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## Chapter 7



# *Toxics Release Inventory Data for Petroleum Refining (SIC Code 29)*

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## **A Look at the Petroleum Refining and Related Industries (SIC Code 29)**

The petroleum refining industry, SIC code 29, manufactures:

- ◆ Fuels—motor gasoline, diesel and distillate fuel oil, liquefied petroleum gas, jet fuel, residual fuel oil, kerosene and coke;
- ◆ Finished non-fuel products—solvents, lubricating oils, greases, petroleum wax, petroleum jelly, asphalt, and coke; and
- ◆ Chemical industry feedstocks—naphtha, ethane, propane, butane, ethylene, propylene, butylenes, butadiene, benzene, toluene, and xylene.

Box 7-1 lists Standard Industrial Classification (SIC) codes for the sector. In TRI, SIC codes are given as reported by the facilities; these may differ from information in economic and other data collections.

Petroleum refineries and related industries shipped \$174.3 billion in products in 1996 and \$151.4 billion in 1995 (in current dollars). The 1996 level surpassed the recent peak in value of shipments of \$172.6 billion in 1990 (also current dollars). Although the petroleum refining industry constitutes a large share of the total value of shipments of the U.S. economy, it comprises only a few hundred facilities (these are counted differently in various sources). Smaller facilities that specialize in production of a single petroleum product may employ as few as 10 people, while the more numerous and larger crude oil processing facilities maintain large staffs. Employment for the sector in 1996 was 106,000.

From 1989 to 1996, production in this sector increased 7.3%, compared to 17.6% for all U.S. manufacturing. During that time, production in SIC code 29 increased in every year but 1991. (See Chapter 4, Table 4-10.)

The largest segment of SIC code 29 is petroleum refining itself (SIC code 291). Refining facilities shipped \$158.07 billion in 1996 and employed 67,200 people. Refining made up 90.7% of the total



**Box 7-1. SIC Code 29, Petroleum Refining and Related Industries: Codes and Classifications**

SIC Code	Industrial Activity
<b>291</b> 2911	<b>Petroleum Refining</b> Petroleum Refining Production of gasoline, kerosene, distillate and residual fuel oils and lubricants.
<b>295</b> 2951	<b>Asphalt Paving and Roofing Materials</b> Asphalt Paving Mixtures and Blocks asphalt and tar. Manufacture of asphalt and tar paving mixtures; and paving blocks made of asphalt and tar.
2952	Asphalt Felts and Coatings and roofing cements and coatings. Manufacture, from purchased materials of asphalt and other saturated felts
<b>299</b> 2992	<b>Products of Petroleum and Coal</b> Lubricating Oils and Greases purchased mineral, animal, and vegetable materials. Blending, compounding, and re-refining lubrication oils and greases from
2999	Products of Petroleum and Coal, nec* petroleum and coal products. Manufacture of packaged fuel, powdered fuel, and other miscellaneous

**Source:** Executive Office of the President, Office of Management and Budget, *Standard Industrial Classification Manual, 1987*: Standard Industrial Classification (SIC) codes and industry descriptions.

\*nec: not elsewhere classified.

value of shipments in SIC code 29 in 1996. As indicated in the SIC designations in Box 7-1, the sector has just two other major groups: asphalt paving and roofing materials (SIC code 295) and miscellaneous petroleum and coal products (SIC code 299, primarily lubricants).

Petroleum refineries supply about 40% of the total energy used in the United States and nearly all of the energy for transportation. The United States accounts for over one-quarter of the world’s petroleum consumption—18.41 million barrels per day in 1996. About half of the crude oil used in the United States is imported. Refineries exported about 4% of their petroleum products in 1994.

Petroleum refining separates and transforms crude oil—physically, thermally, or chemically—into major distillation fractions (or components—fractions of crude oil are usually composed of compounds with similar properties). These are further separated and converted into finished petroleum products, in the three major categories

identified at the beginning of this chapter: fuels, finished non-fuel products, and chemical industry feedstocks. About 90% of the petroleum products used in the United States are fuels. Crude oil contains many hydrocarbons, in mixture, with small amounts of impurities, and its composition can vary significantly. Operations at petroