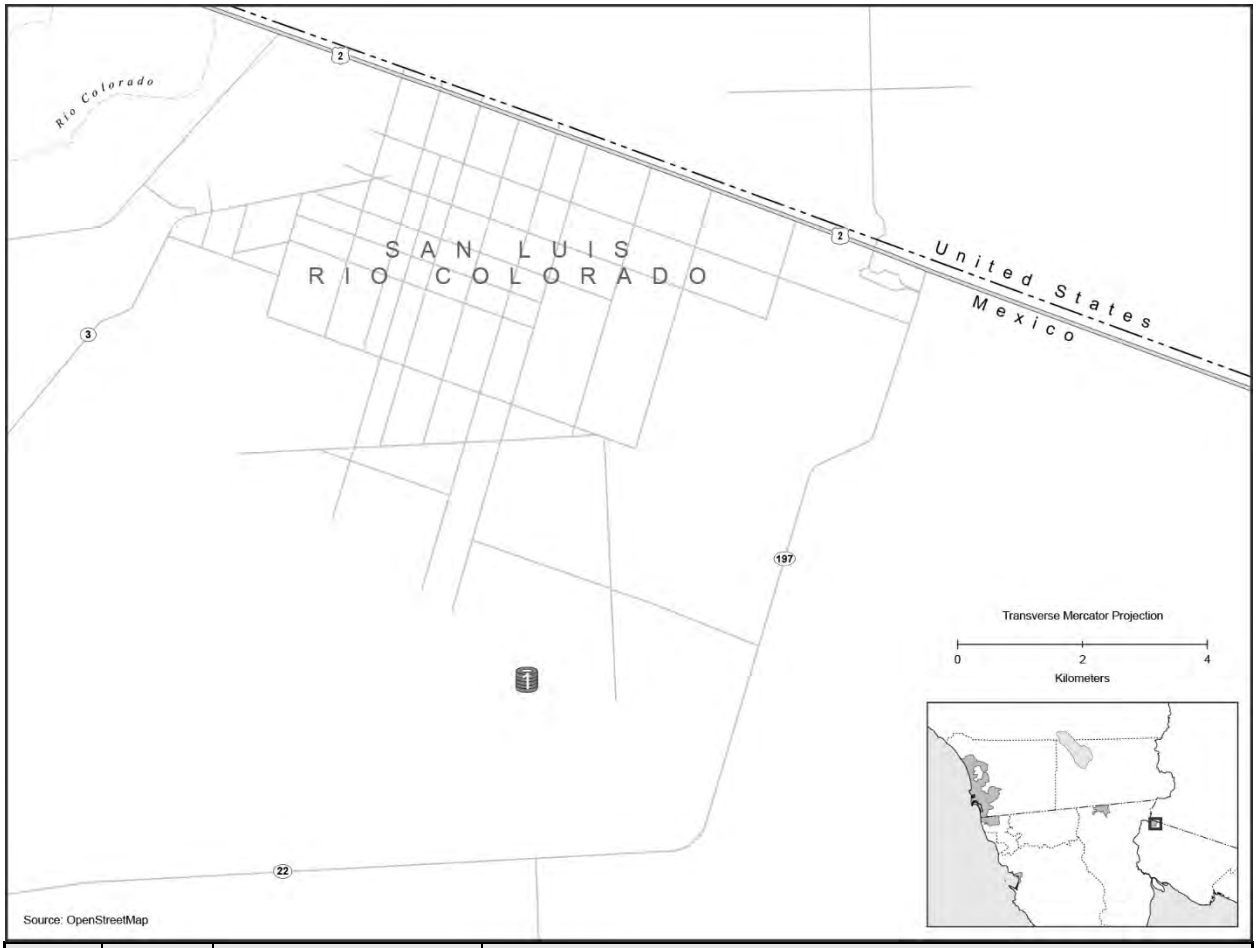
The local government of San Luis Río Colorado, Sonora, has developed one of the most effective independent municipal responses to the management of waste tires in the border region. Faced with problems with daily waste management, accumulation of waste tires, and insufficient state and federal support, the municipality has developed its own collection and transfer station, located adjacent to the city landfill. The waste tire transfer station was funded partly by North American Development Bank/Border Environment Cooperation Commission (NADB/BECC) support, and the city maintains personnel at the site to provide receipts for tires received and prevent unauthorized use.

Local officials estimate that San Luis Río Colorado produces around 50,000 waste tires per year, which is also the number of tires allocated to the municipality under import quotas. However, the surrounding municipalities of Puerto Peñasco and Caborca also contribute to the generation of waste tires and increase the demand for used tires in the region.

Since 2012, the municipality has had an agreement with the cement company Apasco to process tires for alternative fuel. Apasco shreds waste tires and transports them to

the company's cement kilns in Hermosillo, Sonora. Under the agreement with Apasco, the municipality accumulates waste tires at the municipal collection site, located on the southern edge of the urban area. When there is a sufficient quantity, Apasco brings a tire shredder, trucks, and trailers to the municipal collection lot. It then shreds the tires and hauls the tire shreds to the cement kilns in Hermosillo. Apasco provides a supervisor and the truck drivers to haul the shredded tires. The municipality provides laborers for the shredding process and a skip loader for filling the trailers. From 2010 to 2015, 181,000 tires were shredded and hauled to Hermosillo. Each year, shredding the accumulated tires takes about 3 months.

Map 7. San Luis Río Colorado Site with >500 Waste Tires



Site #	# Tires	Latitude / Longitude	Description
1	500+	32°24'12.00"N / 114°45'41.52"W	Municipal waste tire collection lot and tire shedding location for transportation of shredded tires to Hermosillo Apasco cement plant. Adjacent to municipal landfill

Source: IRSC 2017 Waste Tire Field Survey.

The tire collection site is at a large lot near the main canal that runs through San Luis Río Colorado. The lot is on the south side of the canal near the intersection with Calle 37. It is conveniently located so that it is easy for tire shops to transport waste tires here. The tires are dumped in one big pile where they accumulate until there is a sufficient quantity for shredding. Authorities estimate that the capacity of the collection center is around 100,000 to 150,000 tires. Yet because of the shredding program, excessive numbers of tires do not accumulate to constitute a major fire hazard. However, some two and one-half years ago, a fire did start which burned about 10,000 tires. The fire was extinguished by dumping earth over the tires.

The municipal collection site has around-the-clock security and employees log in loads of waste as they arrive. The municipal department of ecology has an agreement with local tire dealers and importers, the *Union de Llanteros.* In the past, union members were required to haul waste tires to Ensenada at a cost of 8 to 9 pesos per tire, which was a significant economic burden. Registered members of the *Union de Llanteros*, who purchase tires from importers with quotas in Mexicali, do not pay any dumping fee at the municipal collection site. Other tire dealers pay about 2.5 pesos per tire. The implication is that the dealers who are not members of the union are doing something illicit, as they do not participate in the local structure to control the import and disposal of tires.

In the past, there have been some problems in the municipality with individuals burning tires to extract scrap steel. However, municipal officials have worked with the local scrap dealers to prohibit the purchase of steel recovered from tires. Within the municipality there are approximately 50 tire dealers and 20-25 vehicle junk yards. The 9 members of the *Union de Llanteros* work with one large importer in Mexicali. In meetings with the research team, officials expressed that the municipality could use help in building a proper tire collection and transfer facility. Various productive end uses have been discussed, including pyrolysis, but the availability of waste tires appears to be insufficient to attract investment by private companies. The decline in the price of petroleum has also reduced the value of tire-derived fuel. This causes some worries for municipal authorities because the value of shredded tires as fuel drives the disposal program.

Waste Tire Disposal from the Perspective of Tire Dealers

According to the 2016 IRSC Tire Dealers Survey, most importers and small tire shops (non-importers) report disposing of the waste tires they generate weekly or monthly. About half the sample (52 percent) claim they dispose of waste tires themselves, while the rest report using a "recycler" without specifying further. In the case of tire shops, this "recycler" is usually the importer they buy used tires from. Self-disposal costs an average $7.23 pesos ($0.40 dollars) per tire or roughly $2,159 pesos ($120 dollars) per load (which is usually 300 tires). The cost for a "recycler" to pick up waste tires ($6.87 pesos or $0.38 dollars per tire) is about the same as for self-disposal.

Importers and tire shops (non-importers) differ in their perceived degree of difficulty in disposing of waste tires: 37 percent of surveyed importers say disposal is complicated or very complicated, while only 20 percent of tire shops indicate the same. Importantly,

the data suggest no apparent relationship between the number of waste tires generated per month and the perceived degree of difficulty or ease in disposing of waste tires.

Table 14. How difficult/easy is it to dispose of waste tires?

Response	Importers %	Non-Importers %	Full Sample %
Very Easy	8.6	25.2	21.2
Easy	54.3	55.0	54.8
Complicated	28.6	18.0	20.6
Very Complicated	8.6	1.8	3.4

Source: 2016 IRSC Tire Dealer Survey (N=147).

Regarding the location of waste tire disposal, 52 percent of interviewees reported that their waste tires go to official collection centers, 37 percent said they take waste tires to recycling companies, although no clarification was made about which one, and only 3 percent report taking them to a construction company.

Table 15. How do you dispose of your waste tires?

Response	Importers %	Non-Importers %	Full Sample %
Community	-	9.9	7.5
Recycler	36.1	36.9	36.7
Collection center	55.6	51.4	52.4
Construction company	5.6	1.8	2.7

Source: 2016 IRSC Tire Dealer Survey (N=147).

In an attempt to obtain information about possible informal waste tire dumping, the survey asked about "donating tires to the community," which yielded interesting answers. While no used tire importers reported taking tires to the community, 11 tire shops did (10 percent of the sample); 9 of these 11 tire shops said it was "easy" or "very easy" to dispose of waste tires. Relatedly, 19.7 percent of interviewees report knowing of at least one "illegal" waste tire dumpsite in the area.

Productive End Uses for Waste Tires in Baja California

Tire-derived fuel processed in cement kilns continues to be the main productive end use for waste tires in Baja California and Sonora. As cited above, 4,475,318 tires were deposited at the official temporary collection and transfer centers between 2012 and 2016, representing the proper disposal of less than half of Baja California's waste tire generation during this period.[103] Of those tires deposited at the collection and transfer center, 3,421,569, or about 76 percent, were diverted to productive end uses. The vast

majority were co-processed as tire-derived fuel in the cement kilns of Hermosillo and Ensenada.[104] Tire derived fuel continues to account for roughly 90 percent of the productive end uses for waste tires in Baja California.[105]

As previously mentioned, the number of waste tires processed as alternative fuel at these cement plants is not so much limited by the technical capacity of the facilities but by the demand for cement, which increases with economic growth and declines with the slowdown of economic activity. The number of waste tires processed by CEMEX and Apasco is dependent upon contract negotiations between the cement companies and the state government. As seen by the lack of a contract with CEMEX Ensenada between 2015 and 2017, and current negotiations by Apasco in Mexicali to attempt to raise collection prices, processing waste tires as TDF is far from a guaranteed and adequate solution for the problem of waste tire management in the border region.

Negotiations with the cement companies continue to be subject to the vagaries of the market and the companies' efforts to be more competitive and profitable. The renewed 2017 contract with CEMEX Ensenada to co-process 500,000 tires annually will greatly help the state of Baja California divert more waste tires, but the problem of waste tire accumulation will continue to be a challenge for municipalities unless more productive end use markets are developed. In particular, as the 2009 Tire Flow Study revealed, Baja California used tire importers and their associations partly control access to waste tire diversion at the cement kilns.[106] Restricted access to disposing waste tires at the cement kilns continues to limit the ability of all waste tire generators to use this option. If waste tire generators are not members of used tire dealers associations or are not import permit holders, then they do not have access to the cement kilns for final disposition. Processing tires as TDF can also be costly for tire dealers when transportation, hauling, and disposal fees are considered. Waste tire generators in the states of Baja California and Sonora lack open and free access to recycling options such as TDF.

Table 16. Final Disposition of Waste Tires Collected at Transfer Centers in Baja California, 2012-2016

2012-2013	2013-2014	2015-2016
1,432,000	705,885	1,283,684
		Total for 2012-2016: 3,421,569

Note: Final destinations were cement kilns in Hermosillo and Ensenada, and Yantek Tijuana. CATENED II Tijuana stopped receiving tires in 2015.
Source: SPA.

The second largest alternative use for waste tires in Baja California continues to be formal civil engineering applications. Apart from the cement kilns in Hermosillo and Ensenada, the civil engineering company Yantek is the only other state SPA-approved final disposition option for waste tires collected at the official SPA transfer stations. The Yantek system uses waste tires that have had the sidewalls removed in order to

construct retaining walls, erosion control structures, gravity walls, and slope stabilization devices. The system is advantageous in that the material used can conform to slopes due to its flexible nature, and vegetation can be grown on the tires on the walls, which makes the projects more aesthetically pleasing. The sidewalls of waste tires are removed and the tire carcasses are stapled in a figure eight form. Then they are stacked, anchored, and filled with earth. The processed tires function similarly to the interlocking concrete blocks that are widely used for retaining wall construction in the United States. Overall, the Yantek system represents a low-cost solution for retaining walls and slope stabilization due to the low cost of skilled labor in Baja California and the availability of waste tires at no cost. From 1999 to 2012, Yantek utilized over 600,000 waste tires in various civil engineering projects throughout the Baja California border region.[107]

Table 17. Notable Yantek Projects, 2009-2012

Year	Project	Location
2009	Retention Wall	Fraccionamiento Los Pinos Residencia
2010	Expansion of existing Yantek wall "Residencias Lutteroth"	Fraccionamiento Chapultepec 9a. Sección, Tijuana B.C
2011	Retaining wall to stabilize sliding	Fracc. Lomas Conjunto Residencial
2012	Retaining wall to restore eroded area	Parque Industrial Valle Sur

Source: Yantek.

Image 2. Yantek constructed retaining wall and house pad. Source: Yantek.

The potential use of waste tires in civil engineering and other applications has led to the development of some new companies and potential markets in the border region. However, both the companies and markets remain limited, small in scale, and are mostly in the development phase. For example, one Mexican company is attempting to develop a new waste conversion, or pyrolysis, project in Tijuana with plans to utilize waste tires, dense plastics, and waste oil for productive end uses.[108] The company suggests that the plant will have the capacity to utilize 1,500 tons of plastic or tires per month plus 600,000 liters of motor oil.[109] At the time of this report, the refinery is not yet operational.

Baja California state environmental authorities have made clear that in order for companies using technologies such as pyrolysis to operate, they must first conduct environmental impact assessments and obtain all required permits from the necessary state and local agencies. SPA officials noted that to date there are no pyrolysis or other similar companies in full compliance with state and municipal regulations.[110]

Image 3. Tire park in Colonia Preaderas, Ensenada. Source: La Jornada.

Apart from processing waste tires as tire-derived fuel, a relatively small number of tires are utilized in the production of other goods, such as water proofing agents, sandals, floor mats, and in community projects. While no data are available from state or municipal authorities on numbers of tires diverted to such final disposition, the research team believes the amount to be minimal. For example, in 2015 Social Services workers from the municipality of Ensenada worked with local families in the town of Maneadero to construct a small park and playground from waste tires.[111] In June 2017, a two-day workshop was held in San Quintín to teach community members how to make useful

products from waste tires.[112] Local schools and other communities throughout Baja California routinely utilize small numbers of waste tires as playground material.

Other small-scale enterprises in the border region include artisanal products such as furniture made from recycled waste tires. One craftswoman in Playas de Rosarito manufactures an assortment of furniture pieces including sofas, chairs, tables, and flooring from local waste tires. The family business has grown since its beginning in 2014 and processes over 100 waste tires per week.[113] The business collects discarded tires from the local community as well as the municipal government of Playas de Rosarito. Similar artisanal companies have also sprung up in Baja California Sur, where waste tire accumulation continues to be problematic. For example, in 2014, one artisanal company began making indoor and outdoor furniture to sell locally in La Paz and Los Cabos as well as to export to other cities in Mexico.[114] All products are made by hand and utilize vehicle, motorcycle, and bicycle tires.

These businesses and projects use a relatively small number of waste tires. However, they are important in attracting attention to the potential value of waste tires and underlining the problem of waste tires and proper disposal at the community level.

Image 4. Muebles ecológicos, Playas de Rosarito, Baja California. Source: Noticias MVS.

Image 5. Makhra furniture, La Paz, Baja California Sur. Source: BCS Noticias.

Latin Americans are exploring other productive end uses for waste tires, including using them as mosquito traps. Called an *ovillanta,* this form of mosquito trap, which was created in collaboration by researchers from Canada and Mexico, utilizes two 20-inch sections of passenger vehicle waste tires secured together with a fluid release valve at the bottom. A non-toxic solution that includes a mosquito pheromone is poured into the trap to attract mosquitoes. The mosquitoes enter and lay eggs on a wooden or paper strip that is floating in the liquid. About twice a week the strip containing the fresh eggs is removed, the eggs are destroyed, and the solution is drained, filtered, and reused.

Image 6. Ovillanta Mosquito Trap. Source: Treehugger.

Researchers state that tires represent up to 29 percent of the breeding sites chosen by the *Aedes aegypti* mosquitoes being targeted and that the traps are one-third as expensive as killing larvae in natural ponds and one-fifth the cost of targeting insects with harmful pesticides. A 10-month study in Guatemala reported great success with the traps, collecting and destroying over 18,000 mosquito eggs per month. The researchers noted that during the 10-month trial, no new dengue cases were reported in the community.[115]

Additionally, many waste tires continue to be used for informal, non-regulated construction purposes, particularly in the coastal zone. Informal communities, squatter settlements, and self-built housing areas occupy large parts of Tijuana, Tecate, Ensenada, and other urban areas of Baja California. As noted previously in the 2009 Tire Flow Study, these self-built houses are typically established on vacant land that was provided by the government or on vacant land taken by migrants. In most of these informal areas there is no existing urban infrastructure such as paved streets, urban lighting, electricity, sewage, and piped-in water when the land is first occupied. These services can often take up to a decade to be installed.

Lots for self-constructed housing, often on the steep slopes of the region's many canyons and arroyos, are leveled by digging away at the hillside and constructing retaining walls, house pads, foundations, and staircases on steep canyon and valley walls, most often of scrap tires. Tires are also used by residents to stabilize steep slopes adjacent to roads as well as to channelize streambeds in an effort to prevent the runoff from eroding nearby house foundations and roadways Over a number of years, a house is built by the individual and his or her family. Scrap materials, including used and scrap lumber, windows, and fixtures—often from Southern California demolition projects—are initially used to erect a small housing structure. Eventually, the initial structure is replaced by a more permanent house of concrete block or wood.

Construction standards and guidelines for building with waste tires continue to be lacking in Baja California. Collapsed walls are a common site in the canyons of Tijuana. The 2009 Tire Flow Study noted that the foundations and retaining walls are usually constructed by laying down a foundation course of rocks or tires and then laying the next course of tires on top of the first, overlapping the joints of the course below. The centers of the tires are filled with soil and rocks. Most of the retaining walls in the region are only one tire course thick and are not anchored back into undisturbed or compacted soil on the hillside. Many retaining walls appear to have been installed without drainage to carry water away from the top and back of the wall. As the soils saturate during wet periods, these walls run the risk of collapsing. When these areas are located in the canyons that drain into the Tijuana River and estuary in the United States, some tires from the failed walls are carried downhill by winter storms. The mixture of tires, other debris, and large amounts of sediment creates a substantial cleanup problem for San Diego authorities and also impacts the Tijuana River National Estuarine Research Reserve.

Practical guidelines for builders, developers, and homeowners are not readily available, and as was the case in 2009, no visible steps have been taken to educate local residents about construction with tires. Baja California state and municipal authorities

should develop technical and engineering standards and building codes for use of waste tires as construction material in public works and private construction projects. Baja California engineering schools, in cooperation with California engineering schools and the Colegio de Ingenieros Civiles de Tijuana, could provide the technical expertise to develop the standards for using tires for many construction projects. Municipal authorities report that sometimes they receive proposals to build structures using waste tires but cannot issue building permits because there are no construction standards in place for these materials.[i]

The areas of self-constructed housing have evolved over the years, beginning with little urban infrastructure and gradually attracting basic amenities such as paved roads and sidewalks along with stormwater diversion structures. Homeowners also stabilize their plots of land with paved patios, concrete retaining walls, and vegetation. All these changes contribute to stabilizing the retaining walls, stairways, and foundations built from waste tires and reduce the number of failures during storm events.

Estimating the number of tires used in informal construction projects by homeowners in the urban coastal areas of Baja California, either historically or on an ongoing basis, continues to be extremely difficult. In 2009, the research team observed one area of Tijuana, Los Laureles Canyon, to estimate informal construction use of waste tires. Los Laureles Canyon is a small Mexican sub-basin of the Tijuana watershed that is approximately 4.5 miles in length and empties into the Tijuana River at the estuary near the coast in San Diego County. Steep slopes, self-constructed housing, and a lack of fully developed urban infrastructure characterize most of the canyon. Because of the steep slopes, the ongoing unplanned urbanization in the upper reaches of the canyon and the lack of erosion control measures, the canyon produces large amounts of sediments and solid waste during the winter storms. Runoff and debris from Los Laureles and other canyons has caused significant and ongoing pollution in the Tijuana River Valley and the Tijuana estuary as well as on local beaches. In 2009, the research team estimated that some 100,000 waste tires had been used in informal construction projects in Los Laureles Canyon. When considering other similar areas throughout the municipality, it was estimated that roughly 500,000 tires were used informally as construction material in urban Tijuana.[116] In addition, there are equivalent areas in Playas de Rosarito, Tecate, Ensenada, and, to a lesser degree due to the flat topography, Mexicali.

Return visits by the research team to Los Laureles Canyon in 2016 and 2017, as well as to other informal settlements throughout the canyons of urban Tijuana such as Cañón de las Carretas, have not revealed large numbers of waste tires being used in new informal construction projects. Instead, most of the canyons show legacy home construction and retaining walls with fewer new building sites that utilize substantial numbers of discarded tires. Most available vacant spaces for informal construction on canyon slopes appear to have been occupied for some time, and thus new construction in these areas is either minimal or limited to replacing tires that have been lost to erosion or carried away by storms. Urban growth and sprawl in areas with less steep

[i] Personal communication, Playas de Rosarito municipal authorities, August 28, 2017.

gradients, as well as the construction of substantial tracts of new low-income apartments and housing by the government and private enterprises, have also contributed to a decrease in the use of tires in informal construction.

In sum, informal construction in Baja California continues to be a widespread and ongoing use of waste tires, but one that appears to be slightly decreasing compared to previous reports. The research team believes that the use of waste tires tapers off as the new settlements with self-constructed housing mature. New residents use a variety of inexpensive or free materials to build shelters that are gradually improved over time. Waste tires are plentiful and thus widely used. As urban services are brought to these areas, including paved streets and storm channels, and as individual houses and lots are built out in the settlements, the slopes are stabilized and the canyons are less susceptible to erosion from storm events. Thus, sedimentation and transport of tires downstream into the U.S. should taper off when Canyon Los Laureles is fully built out and settled.

4. Physical Infrastructure for Waste Tire Management

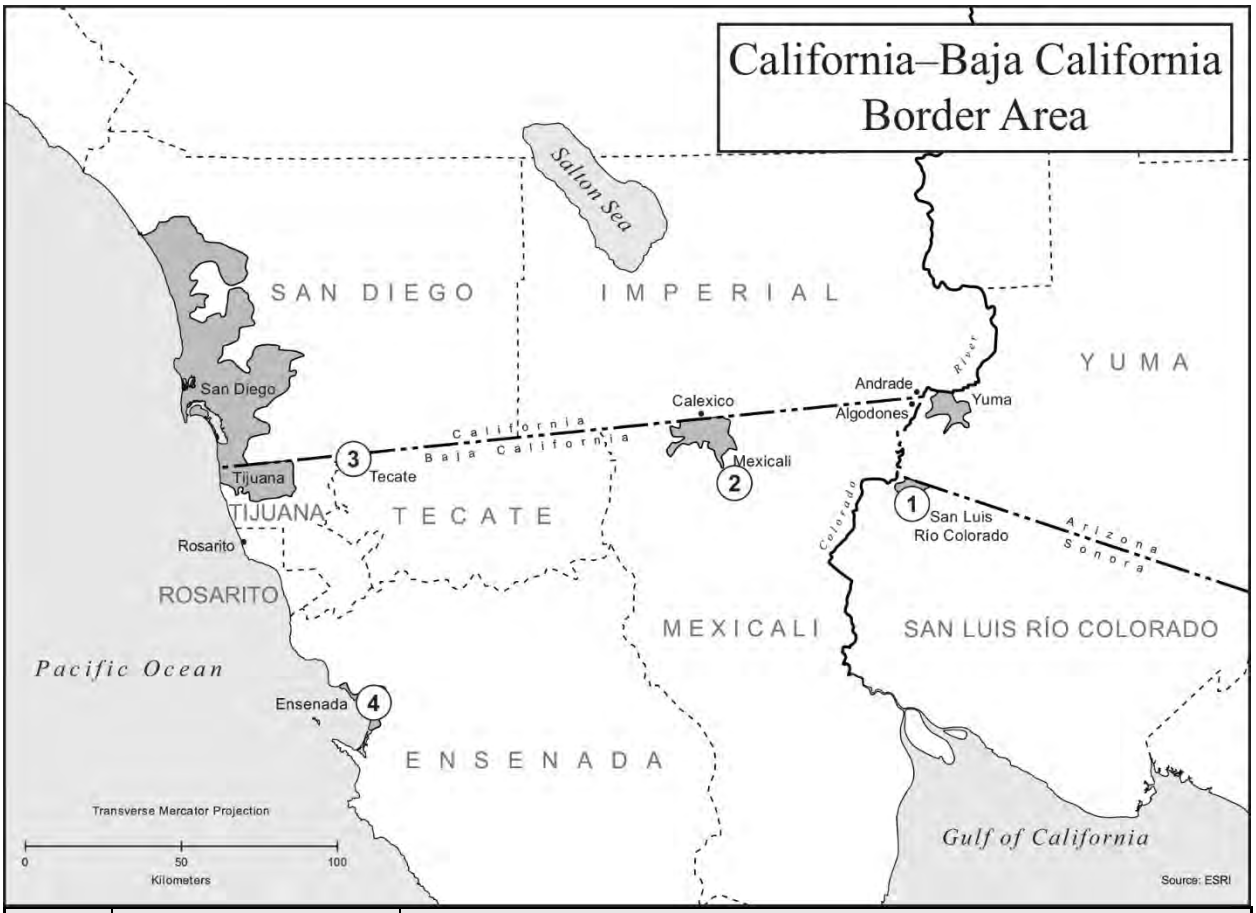
A key factor for the establishment of an efficient waste tire management system in the state of Baja California and the San Luis Río Colorado, Sonora, region lies in the physical infrastructure necessary to address the issue. Historically, lack of adequate facilities to collect, handle, and process waste tires in the California-Mexico border region has contributed to this ongoing problem.[117] Over the years, there have been several "transfer centers" in different parts of Baja California, although they have proved insufficient in the end or were not managed well. This section describes the current physical infrastructure for waste tire management in the region in detail and outlines the current challenges and limitations local officials and stakeholders face.

The state of Baja California and the municipality of San Luis Río Colorado have made great strides in improving the regional infrastructure for waste tire management since 2009. This includes opening two state-authorized waste tire sites in Mexicali and Tijuana and a municipal collection center in San Luis Río Colorado where generators can formally dispose of their tires and obtain an official receipt as required for those importers who have import quotas. The CEMEX plant in Ensenada continues to be an authorized disposal site when it is actually accepting waste tires. Municipal landfills in Baja California also receive waste tires temporarily but, unfortunately, municipalities lack the capacity and resources to comply with their legal mandate of transferring them to the authorized state sites. While there are some obvious limitations, these improvements point in the right direction and represent a substantial contribution and a starting point to developing an integrated and sustainable waste tire management system in the region that takes into account the principle of shared responsibility by producers, users, businesses, and government authorities at the federal, state, and municipal levels.[118]

Baja California Authorized Waste Tire Sites

Early in 2009, the Secretary of Environmental Protection for Baja California (SPA) recognized the proliferation of clandestine and irregular waste tire dumpsites across the state and increased efforts to create state-administered collection centers.[119] These facilities were not intended to be monofills or sites for final disposition, but rather to serve as provisional transfer centers where waste tires could be accumulated for recycling or diversion for productive end uses in the short term. Since then, SPA has opened two Authorized Temporary Collection Centers for Waste Tires (CATENED) located in the municipalities of Mexicali (2009) and Tijuana (2013). SPA manages these sites and, according to official state indicators, they "comply with the safety, location, and infrastructure measures guaranteeing the lowest environmental impact from their operation."[120] These facilities not only receive tires from used tire importers that are required to comply with disposal regulations, but also from the general public, NGOs, and other government agencies (i.e., municipal authorities, state public health service, firefighters) that request the support from SPA to receive waste tires from clean-up activities.

Map 8. Authorized Tire Disposal Facilities in Baja California and Adjacent Area of Sonora



Site #	Latitude / Longitude	Description
1	32°24'11.72"N / 114°45'43.21"W	San Luis Río Colorado municipal tire transfer center
2	32°25'10.62"N / 115°22'20.52"W	CATENED I, Mexicali
3	32°33'51.50"N / 116°37'2.48"W	Tecate solid waste transfer center
4	31°50'47.24"N / 116°34'46.25"W	CEMEX Ensenada

Source: IRSC 2017 Waste Tire Field Survey.

CATENED I (Mexicali)

This site, active at the time of the writing of this report, is located some19 miles south of the Mexicali-Calexico port of entry (32°25'07.9"N 115°22'31.4"W) and it is operated and administered by the Secretary of Environmental Protection for Baja California (SPA). The area is located in a barren desert and was the site of a large surface mining operation that removed sand and gravel for construction and left a very large depression approximately 30 feet deep. Some 25 acres of the depression are occupied by waste tire piles arranged in cells along with an office building, equipment shed, and an area for shredding tires. CATENED I is open Monday-Saturday and SPA employees are present on site to monitor disposal, to issue required disposal receipts, and to provide security for the facility. The site is easily accessible by Highway 5, with a dirt roadway leading to a large fenced area with a gate and a guard office. CATENED I is the only state-operated collection and transfer facility receiving waste tires in 2017. Waste tires are stacked in sections and by type of tire (i.e., passenger vehicle, truck, and tractor). Haulers are directed to deposit their waste tire loads in cells that are separated by roads for easy access and fire safety. The estimated capacity is at least 3 million tires, although it usually accumulates no more than 700,000 to 1 million at any given time.

Image 7. Entrance to CATENED I (Mexicali), 2017.

Image 8. Satellite image of CATENED I (Mexicali). Note the shredding equipment (A) and the front-end loader (B) filling the trailer (C) with shredded tires for transport to the Hermosillo cement kiln. November 2016. Source: GoogleEarth.

According to data from SPA, CATENED I has received 3,710,798 waste tires since starting operations in July 2009 and has diverted over 3 million for alternative uses, mainly tire-derived fuel.

Table 18. Waste Tires Received in CATENED I (Mexicali)

Year	Number
2009	n/a
2010	n/a
2011	560,415
2012	340,668
2013	557,368
2014	458,267
2015	770,985
2016	684,654
Total	3,710,798

Source: SPA.

At times, CATENED I operates with one or two shredding portable machines owned by Cementos Apasco, which transports the shredded tires to its cement kiln in Hermosillo, Sonora (450 miles away) to use as tire-derived fuel (TDF). Between 2015 and 2016, about 1.6 million waste tires were shredded on site to be used as TDF in the Apasco cement kiln. When authorized used tire importers have accumulated a sufficient quantity of waste tires in the San Luis Río Colorado collection center (see below), Apasco sends one of the shredders from Mexicali to San Luis to shred tires and then hauls the shredded tires to Hermosillo. This is an ongoing effort of the cement company in coordination with SPA for Mexicali and with municipal authorities in San Luis Río Colorado.

Image 9. Loading shredded tires at CATENED I (Mexicali) for transport to Hermosillo, 2017.

CATENED II (Tijuana)

This site, inactive at the time of the writing of this report, is located 15 miles south of the Otay Mesa port of entry (32°24'45.4"N 116°54'25.8"W). When operating, from 2013 to 2015, it served the municipalities of Tijuana, Tecate, and Playas de Rosarito. The site is easily accessible by highway, with a dirt roadway leading to the top terrace where there is a simple gate and a guardhouse with one employee. The site has large tire piles stacked on cleared and terraced land on the hillside. There is no fencing around the location and the surrounding brush appears to be growing in close proximity to the tire piles. Adjacent to the office and the tire piles on the upper terrace, there is a fenced-in pyrolysis plant, but there is no tire shredding or baling equipment. Several used tire shops were located close to the collection site.

Image 10. Satellite image of CATENED II (Tijuana), November 2016. Source: GoogleEarth.

Image 11. Entrance to CATENED II (Tijuana), 2017.

During its operating years, CATENED II received a total of 306,703 waste tires according to official SPA data and it is currently at its maximum capacity. In 2013, over 100,000 tires were shredded and sent to Cementos Apasco in Hermosillo for use as Tire Derived Fuel for their cement kiln. CATENED II Tijuana was closed in September 2015 because the site had reached capacity and no diversion alternatives were available at the time. Although no waste tires have been received since then, the site currently holds about 200,000 waste tires.

Table 19. Waste Tires Received in CATENED II (Tijuana)

Year	Number
2013	122,547
2014	79,595
2015	104,561
Total	306,703

Source: SPA.

Waste Tire Fees and Disposal Receipts

To assist with the operating costs of both CATENED sites, the state of Baja California, through SPA, introduced a waste tire disposal fee in 2010.[121] All fees for waste tire disposal at CATENED I are paid directly to the state of Baja California treasury and go to the general state fund. In other words, unlike the California tire fee, these fees do not go to a special tire fund specifically for waste tire management. SPA negotiates the fee structure with the Used Tire Dealers Association and it currently stands at $5.18 pesos ($0.29 USD)[i] per passenger vehicle or motorcycle tire and $10.34 pesos ($0.57 USD) for bus, truck, and tractor tires (See Table 18).[122]

Table 20. 2017 Waste Tire Fee (in Dollars)

Type of Tire	Fee
Passenger Vehicle and Motorcycle	$0.29
Buses/Trucks	$0.57
Tractor	$0.57

Source: Ley de Ingresos de Baja California 2017.

The process of formally disposing waste tires at CATENEDs is somewhat complicated. It starts with waste tire generators pre-paying the previously mentioned disposal fee at one of the state of Baja California treasury urban offices as a credit toward their account. Usually, waste tire generators make a pre-disposal payment for a large number of tires. Over a period of time, these waste tire generators gradually deliver small numbers of waste tires for disposal until they reach their prepaid credit limit. When disposing of tires at these centers, SPA issues an official disposal certificate, which

[i] Throughout this report, the peso-dollar ratio is calculated at 18 to 1.

used tire importers are required to have to prove proper disposal of waste tires to maintain their used tire import quota and renew their import permits.

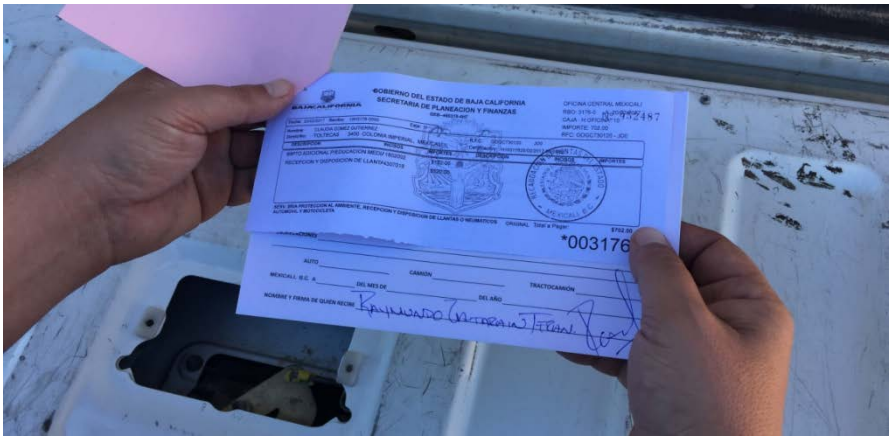


Image 12. Disposal receipt at CATENED I (Mexicali), 2017.

CEMEX Ensenada

This site, closed at the time of the writing of this report, is property of Cementos de México (CEMEX), located 67 miles south of the San Ysidro port of entry (31°50'43.9"N 116°34'44.5"W) in the municipality of Ensenada. It is easily accessible by paved roads and is fenced, gated, and guarded by security. It is part of the CEMEX cement plant.

Image 13. Ensenada CEMEX plant with cells of waste tires, November 2016. Source: GoogleEarth.

The CEMEX Ensenada facility has continued to serve as a waste tire disposal site since before 2009. The site has a shredder within the facility and shredded tires are used on site as tire-derived fuel for the cement kiln. In 2016, the waste tire disposal area of the facility temporarily stopped receiving tires because it had reached capacity. This may

have been due to a slowdown of construction projects in Baja California and the consequent lower demand for cement.[123] Nevertheless, SPA officials have negotiated a new arrangement with the company and CEMEX Ensenada is expected to resume receiving waste tires in 2017.

One additional limitation of CEMEX as a formal disposal site is that the company has imposed several requisites for individuals taking waste tires to the facility. This includes a background check and an anti-doping/substance abuse check. In addition, the cement company is no longer providing personnel to unload the tires at their premises. This means that those hauling the tires are responsible for unloading and arranging them according to CEMEX guidelines.

In November 2016, there were approximately 200,000 waste tires stored in cells at the CEMEX facility in Ensenada. In addition, by mid-2017, about 350 tires had accumulated on a vacant lot adjacent to an entrance door to the CEMEX facility. Apparently, individuals were dropping waste tires there on the assumption or hope that the cement company would remove them.

Municipal Landfills, Collection Centers, and Temporary Lots

Tijuana

Image 14. Accumulation of waste tires at Tijuana's GEN-operated landfill in Valle de Las Palmas. November 2016. Source: GoogleEarth.

The municipality currently deposits waste tires collected as solid urban waste in the municipal landfill located 30 miles southeast of the city center in the area called Valle de las Palmas (32°24'31.2"N 116°44'53.1"W). The municipal landfill is privately operated by GEN, a waste management and recycling company with a large presence in Baja California. At the time of the writing of this report, this site had accumulated approximately 18,000 waste tires.

Tecate

Image 15. Tecate solid waste transfer center where waste tires are collected prior to transport to CATANED I in Mexicali, 2017.

Tecate gathers waste tires at its solid waste transfer center located near the city's center. Once a sufficient quantity of waste tires is accumulated, tires are transported to the CATANED I official disposal site in Mexicali. Tecate does not collect waste tires at the municipal landfill.

Playas de Rosarito

The municipality currently deposits waste tires collected as solid urban waste in the municipal landfill located 7.2 miles to the east of the city center (32°22'42.9"N 116°58'38.2"W). The municipal landfill is privately operated by GEN. In addition, the municipality has a temporary lot located about 2.2 miles north of the city center in Colonia Benito Juárez (32°23'43.68"N 117° 2'48.18"W) where, according to municipal officials, waste tires are stored temporarily.[124] Together, the two sites in Playas de Rosarito have approximately 30,000 waste tires accumulated.

Image 16. Accumulation of waste tires at the municipal landfill of Playas de Rosarito, operated by GEN. November 2016. Source: GoogleEarth.

Image 17. Playas de Rosarito temporary waste tire site, 2017.

Ensenada

The municipality currently deposits waste tires collected as solid urban waste in the municipal landfill located 9 miles to the east of the city center (31°52'55.2"N 116°29'52.5"W). GEN privately operates the municipal landfill. This site has accumulated at least 20,000 waste tires.

Image 18. Ensenada municipal landfill, 2016.

Image 19. Waste tires accumulated at the Ensenada municipal landfill, operated by GEN. November 2016. Source: GoogleEarth.

San Luis Río Colorado

The municipality has a dedicated waste tire collection center in a large lot adjacent to the municipal landfill. It is located 8 miles southeast of the San Luis port of entry (32°24'11.0"N 114°45'45.3"W). Access is by a road that leads to the municipal landfill and the collection center entrance has a small house where the person who oversees the collection center lives. The tires are dumped in one big pile where they accumulate until there is a sufficient quantity for shredding. The capacity of the site is 100,000 to 150,000 tires. The tires brought in to the collection center by members of the local Tire Dealers Association do not pay a disposal fee. Waste tire generators who are not members of the association pay 2.5 to 3 pesos per tire ($ 0.14 to 0.17 USD) as a disposal fee.

Since 2012, the municipality of San Luis Río Colorado has had an agreement with Cementos Apasco for shredding tires. The new municipal administration, which took office in 2016, renewed the agreement with Apasco to shred tires and transport them to their cement kiln in Hermosillo where they are used as tire-derived fuel (TDF). Under this agreement, the municipality accumulates waste tires in the collection center and, when there is a sufficient quantity, Apasco brings the shredder and trucks and trailers (usually from CATENED I in Mexicali) to haul away the shredded tires to the cement kiln. Staffing provided by Apasco includes a supervisor and the truck drivers. The municipality provides laborers for the tire shredding process and a skip loader for filling the trailers. From 2012 to 2015, about 180,000 tires were shredded at the site and subsequently hauled to Hermosillo for TDF. It takes approximately 3 months to shred a pile of accumulated ties. Tire shredding last took place November thru December 2016 and January 2017. Currently, there are about 100,000 waste tires accumulated at the site.

Image 20. San Luis Río Colorado collection center, November 2016. Source: GoogleEarth.

San Luis Río Colorado authorities do not require that tires be piled and divided by wide access paths. Because tires are shredded, large numbers of tires do not accumulate and create a major fire hazard. That said, about two and a half years ago, a fire started and burned about 10,000 tires. Earth was dumped onto the fire to extinguish it. In the past, there have been some problems with individuals burning tires to extract scrap steel. However, they have worked with local scrap dealers to prohibit the purchase of steel recovered from tires.

Image 20. San Luis Río Colorado collection center tire pile, 2017.

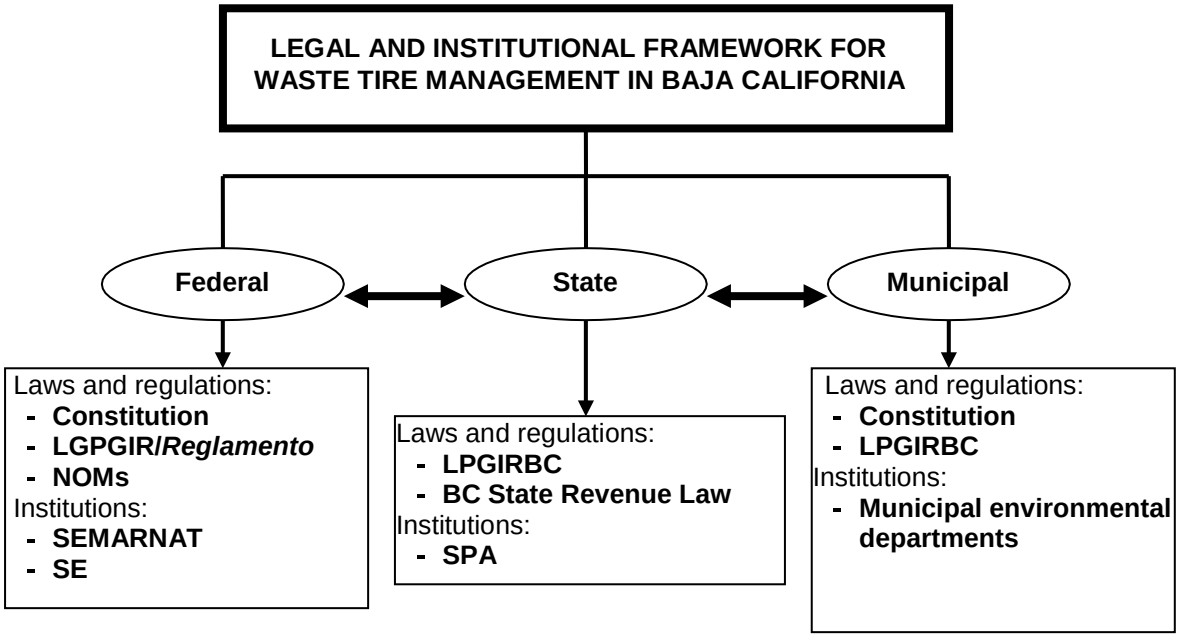
Infrastructure Limitations

Due to the temporary closure of CATENED II Tijuana and CEMEX Ensenada, used tire importers in Tecate, Ensenada, Playas de Rosarito, and Tijuana are required to formally dispose of waste tires in CATENED I Mexicali. This puts them at a competitive disadvantage relative to importers in Mexicali and San Luis Río Colorado. The distance to approved disposal sites discourages businesses and individuals from properly disposing waste tires and makes clean-up efforts of municipalities more difficult.

5. Legal and Institutional Framework for Waste Tire Management

The legal and institutional framework governing waste tire management in Mexico consists of an interrelated system of constitutional provisions, federal and state laws and regulations, and federal standards issued by the Secretary of the Environment and Natural Resources.[125] To develop sustainable solutions to the waste tire problem in the California-Baja California border region, the research team believes it is important to understand and acknowledge the legal and institutional context establishing responsibilities for authorities at the federal, state and municipal levels.[126] This section provides an overview of Mexico's, and specifically Baja California's, legal, regulatory, and institutional framework for waste tire management, with a focus on reforms and changes occurring since 2008.

Figure 4. Legal and Institutional Waste Management Framework



Constitutional Provisions

The Mexican Constitution is the "supreme law" to which all secondary laws, regulations, and norms should conform. As such, it establishes individual rights, provides general guidelines for rulemaking, and distributes responsibilities for federal, state, and municipal authorities, including those related to environmental protection. Article 4 of the Constitution, reformed in 2012, states that every person has the right to a *healthy environment* for their development and well-being (emphasis added) and that those who damage and deteriorate the environment are subject to responsibility.[127] Since 2008, the Constitution has had no changes on guidelines for rulemaking or distribution of responsibilities related to the environment or waste management.

Federal Regulations and Institutions

The General Law for the Prevention and Integral Management of Waste (LGPGIR) from 2003 and its *Reglamento* from 2006 are the legal instruments currently regulating waste management and determining the distribution of responsibilities in this matter.[128] The LGPGIR classifies solid waste as 1) *hazardous*; 2) *special management*; and 3) *urban,* establishing the need to develop management plans for each type.[129]

When the LGPGIR was published in 2003, tires were initially included and classified as *special management* waste, but the law was reformed in 2007 to eliminate this provision. The LGPGIR remained unclear on the classification of tires until 2014, when waste tires were incorporated and made subject again to "special management".[130] It is important to note that this reform explicitly made state governments responsible for waste tire management with municipal governments remaining responsible for solid urban waste.

The LGPGIR and its *Reglamento* establish that the generation, management plans, and final disposal of special management waste should conform to NOMs, Mexican official standards issued specifically for that reason.[131] The federal Secretary of the Environment and Natural Resources (SEMARNAT) is responsible for issuing NOMs related to waste management and, in fact, has issued two relevant Mexican official standards that impact waste tires:

- NOM-083 -SEMARNAT-2003[132] (valid since December 20, 2004): establishes specifications for environmental protection related to disposal sites of special management waste; and
- NOM-161-SEMARNAT-2011[133] (valid since August 1, 2013): classifies tires as special management waste and establishes they are subject to a management plan.

It is important to note that these NOMs were issued prior to the 2014 LGPGIR reforms, which, as mentioned above, expressly classify tires as a type of "special management" waste. Therefore, even though NOM-083-SEMARNAT-2003 was valid since 2004, and applicable at the time of publication of the 2009 Tire Flow Study, it did not formally apply to waste tires until after the 2014 reform.

Local Regulations and Institutions

In 2007, the Baja California state legislature passed the Law for Prevention and Integral Waste Management for Baja California (LPGIRBC), which repealed existing provisions pertaining to waste management from the Baja California Law for Environmental Protection (LPA).[134] Through the LPGIRBC, the state of Baja California establishes requirements for new and used tire dealers, distributors, and importers that must be subject to waste management plans and programs, and it establishes municipal requirements to handle waste tires on public roads, vacant lots, ravines, and canyons.[135] However, the Baja California state legislature has not yet passed a regulation for the LPGIRBC, which has complicated efforts to manage waste tires.

Implementation and enforcement of the LPGIRBC, as it relates to waste tires and elaboration of the State Program for the Prevention and Integral Management of Special Management Waste, are the responsibilities of the Secretary of Environmental Protection for Baja California (SPA).[136] SPA monitors the proper disposal and handling of waste tires at authorized facilities and for approved end uses to ensure the proper operation of the collection, transportation, storage, handling, treatment, recycling, confinement, and final disposition of waste tires. More specifically, SPA meets requests for compliance with the disposal and proper handling of waste tires at state-operated facilities and supervises compliance of used tire importers prior to approval of a new import permit.

In 2008, the Secretary of the Economy (SE), Secretary of the Environment and Natural Resources (SEMARNAT), Secretary of Environmental Protection for Baja California (SPA), and the local chambers of commerce (CANACO) formed an inter-institutional working group to establish formal criteria for used tire imports from the United States and the requirements for their proper disposal. The agreed regulatory mechanisms among the agencies and stakeholders involved for importers of used tires are:

- Permission to import authorized tires from SE
- List of customers and quantity per customer
- Manifests of disposal at SPA-authorized facilities and end uses
- Proof of fulfillment by SPA

In addition, SPA established a waste tire program called "Comprehensive Program for the Management and Final Disposal of Waste Tires" in 2015 with the goal of minimizing, recovering, treating, recycling, and disposing waste tires under regulatory compliance and to avoid clandestine dumpsites.[137] In addition to importer regulations, SPA's waste tire program contemplates regulatory mechanisms and obligations for the following stakeholders:

- Distributors and dealers of new tires must provide:
    - Number of marketed tires, per semester or each six months
    - Number of used tires collected for disposal
    - List of wholesale and sub-wholesale[i] customers
    - Disposal manifests from SPA
- Small tire shops must provide:
    - Review of the purchase of tires for sale
    - Disposal manifests from SPA
- Recyclers, junk yards, and / or automobile dismantlers are required to provide:
    - Number of tires entering the property
    - Number of wheels (with tires) to be sold
    - Disposal manifests from SPA

[i] Sub-wholesaler, or *submayorista*, is a category of business between wholesaler and retailer.

SPA's implementation of this comprehensive program and the ability of municipalities to comply with their mandated responsibility depends largely on resource availability. As mentioned previously in this report, however, state and municipal budgets are fairly limited. For the 2017 fiscal year, for example, the SPA budget is $51,284,500 pesos (equivalent to $2,849,138 USD), of which roughly 50 percent is destined for personnel-related expenses.[138] The 2017 budget represents a 1.4 percent decrease from Fiscal Year 2016. At the municipal level, the budgets for environment departments are further reduced. For instance, the municipal Environmental Protection Directorate in Mexicali has an annual budget of $11,317,741 pesos (equivalent to $628,763 USD) for 2017.[139] This challenge is compounded by the fact that municipal environmental departments are usually under the umbrella of either urban development or public works, which prioritize resources for infrastructure projects. Therefore, it is difficult for state authorities to implement comprehensive waste tire management in the absence of necessary resources and almost impossible for municipal authorities to fulfill their mandate of formally disposing of waste tires when they collect urban solid waste.

Baja California Waste Tire Fee

Finally, as detailed in the previous section, the state of Baja California introduced a waste tire disposal fee in 2010, which has been maintained ever since.[140] The inter-institutional working group detailed above negotiates the fee structure with the Used Tire Dealers Association. The 2017 fee stands at $5.18 pesos ($0.29 USD) per passenger vehicle or motorcycle tire and $10.34 pesos ($0.57 USD) for bus, truck, and tractor tires. For 2016, the fee for passenger vehicle tires was $5.02 pesos ($0.28 USD), meaning it increased by 3.1 percent.[141]

Nevertheless, all fees for disposal of waste tires are paid directly to the state of Baja California treasury and they go to the general state fund without the possibility of being retained by SPA. Whatever amount returns to SPA from the fee is integrated into its annual budget for operation and the maintenance of the official waste tire collection and transfer sites. In other words, the funds collected from waste tire fees do not go to a special environmental fund nor are funds reinvested specifically for waste tire management and the development of productive end uses. SPA and municipal authorities lack a stable stream of resources for implementing waste tire management initiatives in the state.

6. Conclusions and Recommendations

Conclusions

The goal of this study was to analyze the flow of used tires from California to Baja California and the San Luis Río Colorado area of Sonora and the challenges posed by the generation of waste tires in these regions. Providing recommendations to address these challenges is also central to this study. The cross-border used tire commerce is a valuable economic activity for California, providing a stable market for California exporters and relieving California tire businesses of the burden of properly disposing between 800,000 to 1 million waste tires each year. The commerce also provides value in Mexico through job creation and profits for Mexican companies, taxes for the Mexican federal government, and a good value for Mexican consumers. However, the flow generates additional waste tires that complicate Mexican government and private sector efforts to properly dispose of them, producing environmental impacts in the border region of Mexico and negative spillover effects in areas of California adjacent to the U.S.-Mexico border.

In the years since the 2009 tire flow study, the research team has a number of conclusions regarding the cross-border tire flow and its impacts in Mexico:

First, the Secretaría de Protección al Ambiente of Baja California (SPA), in cooperation with municipal environmental and urban services authorities, federal authorities, and the private sector, has made important advances in the collection, management, and disposition of waste tires in the border region. The Municipality of San Luis Río Colorado, Sonora, has made excellent progress as well. As we elaborate below, the creation of government-managed waste tire collection centers in Tijuana, Mexicali, and San Luis Río Colorado has been key to these improvements. These centers provide many waste tire generators with a convenient way to dispose of the waste tires. Unmanaged large accumulations of waste tires have been eliminated, and the number of smaller piles that formerly dotted urban and peri-urban areas has been reduced somewhat in number. There are fewer piles of 500 or more waste tires littering the urban landscape and surrounding areas than encountered in the 2009 study.

Second, development and continued operation by SPA of the CATENED I facility in Mexicali has been an important achievement, providing a reliable location for dealers to dispose of waste tires. CATENED I also provides a site for shredding waste tires prior to trucking to cement kilns in Hermosillo, Sonora, for co-processing as tire-derived fuel. However, stable financing for the facility and developing additional productive end uses for the tires remain a challenge. The distance of the CATANED I facility from the coastal population centers imposes an additional financial burden on the tire dealers of Ensenada, Rosarito, Tecate, and Tijuana as well as on the municipal authorities of those cities who remain responsible for collecting waste tires in streets, empty lots, drains, ravines, canyons, and other urban areas.

Finally, the research team has observed enhanced willingness on the part of public and private stakeholders at all levels to cooperate and be part of developing sustainable solutions to the border waste tire problems. Municipal authorities are willing to

contribute to and recognize the need for effective programs to clean up existing tire piles and regularly remove waste tires that have been improperly disposed of in their jurisdictions. The state environmental agency, SPA, is strongly committed to addressing the waste tire issues and finding long-term solutions to them. CalRecycle is engaged in working on these issues and the California Border Relations Council and the Solid Waste Working Group provide an important institutional context for enhanced cross-border efforts. Importantly, private stakeholders, especially CANACO, the business chambers, and the tire dealers associations demonstrate interest in cooperating with government authorities to develop solutions. Federal environmental authorities, including EPA and its Mexican counterpart SEMARNAT, continue to prioritize solid waste issues as part of the U.S.-Mexico Border Environment Program, Border 2020. The binational agency Border Environment Cooperation Commission/North American Development Bank has developed expertise and has provided support for tire initiatives in the border region. NGOs and community groups are also engaging in the issues and some are working to develop alternative productive uses for waste tires.

Recommendations

It is the assumption of the research team that solutions for the challenges posed by the flow of used tires from California into Mexico can be developed and implemented most effectively through joint and coordinated efforts by California and Baja California in concert with their respective federal governments, private sector groups, and other stakeholders. At the same time, there are actions that California and Baja California can take independently that will facilitate progress on the waste tire issue:

Joint and Coordinated Initiatives

- CalRecycle and SPA should cooperate on a technical workshop in Baja California in late 2017 or early 2018 to follow up on results of the two information sharing workshops of April and August 2017. CalRecycle could provide technical assistance to cover topics on waste tire management; designing and implementing a hauler registry and tire manifest system; recycling alternatives; and diversion to productive end uses. SPA could convene key stakeholders from government and the private sector to participate in this technical workshop to spearhead solutions to the waste tire issues in Baja California.

- CalRecycle and SPA should organize a technical workshop in Baja California on rubberized asphalt concrete (RAC), with presentations by CalRecycle and CalTrans technical experts on RAC, California paving experts, Mexican transportation agency representatives, Mexican public works officials, and Mexican paving industry representatives. The purpose of this workshop would be to support use of RAC in Baja California paving projects and to develop an important productive use for waste tires. The workshop should also include discussion of national and bi-national financing mechanisms.

- CalRecycle and SPA should organize a technical workshop on the use of waste tires for construction and civil engineering projects, such as tire-derived aggregate (TDA). Presentations should include CalRecycle experts on TDA, Mexican urban development officials, and Mexican contractors and civil engineering associations. This will further encourage productive use of waste tires in Baja California.

CalRecycle Initiatives

- CalRecycle should support the research efforts of California and Baja California universities to develop tire-derived products for the Mexican market. This could help develop sustainable productive end uses for waste tires in the region. This effort should involve engineering as well as business administration divisions of the California and Mexican universities, focusing on innovation and entrepreneurship and business incubators. Such programs could develop new products and encourage collaboration among entrepreneurs, innovators, and startup companies within the emerging manufacturing industry of Mexico, as seen in the aerospace industry and other sectors.

- Continue to strengthen the California manifest and tire tracking system so that it is possible to quantify the numbers of used tires flowing from California into Baja California as well as *through California* from other U.S. states into Baja California.

- CalRecycle should work with U.S. Customs and Border Protection to obtain detailed data on California used tire exports to Baja California, as well as exports of scrap vehicles for automobile dismantlers. This information will assist Baja California in managing the waste tire issues related to authorized imports of used tires.

- CalRecycle should encourage the State of California to adopt standards for used tires that are equal to or better than the recommendations and standards of most other U.S. states, the U.S. federal government, and Canada to assure that only acceptable used tires are exported to Baja California.

Baja California Initiatives

- SPA and Baja California should encourage establishment of a Mexican national standard for used tires. This would help address safety concerns about used tire imports and domestic used tires and, ideally, it would help establish a common North American standard for used tires.

- Baja California should develop an environmental fund that would generate stable resources for waste tire management in the state. A proposal should be

developed by environmental, academic, and legal experts in concert with CANACO and tire dealers associations that would create a legal and regulatory path to collect a fee on imported used tires that would go to a specific waste tire management fund to support infrastructure, disposal efforts, and the development of alternative end uses.

- SPA should work in collaboration with municipal authorities to properly manage the current ad hoc municipal waste tire collection lots and to clean up municipal landfills with accumulated waste tires. Municipal authorities have made significant progress in eliminating large informal tire piles through local cleanup efforts. However, these municipal lots, as well as tires stored at municipal landfills, do not appear to be properly managed and pose potential health, safety, and environmental hazards. Collaboration between SPA and municipal authorities should emphasize final disposition and diversion for alternative uses of waste tires collected and stored at these locations.

- State authorities should conduct a market analysis of current and potential productive end uses of waste tires in the region. This analysis should be part of an effort to prioritize productive end use beyond reliance on co-processing waste tires as fuel in the cement kilns of Hermosillo and Ensenada. This analysis will be an important step in overcoming the current bottleneck occurring in the management and disposal of waste tires in Baja California.

- Municipal authorities should continue to regularize the licensing, monitoring, and enforcement of local used and new tire dealer businesses to ensure proper management and disposal of used and waste tires in the region. These efforts could include a registry of large and small waste tire generators.

- As mentioned above, large numbers of waste tires can be used as low-cost building material for public works projects and by homeowners or neighborhood associations in urban areas of Baja California. State and municipal authorities should work together to develop technical and engineering standards, building codes, and conduct practical training and information for use of waste tires as construction material. This should apply for public works as well as private construction projects. Development of technical and engineering standards could be accomplished through collaboration between Mexico's universities and their U.S. counterparts and professional civil engineering and architecture associations.

Abbreviations and Acronyms

ADC – Alternative Daily Cover

ANDELLAC – Mexican Association of Tire Distributors and Renewal Plants (Asociación Nacional de Distribuidores de Llantas y Plantas Renovadoras)

APASCO – Mexican cement company (Cementos Apasco)

BECC – Border Environment Cooperation Commission

Border 2012 – U.S.-Mexico binational border environmental program led by U.S.E.PA. and Mexico's environmental agency. Active from 2003-2012 and followed by the Border 2020 program.

Cal/EPA – California Environmental Protection Agency

CalRecycle – California Department of Resources Recycling and Recovery

CANACO – Mexico's National Chamber of Commerce (Cámara Nacional de Comercio)

CATANED I – Authorized Temporary Collection Center for Waste Tires, Mexicali location

CATANED II – Authorized Temporary Collection Center for Waste Tires, Tijuana location

CBP – U.S. Customs and Border Protection

CEMEX – Mexican Cement Company (Cementos de México)

CIWMB – California Integrated Waste Management Board

CNIH – Mexico's National Chamber of Rubber Industries (Cámara Nacional de la Industria Hulera)

GEN – Gen Industrial, private waste management company in Baja California

HS – Harmonized System Code

INFONAVIT – Mexico's Institute of the National Housing Fund (Instituto del Fondo Nacional de la Vivienda)

IRSC – Institute for Regional Studies of the Californias, San Diego State University

IVA – Value Added Tax (Impuesto al Valor Agregado)

LGEEPA – Mexico's Federal General Law of Ecological Equilibrium and Environmental Protection (Ley General del Equilibrio Ecológico y Protección al Ambiente)

LGPGIR – Mexico's Federal General Law for the Prevention and Integral Management of Wastes (Ley General de Prevención y Gestión Integral de los Residuos)

LGPIRBC – State of Baja California Law for the Prevention and Integral Management of Wastes (Ley de Prevención y Gestión Integral de los Residuos de Baja California)

LPABC – State of Baja California Law for Environmental Protection (Ley de Protección al Ambiente de Baja California)

NADB – North American Development Bank

NAFTA – North American Free Trade Agreement

NAICS – North American Industrial Classification System

NGO – Non Governmental Organization

NOM – Mexican Official Standard (Norma Oficial Mexicana)

RAC – Rubberized Asphalt Concrete

R&D – Research and Development

RMA – Rubber Manufacturers Association

SDSU – San Diego State University

SE – Mexico's Secretariat of Economy (Secretaría de Economía)

SEDESOL – Mexico's Federal Secretariat of Social Development (Secretaría de Desarrollo Social)

SEMARNAT – Mexico's Federal Secretariat of Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales)

SLRC – San Luis Río Colorado, Sonora

SPABC or SPA – State of Baja California Secretariat of Environmental Protection (Secretaría de Protección al Ambiente de Baja California)

TDA – Tire Derived Aggregate

TDF – Tire Derived Fuel

TRNERR – Tijuana River National Estuarine Research Reserve

UN Comtrade – The United Nations Commodity Trade Statistics Database

USEPA – United States Environmental Protection Agency

WNV – West Nile Virus

WTMS – Waste Tire Manifest System

References

"Acuerdo que Establece la Clasificación y Codificación de Mercancías cuya Importación y Exportación está sujeta al Requisito de Permiso Previo por parte de la Secretaría de Economía," Artículo 1, Fracción 4012.20.01-4012.20.99.

"Acuerdo que establece los criterios para otorgar permisos previos a mercancías diversas," Diario Oficial de la Federación, México, D.F., May 31, 2006.

"Acuerdos de la reunión celebrada el 15 de enero de 1996 en la ciudad de Tijuana, B.C., para el establecimiento de la cuota de llantas usadas para Baja California y la región parcial del estado de Sonora."

Alvarez Gutiérrez, Gildardo and Eleazar Treviño García, "Análisis de la Situación del Manejo Integral de Llantas Desechadas en Baja California Sur," report prepared for the Institute for Regional Studies of the Californias for the CIWMB Tire Flow Study, 2008.

Alvarez Gutiérrez, Gildardo et al., "Análisis de la Situación del Manejo Integral de Llantas Desechadas en Baja California Sur," Secretaría de Medio Ambiente y Recursos Naturales (Secretariat of Environment and Natural Resources), México, D.F., May 2008.

"Anexo de Mercancías Aprobadas a Importar o Exportar," Secretaría de Economía (Secretariat of Economy), México, D.F., March 15, 2007.

"At the Crossroads: US / Mexico Border Counties in Transition," US / Mexico Border Counties Coalition, El Paso, TX, March 2006.

"Atiende Economía problema de llantas usadas en Mexicali y Ensenada," Monitor Económico de Baja California, May 2, 2017, http://monitoreconomico.org/noticias/2017/may/02/atiende-economia-problema-de-llantas-usadas-en-mexicali-y-ensenada/> (May 3, 2017).

Bastida, Sócrates, "Llantas de Desecho: La Problemática Actual en Baja California," speech given at Used and Waste Tire Flow in the California-Baja California Border Region conference, San Diego, March 4, 2008.

"Best Practices for Used Tire Inspection," Tire Industry Association, Bowie, MD.

Blackman, Allen and Alejandra Palma, "Scrap Tires in Ciudad Juárez and El Paso: Ranking the Risks," Journal of Environment & Development, September 2002.

Blumenthal, Michael, "Scrap Tire Market Overview," speech given at the Business Assistance Program meeting, Washington, D.C., March 9, 2006.

"Border 2012: U.S.-Mexico Border Scrap Tire Inventory Summary Report," United States Environmental Protection Agency Office of Solid Waste, Washington, D.C., February 22, 2007.

"Border 2012: U.S.-Mexico Environmental Program," United States Environmental Protection Agency, Washington, D.C., May 5, 2003.

Breyer, M. "Mosquito traps made from old tires are 7 times more effective than standard traps," *Treehugger*, April 8, 2016, <https://www.treehugger.com/green-home/mosquito-traps-made-old-tires-7-times-more-effective-standard-traps.html> (July 24, 2017).

Caballero Meza, Juan Paulino, "Municipal Involvement with Waste Tires," speech given at Used and Waste Tire Flow in the California-Baja California Border Region conference, San Diego, March 5, 2008.

California Department of Health Services, "Waste Tires, Mosquitoes, and Public Health," letter addressed to California Integrated Waste Management Board (September 24, 2004).

California Integrated Waste Management Board, "Alternative Daily Cover (ADC)," <http://www.ciwmb.ca.gov/LGCentral/Basics/ADCBasic.htm> (June 22, 2008).

———, "Board Meeting, May 11-12, 2004, Agenda Item 11," <http://www.ciwmb.ca.gov/agendas/mtgdocs/2004/05/00016279.doc> (April 27, 2007).

———, "Electronic Data Transfer (EDT) Pilot Program," April 11, 2005, <http://www.ciwmb.ca.gov/Tires/Manifest/EDT/EDTPilot.htm> (February 18, 2009).

———, “Panoche Burn Site Remediation,” <http://www.ciwmb.ca.gov/Tires/Fires/Panoche/ default.htm> (April 24, 2007).

“California Waste Tire Generation, Markets, and Disposal: 2004 Staff Report,” California Integrated Waste Management Board, Sacramento, CA, March 2007.

“California Waste Tire Generation, Markets, and Disposal: 2005 Staff Report,” California Integrated Waste Management Board, Sacramento, CA, February 2007.

“California Waste Tire Generation, Markets, and Disposal: 2006 Staff Report,” California Integrated Waste Management Board, Sacramento, CA, June 2007.

“Causa contrabando de llantas pérdida de cuatro mil empleos,” Diario de México, February 7, 2007, http://www.diariodemexico.com.mx/ (March 13, 2007).

———, “Image: Tires as Breeding Sites,” November 7, 2005, <http://www.cdc.gov/ncidod/ dvbid/arbor/tires.htm> (May 2, 2007).

Center for Environmental Public Policy University of California, Berkeley, Methodology for the Development of a Model Integrated Waste Tire Management Plan Framework for Baja California (Sacramento: CalRecycle, 2012).

Cervantes, Sandra, “Entrarán llantas usadas si se reciclan,” Frontera.info, March 3, 2007, <http://www.frontera.info/buscar/traernotanew.asp?NumNota=480892> (March 27, 2007).

“Chula Vista Municipal Code,” Title 5, Chapter 5.38.

“Comprehensive Trip Log Guidance Manual,” California Integrated Waste Management Board, Sacramento, CA, June 2005.

“Conservación y Prevención de la Contaminación en una Frontera Compartida,” Secretaría Estatal de Protección Ambiental de California, Sacramento, CA, 2007.

Consumer Reports, “How Safe are Worn Tires? Even Tires with Half Their Tread Intact May Be Riskier Than You Think,” <www.consumerreports.org/cro/cars/ties-auto- parts/tires/> (July 12, 2008).

“Convenio de concertación de acciones para prevenir y controlar la contaminación ambiental ocasionada por el comercio incontrolado de llantas usadas provenientes del extranjero para

ser vendidas directamente en la zona libre de Baja California," September 1991.

"Convenio para la Importación de Llantas Usadas," Secretaría de Economía (Secretariat of Economy), México, D.F., May 22, 2008.

Convierten llantas usadas en muebles ecológicos en BC. (2015, October 31). Noticias MVS. Retrieved July 10, 2016.

del Villar Alvelais, Edgar, "Mexico's Federal Experience with Scrap Tires," speech given at Used and Waste Tire Flow in the California-Baja California Border Region conference, San Diego, March 4, 2008.

"Diagnóstico Básico para la Gestión Integral de Residuos," Instituto Nacional de Ecología (National Institute of Ecology), México, D.F., October 2006.

El parque de las llantas: impacto ecológico y social. (2015, August 4). La Jornada Baja California. Retrieved February 6, 2017.

Estudio de Emisiones y Actividad Vehicular en Baja California, México, Instituto Nacional de Ecología y Cambio Climático, Dirección de Investigación sobre la Contaminación Urbana y Regional, y Dirección de Investigación sobre la Calidad del Aire, Mexico, 2011.

"Five-Year Plan for the Waste Tire Recycling Management Program," California Integrated Waste Management Board, Sacramento, CA, July 1, 2007.

"Formato de Plan de Manejo de Residuos Especiales," Secretaría de Desarrollo Urbano, Obras Públicas y Ecología, Gobierno del Estado de Tamaulipas (Secretariat of Urban Development, Public Works, and Ecology, Government of the State of Tamaulipas), Cuidad Victoria, Tam., July 2007.

"Formato Generación de Residuos de Manejo Especial," Secretaría de Medio Ambiente y Recursos Naturales, Gobierno del Estado de Coahuila (Secretariat of Environment and Natural Resources, Government of the State of Coahuila), Saltillo, Coah.

"Foro Binacional Fronterizo de Manejo y Disposición de Llantas de Deshecho" FUMEC-EL COLEF, Cuidad Juárez, Chihuahua, April 10-12, 2003.

"En vigor, cambios aprobados en materia de IVA," *El Universal*, January 1, 2014, <http://archivo.eluniversal.com.mx/finanzas-cartera/2014/nuevos-impuestos-2014-976588.html> (July 7, 2017).

Ganster, Paul, and Kimberly Collins, “Binational Cooperation and Twinning: A View from the US–Mexican Border, San Diego, California, and Tijuana, Baja California,” Journal of Borderlands Studies, 32:2 (Spring 2017 forthcoming)

Ganster, Paul, with David E. Lorey. 2016. The U.S.-Mexican Border Today. Conflict and Cooperation in Historical Perspective. Lanham, MD: Rowman & Littlefield

González Narro, Alexandra, “Overview of Scrap Tire Issues in The U.S.-Mexico Border Region and The California-Baja California Border Region,” speech given at Scrap Tire Issues in the California-Baja California Border Region conference, National City, September 6, 2007.

Good Neighbor Environmental Board. Climate Change and Resilient Communities along the U.S.-Mexico Border: The Role of Federal Agencies (Washington, D.C.: USEPA 202-R-16-001), December 2016.

Guillén López, Tonatiuh and Glen Sparrow, “Governance and Administrative Boundaries,” in Paul Ganster (ed.), San Diego-Tijuana International Planning Atlas, San Diego State University Press, San Diego, CA, 2000, pp. 41–47.

Gutiérrez, Carmen, “Destruirán 100 mil llantas en Rosarito,” Frontera.info, September 15, 2006, <http://frontera.info/buscar.traernotanew.asp?NumNota=425605> (January 26, 2007).

———, “Limpiarán calles de Rosarito de llantas,” Frontera.info, March 29, 2007, <http://www.frontera.info/buscar/traernotanew.asp?NumNota=483897> (April 12, 2007).

Guzmán, Saúl (Chief of the Environmental Administration Unit, Secretaría de Medio Ambiente y Recursos Naturales (Secretariat of Environment and Natural Resources), office communication (2007).

“¿Ha tenido que cambiar o reparar sus llantas por caer en baches?” Frontera.info, <http://www.frontera.info/encuestas/barrasrediseno.asp?encuesta=3635&repuesta=0 &presentar=N> (February, 23, 2007).

Hammer, Chris and Terry A. Gray, “Designing Building Products Made with Recycled Tires,” California Integrated Waste Management Board, Sacramento, CA, June 2004.

Heras, Jorge, "Es necesario un padrón oficial de autos 'chocolate' antes de la regularización: Vega," La Jornada Baja California, August 9, 2016, <http://jornadabc.mx/tijuana/09-08-2016/es-necesario-un-padron-oficial-de-autos-chocolate-antes-de-la-regularizacion-vega> (May 17, 2017).

Hernández, Esther, "Sin operar centro de acopio de llantas," Frontera, May 22, 2016, <http://www.frontera.info/EdicionEnLinea/Notas/Noticias/22052016/1084223-Sin-operar-centro-de-acopio-de-llantas.html> (April 18, 2017).

“Importación de llantas usadas en Baja California,” Secretaría de Comercio y Fomento Industrial (Secretariat of Commerce and Industrial Promotion), México, D.F., 1995.

INEGI, Estadísticas a propósito de la Industria hulera 2016. www.cnih.org.mx/hule_8ago2016_camara.pdf (July 14, 2017).

Institute for Regional Studies of the Californias, The Flow of Used and Waste Tires in the California-Mexico Border Region (Sacramento: California Integrated Waste Management Board, 2009. Publication #IWMB-2009-018)

“Ley de Prevención y Gestión Integral de Residuos para el Estado de Baja California (LPGIRBC),” Título Primero, Capítulo II.

“Ley de Protección al Ambiente para el Estado de Baja California (LPABC),” Título Cuarto, Capítulo IV, Sección II, Artículos 135-136.

“Ley General para la Prevención y Gestión Integral de los Residuos (LGPGIR),” 2003, Título Segundo, Capítulo III, Artículo 20, Fracción IX.

“Ley General para la Prevención y Gestión Integral de los Residuos (LGPGIR),” 2007, Título Primero, Capítulo Único.

Lin, Chen-Luh et al., “Disposal Alternatives for Waste Tires in the Border Region,” Southwest Center for Environmental Research and Policy (SCERP), San Diego, CA, 2002.

Louis Berger, California Waste Tire Market Report: 2015 (Sacramento: CalRecycle, 2016), p. 17.

“Makhra, una empresa de BCS que recicla llantas y las vende como muebles en todo México,” BCS Noticias, November 3, 2014, <http://www.bcsnoticias.mx/makhra-una-empresa-de-bcs-que-recicla-llantas-y-las-vende-como-muebles-en-todo-mexico/> (July 24, 2017).

Manejo Responsible de Llantas Usadas, A.C. Plan de manejo de neumáticos usados de desecho Conforme a la NOM-161-SEMARNAT-2011. Mexico, 2015, <http://reciclallantas.org.mx/> (July 30, 2017).

Martínez, Oscar J., Border People: Life and Society in the U.S.-Mexico Borderlands, University of Arizona Press, Tucson, AZ, 1994.

Martínez, Oscar J., Mexico's Uneven Development: The Geographical and Historical Context of Inequality, Routledge,London, 2015.

Martínez López, Cornelio, Los Vehículos Usados de Procedencia Extranjera en México, Centro de Estudios Sociales y de Opinión Pública, Documento de Trabajo, #142, September, 2012.

Mascareño, David, “Alternative Uses for Waste Tires and Tire Derived Products,” speech given at Used and Waste Tire Flow in the California-Baja California Border Region conference, San Diego, March 5, 2008.

“México es el único país en el mundo que compra llantas usadas,” El Universal, August 2, 2006, <http://www.eluniversal.com.mx/articulos/33565.html> (June 27, 2008).

Murray, Ashley and Lynn Price, “Use of Alternative Fuels in Cement Manufacture: Analysis of Fuel Characteristics and Feasibility for Use in the Chinese Cement Sector,” Ernesto Orlando, Lawrence Berkeley National Laboratory, Berkeley, CA, June 2008.

National University System Institute for Policy Research, Cali Baja Mega-Region Regional Asset Map. San Diego: 2010. www.nusinstitute.org/assets/resources/.../EDC_Mega_Region_Final_November_2010

"Obtiene UNAM productos de alto valor con llantas desechadas," Noticias Terra, February 29, 2012, <https://noticias.terra.com.mx/mexico/bien-por-mexico/obtiene-unam-productos-de-alto-valor-con-llantas-desechadas,a9586cde71cc5310VgnVCM4000009bf154d0RCRD.html> (March 21, 2017).

Overview of Scrap Tire Disposal and Recycling Options, Border Environment Cooperation Commission (BECC), Houston Advanced Research Center (HARC), December, 2003.

“Pedimento,” Administración General de Aduanas (General Customs Administration), México, D.F., May 4, 2007.

Plan Estatal de Manejo de Llantas Usadas de Vehículos Automotores para el Estado de Tabasco, Secretaría de

Medio Ambiente y Recursos Naturales, Tabasco, Mexico, September, 2012.

Propuesta de Estrategia y Política Pública para el Manejo Integral de Llantas de Desecho en la Región Fronteriza, Comisión de Cooperación Ecologica Fronteriza, October, 2008.

Ramírez-Bareto, Elizabeth et al., "Waste Tires: Procedures for Characterizing and Quantifying a Final Disposal Site," University College Northampton and Universidad Autónoma de Baja California.

Revista ANDELLAC. <http://andellac.com.mx/> *(*February 6, 2017).

Ruiz Burgueño, Martín Alberto, "Problemática de quema de llantas en la ciudad," speech given at Used and Waste Tire Flow in the California-Baja California Border Region conference, San Diego, March 5, 2008.

Safety Research & Strategies, "Tires: Aging Dangerously," 2006, <http://www. safetyresearch.net/tires/htm> (July 25, 2008).

Sánchez Quiroz, Alberto, "Mexico's Federal Experience with Scrap Tires," speech given at Used and Waste Tire Flow in the California-Baja California Border Region conference, San Diego, March 4, 2008.

Torres, Atzayaelh, "Industria llantera, contra la pared por contrabando," Excélsior, June 23, 2008, <http://www/exonline.com.mx/XStatic/excelsior/template/content.aspx?se=nota&ide=261650> (June 27, 2008).

Ulrich, Bob, 2017 US Tire Market Fact Sheet, Modern Tire Dealer, January 2017.

United Nations, "United Nations Commodity Trade Statistics Database," <http://comtrade. un.org> (November 24, 2008).

United States Census Bureau, "North American Industrial Classification System: FAQs (Ask Dr. NACIS)," October 22, 2008, <http://www.census.gov/eos/www/naics/faqs/faqs.html#q1> (February 24, 2009).

United States Environmental Protection Agency, "US-Mexico Border 2012 Program," <http://www.epa.gov/Border2012/> (April 12, 2007).

United States International Trade Commission, "USITC Interactive Tariff and Trade DataWeb,"

<http://www.dataweb.usitc.gov/scripts/user_set.asp> (January 14, 2009).

"Utilización de llantas usadas en la construcción de vivienda popular," Administración Ambiental Integral, S.C., México, D.F., 2008.

Vellegas, Manuel, "Fuera de Control las Llantas Usadas," Frontera.info, April 6, 2004,<http://www.frontera.info/edicionenlinea/nota.asp?NumNota=48230> (February 7,2007).

Villegas, Enrique, "CA-BC Waste Tire Flow – Draft Report, Review and Comments," memo, April 2009.

"YANTEK: Tecnología en Construcción," GEOCIM, Tijuana, B.C., April 2, 2006.

Endnotes

[1] CalRecycle Publication # IWMB-2009-018.

[2] http://www.calrecycle.ca.gov/Tires/Products/default.htm

[3] Paul Ganster with David E. Lorey. 2016. The U.S.-Mexican Border Today. Conflict and Cooperation in Historical Perspective. Lanham, MD: Rowman & Littlefield.

[4] "At the Crossroads: US / Mexico Border Counties in Transition," US / Mexico Border Counties Coalition, El Paso, TX, March 2006, pp. 4-1

[5] National University System Institute for Policy Research, Cali Baja Mega-Region Regional Asset Map. San Diego: 2010. www.nusinstitute.org/assets/resources/.../EDC_Mega_Region_Final_November_2010

[6] Interview with Tijuana municipal environmental officials, Tijuana 5/8/17.

[7] A useful overview of governance in Baja California is: Tonatiuh Guillén López and Glen Sparrow, "Governance and Administrative Boundaries," in Paul Ganster (ed.), San Diego- Tijuana International Planning Atlas, San Diego State University Press, San Diego, CA, 2000, pp. 41–47.

[8] April 17, 2017 interview with San Luis Río Colorado municipal officials. http://www.becc.org/projects/certified-projects/construction-of-a-sanitary-landfill-closing-of-current-dumpsite-and-improvements-to-the-municipal-solid-waste-services-in-san-luis-rio-colorado-sonora-

[9] Paul Ganster and Kimberly Collins, "Binational Cooperation and Twinning: A View from the US–Mexican Border, San Diego, California, and Tijuana, Baja California," Journal of Borderlands Studies, 32:2 (Spring 2017 forthcoming) explores ad-hoc versus institutionalized cross border cooperation in the California-Baja California Border Region.

[10] For a list of these projects, see the BECC website: http://www.becc.org/search?q=waste+tires (accessed 7/23/2017).

[11] A useful typology of U.S. and Mexican border residents, people who regularly cross the border is presented in: Oscar J. Martínez, Border People: Life and Society in the U.S.-Mexico Borderlands, University of Arizona Press, Tucson, AZ, 1994.

[12] Institute for Regional Studies of the Californias, The Flow of Used and Waste Tires in the California-Mexico Border Region (Sacramento: California Integrated Waste Management Board, 2009. Publication #IWMB-2009-018)

[13] For a discussion of the dynamic U.S.-Mexico border region see Paul Ganster, with David E. Lorey, The U.S.-Mexican Border Today: Conflict and Cooperation in Historical Perspective (Lanham, MD: Rowman & Littlefield, 2016), especially chapters 5-8.

[14] Center for Environmental Public Policy University of California, Berkeley, Methodology for the Development of a Model Integrated Waste Tire Management Plan Framework for Baja California (Sacramento: CalRecycle, 2012).

[15] 2016 IRSC Tire Dealers Survey.

[16] Louis Berger, California Waste Tire Market Report: 2015 (Sacramento: CalRecycle, 2016), p. 17.

[17] Louis Berger, California Waste Tire Market Report: 2015 (Sacramento: CalRecycle, 2016), p. 17.

[18] Louis Berger, California Waste Tire Market Report: 2015 (Sacramento: CalRecycle, 2016), p. 10.

[19] Paul Ganster with David E. Lorey. 2016. The U.S.-Mexican Border Today. Conflict and Cooperation in Historical Perspective. Lanham, MD: Rowman & Littlefield., p. 139; especially endnote 15.

[20] For regulations on importation of used vehicles, see: http://www.sat.gob.mx/aduanas/vehiculos/Paginas/default.aspx (accessed 7/24/2017)

[21] 2009 Tire Flow Study, 19.

[22] The information on Baja California's vehicle fleet is based mainly on an interview of CP Nolberto Gonzalez Grajeda, Director of Ingresos del Estado, Mexicali, June 29, 2017.

[23] Paul Ganster with David E. Lorey. 2016. The U.S.-Mexican Border Today. Conflict and Cooperation in Historical Perspective. Lanham, MD: Rowman & Littlefield., p. 139; especially endnote 15

[24] Gonzalez Grajeda interview, June 29, 2017.

[25] 2009 Tire Flow Study.

[26] Oscar J. Martinez, Mexico's Uneven Development: The Geographical and Historical Context of Inequality. Routledge, 2015,p. 242.

[27] 2009 Tire Flow study, p. 19.

[28] 41 "Acuerdos de la reunión celebrada 15 de enero de 1996 en la ciudad de Tijuana, B.C., para el establecimiento de la cuota de llantas usadas para Baja California y la región parcial del estado de Sonora"; Enrique Villegas, "CA-BC Waste Tire Flow – Draft Report, Review and Comments," memo, April 2009, cited in ibid, p. 20.

[29] Enrique Villegas, "CA-BC Waste Tire Flow – Draft Report, Review and Comments," memo, April 2009.

[30] 2009 Tire Flow Study, p. 21, Table 3.

[31] "Acuerdo que establece los criterios para otorgar permisos previos a mercancías diversas," Diario Oficial de la Federación, México, D.F., May 31, 2006.

[32] Alberto Sánchez Quiroz, (Promotions Director, Secretaría de Economía [Ministry of Economy]), “Mexico’s Federal Experience with Scrap Tires,” speech given at Used and Waste Tire Flow in the California-Baja California Border Region conference, San Diego, March 4, 2008.

[33] Enrique Villegas, “CA-BC Waste Tire Flow – Draft Report, Review and Comments,” memo, April 2009.

[34] The trade journal of ANDELLAC regularly has articles that carry this message: http://andellac.com.mx/

[35] El Financiero, April 22, 2014.

[36] Oscar Martinez, new book, find citation

[37] “En vigor, cambios aprobados en materia de IVA,” El Universal, January 1, 2014: http://archivo.eluniversal.com.mx/finanzas-cartera/2014/nuevos-impuestos-2014-976588.html. Accessed July 7, 2017.

[38] Data from Tijuana Tire Dealers Survey, January 2007.

[39] 2016 IRSC Tire Dealers Survey.

[40] Personal interviews with members of Asociación de Llanteros de Tijuana (Tijuana Tire Dealers Association), January 2007.

[41] 2016 IRSC Tire Dealers Survey.

[42] San Luis Río Colorado interview.

[43] San Luis Río Colorado Interview.

[44] 2009 Tire Flow Study, p. 25.

[45] 2009 Tire Flow Study, p. 26.

[46] The trade journal of ANDELLAC regularly has articles that carry this message: http://andellac.com.mx/

[47] “México es el único país en el mundo que compra llantas usadas,” El Universal, August 2, 2006, <http://www.eluniversal.com.mx/articulos/33565.html> (June 27, 2008).

[48] 2009 Tire Flow Study, p. 26; Atzayaelh Torres, “Industria llantera, contra la pared por contrabando,” Excélsior, June 23, 2008, <http://www/exonline.com.mx/XStatic/excelsior/template/content.aspx?se=nota&ide=261650> (June 27, 2008).

[49] This discussion is taken from the 2009 Tire Flow Study, p. 29ff.

[50] California Vehicle Code Section 27465, http://www.dot.ca.gov/hq/roadinfo/vctires.htm

[51] https://one.nhtsa.gov/cars/rules/TireSafety/ridesonit/brochure.html

[52] California Waste Tire Market Report: 2015 (CalRecycle, July 2016), p. 5.

[53] "Convenio para la Importación de Llantas Usadas," Secretaría de Economía (Secretariat of Economy), México, D.F., May 22, 2008.

[54] The trade journal of ANDELLAC regularly has articles that carry this message: http://andellac.com.mx/. Also see, Invade a BC 'basura' importada de EU (Baja California is invaded by junk imported from the U.S.), http://www.uniradioinforma.com/noticias/bajacalifornia/410480/invade-a-bc-basura-importada-de-eu.html; and ¿Cuál es el riesgo de comprar llantas usadas? (what is the reik of buying used tires?), http://www.neumarket.com.mx/blog/riesgo-comprar-llantas-usadas/.

[55] Interview with Mexican Customs, Mexicali, June 29, 2017.

[56] For example, Table 6 of this report includes data from different sources on export of used tires from California to Mexico.

[57] See Plate 2, p. 16, 2009 Tire Flow Study.

[58] Michael Spitz, personal communication 2017.

[59] 2009 Tire Flow Study, p. 31.

[60] Data from San Diego and Imperial Valley Tire Dealers Survey, 2006-2007. 2009 Study, p. 32.

[61] Based on 8 percent of the Economically Active Population in Baja California. See above endnote 20.

[62] U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, based on data from the Department of Homeland Security, U.S. Customs and Border Protection, Office of Field Operations. https://transborder.bts.gov/programs/international/transborder/TBDR_BC/TBDR_BCQ.html. Accessed July 10,2017.

[63] 2009 Tire Flow Study, p. 34; Berenice Cuenca (President, Asociación de Llanteros de Tijuana [Tijuana Tire Dealers Association]), personal interview, June 11, 2007.

[64] 2016 IRSC Tire Dealers Survey.

[65] Lic. Gildardo Álvarez Gutiérrez et al., "Análisis de la Situación del Manejo Integral de Llantas Desechadas en Baja California Sur," Secretaría de Medio Ambiente y Recursos Naturales (Secretariat of Environment and Natural Resources), México, D.F., May 2008, p. 3.

[66] Paul Ganster, Interviews with Loreto tire shops, June 2016 and January 2017.

[67] United Nations, "UN Comtrade," <http://comtrade.un.org/db/> (November 24, 2008). Based on HTS code 401220, Mexican reported imports from China.

[68]2016 IRSC Tire Dealer Survey; The economic challenges of waste tire disposal in Baja California were outlined in detail in the 2009 report The Flow of Used and Waste Tires in the California-Mexico Border Region and are mentioned throughout this study.

[69] 2009 Tire Flow Study.

[70] INEGI

[71] Interview of CP Nolberto González Grajeda, Director of Ingresos del Estado, Mexicali, June 29, 2017.

[72] Heras, Jorge, "Es necesario un padrón oficial de autos 'chocolate' antes de la regularización: Vega," La Jornada Baja California, August 9, 2016, <http://jornadabc.mx/tijuana/09-08-2016/es-necesario-un-padron-oficial-de-autos-chocolate-antes-de-la-regularizacion-vega> (May 17, 2017).

[73] Martínez López, Cornelio, Los Vehículos Usados

de Procedencia Extranjera en México, Centro de Estudios Sociales y de Opinión Pública, Documento de Trabajo, #142, September, 2012.

[74] Ibid.

[75] Estudio de Emisiones y Actividad Vehicular en Baja California, México, Instituto Nacional de Ecología y Cambio Climático, Dirección de Investigación sobre la Contaminación Urbana y Regional, y Dirección de Investigación sobre la Calidad del Aire, Mexico, 2011.

[76] The market demand is estimated using the formula: (# of vehicles x 4 tires) / 3.83 (or 46 months), subtracting out the average percentage of motorcycles.

[77] "México con una demanda del mercado de 39.400 millones de llantas: Elizabeth Ventura, presidenta de ANDELLAC," México Automotriz, March 9, 2017,<http://www.mexicoautomotriz.mx/llanteras/1-millon-200-mil-llantas-usadas-en-el-centro-del-pais-elizabeth-ventura-presidenta-de-andellac/> (May 17, 2017).

[78] A detailed discussion of issues relating to used tire service life in Mexico can be found in: Plan de Manejo de Neumáticos Usados de Desecho, ANDELLAC, ANILLAC and CNIH, August, 2013.

[79] Plan Estatal de Manejo de Llantas Usadas de Vehículos Automotores para el Estado de Tabasco, Secretaría de Medio Ambiente y Recursos Naturales, Tabasco, Mexico, September, 2012.

[80] In a survey conducted by the research team in 2016 with Baja California tire importers, waste tires included in wholesale used tire imports was not reported to be a significant problem.

[81] Propuesta de Estrategia y Política Pública para el Manejo Integral de Llantas de Desecho en la Región Fronteriza, Comisión de Cooperación Ecologica Fronteriza, October, 2008.

[82] Ulrich, Bob, 2017 US Tire Market Fact Sheet, Modern Tire Dealer, January, 2017.

[83]Transportation Statistics Annual Report 2016, U.S. Department of Transportation, Bureau of Transportation Statistics, Washington, DC, 2016.

[84] Mexico's registered vehicle fleet in 2014 was 38,025,389. 2014 new replacement tire sales for passenger, truck, bus, agricultural and industrial tries totaled 30,340,854 units.

[85] United States Census Bureau, USA Trade. Visit: https://usatrade.census.gov

[86] This ratio was first suggested in the 2009 Tire Flow Study and continues to be suggested by current stakeholders.

[87] The estimation of 2 million waste tires generated annually in Baja California was posited by SPA officials during a binational tire workshop hosted by CalRecycle on April 25, 2017 in San Diego, Ca.

[88] Propuesta de Estrategia y Política Pública para el Manejo Integral de Llantas de Desecho en la Región Fronteriza, Comisión de Cooperación Ecologica Fronteriza, October, 2008.

[89] Overview of Scrap Tire Disposal and Recycling Options, Border Environment Cooperation Commission (BECC), Houston Advanced Research Center (HARC), December, 2003.

[90] "Obtiene UNAM productos de alto valor con llantas desechadas," Noticias Terra, February 29, 2012, <https://noticias.terra.com.mx/mexico/bien-por-mexico/obtiene-unam-productos-de-alto-valor-con-llantas-desechadas,a9586cde71cc5310VgnVCM4000009bf154d0RCRD.html> (March 21, 2017).

[91] Border 2012: U.S.-Mexico Border Scrap Tire Inventory Summary Report. Washington, D.C.: EPA 530-R-07-005, May 2007.

[92] Good Neighbor Environmental Board. Climate Change and Resilient Communities along the U.S.-Mexico Border: The Role of Federal Agencies (Washington, D.C.: USEPA 202-R-16-001), December 2016. Chapter 7.

[93] Hernández, Esther, "Sin operar centro de acopio de llantas," Frontera, May 22, 2016, <http://www.frontera.info/EdicionEnLinea/Notas/Noticias/22052016/1084223-Sin-operar-centro-de-acopio-de-llantas.html> (April 18, 2017).

[94] This information was obtained during the research team's site visit to CANTENED II Tijuana on February 3, 2017.

[95] This estimate was given by SPA officials in 2009 Tire Flow Study. Current data cited in this study suggests that this estimate remains reasonable.

[96] "Atiende Economía problema de llantas usadas en Mexicali y Ensenada," Monitor Económico de Baja California, May 2, 2017,

<http://monitoreconomico.org/noticias/2017/may/02/atiende-economia-problema-de-llantas-usadas-en-mexicali-y-ensenada/> (May 3, 2017).

[97] Workshop on the Flow of Used Tires from California to Mexico. Sacramento, California. Monday, August 28, 2017.

[98] source: SPA

[99] source: SPA

[100] Interview with Ensenada Public Works employees on June 7, 2016.

[101] Interview with Tecate Departamento de Protección al Ambiente and Asociación de Llanteros on July 20, 2017.

[102] Interview with Mexicali Bomberos on February 20, 2017.

[103] SPA presentation made at binational waste tire workshop hosted by the research team on April 25, 2017 in San Diego.

[104] SPA presentation made at binational waste tire workshop hosted by the research team on April 25, 2017 in San Diego.

[105] This estimate was originally posited in 2009 Tire Flow Study and remains accurate.

[106] see 2009 Tire Flow Study, p.44.

[107] see yantek.com for more information

[108] See www.blueskybioenergy.com.mx for more information

[109] see *www.blueskybioenergy.com.mx* for more information.

[110] Workshop on the Flow of Used Tires from California to Mexico. Sacramento, California. August 28, 2017.

[111] El Parque de las Llantas: impacto ecológico y social. (2015, August 4). La Jornada Baja California. Retrieved February 6, 2017.

[112] http://terrapeninsular.org/en/san-quintin-residents-learn-recycle-tires/ (accessed 7/28/2017)

[113] Convierten llantas usadas en muebles ecológicos en BC. (2015, October 31). Noticias MVS. Retrieved July 10, 2016.

[114] Makhra, una empresa de BCS que recicla llantas y las vende como muebles en todo México. (2014, November 3). BCS Noticias. Retrieved July 24, 2017, from http://www.bcsnoticias.mx/makhra-una-empresa-de-bcs-que-recicla-llantas-y-las-vende-como-muebles-en-todo-mexico/

[115] Breyer, M. (2016, April 8). Mosquito traps made from old tires are 7 times more effective than standard traps. Treehugger. Retrieved July 24, 2017, from https://www.treehugger.com/

[116] For more detail regarding these estimations, see 2009 Tire Flow Study.

[117] 2009 Tire Flow Study.

[118] “Ley General para la Prevención y Gestión Integral de los Residuos (LGPGIR),” 2007, Título Primero, Capítulo Único, Artículo 5, Fracción XXXIV.

[119] Interview with SPA.

[120] State of Baja California website (accessed 7/17/17): http://indicadores.bajacalifornia.gob.mx/consultaciudadana/resumen-indicador-17.jsp?indicador=ES-SPA-14&sector=4

[121] Ley de Ingresos del Estado de Baja California para el Ejercicio Fiscal 2010.

[122] Ley de Ingresos del Estado de Baja California para el Ejercicio Fiscal 2017.

[123] Interview with SPA.

[124] Interview with Playas de Rosarito officials.

[125] In addition, there are international instruments related to used and waste tire management. Since 1991, Mexico is part of the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal. In 2011, the Basel Convention established the Technical Guidelines for the Environmentally Rational Management of Used and Disposable Tires adopted at the 10th Meeting of the Conference of the Parties to the Basel Convention in Colombia.

[126] The wide range of rules, norms, and instruments in the area of waste management that we describe in this section could possibly cause what is known as "legislative dispersion." This detracts from the principle of legal certainty and leads to insecurity for both authorities in their scope of attributions, as well as for obligated citizens.

[127] The original article was first introduced to the Constitution in 1999 and it read "adequate environment for development and well-being."

[128] Prior to the enactment of the LGPGIR, the General Law of Ecological Equilibrium and Environmental Protection (LGEEPA) was the federal law establishing criteria for waste management. However, the third transitory article of the LGPGIR abrogated all the provisions of the LGEEPA related to waste management. See also Chapter I, Section 1.4 of the National Program For the Prevention and Integral Management of Waste 2009-2012.

[129] "Reglamento de la Ley General para la Prevención y Gestión Integral de Residuos," Artículos 20, 27, 28.

[130] "Ley General para la Prevención y Gestión Integral de Residuos," Artículo 19, Fracción X. Reform published in *Diario Oficial de la Federación*, México, D.F., June 4, 2014.

[131] "Ley General para la Prevención y Gestión Integral de Residuos," Artículo 7, Fracción IV, and "Reglamento de la Ley General para la Prevención y Gestión Integral de Residuos," Artículo 12.

[132] Published in Diario Oficial de la Federación, México, D.F., October 20, 2004.

[133] Published in Diario Oficial de la Federación, México, D.F., February 1, 2013.

[134] “Ley de Prevención y Gestión Integral de Residuos para el Estado de Baja California,” Título Primero, Capítulo II; Decreto No. 387 por el que se reforma la LPABC.

[135] “Ley de Prevención y Gestión Integral de Residuos para el Estado de Baja California,” Artículo 6, Fracción XV.

[136] “Ley de Prevención y Gestión Integral de Residuos para el Estado de Baja California,” Artículo 5, Fracción XIII; Artículo 7.

[137] Programa para la Gestión Integral de Llantas de Desecho, Secretaría de Protección al Ambiente de Baja California.

[138] Presupuesto de Egresos del Estado de Baja California para el Ejercicio Fiscal 2017.

[139] Presupuesto de Egresos de la Administración Pública Centralizada del Municipio de Mexicali, Baja California, para el Ejercicio Fiscal 2017.

[140] Ley de Ingresos del Estado de Baja California para el Ejercicio Fiscal 2010; Ley de Ingresos del Estado de Baja California para el Ejercicio Fiscal 2017.

[141] Ley de Ingresos del Estado de Baja California para el Ejercicio Fiscal 2016.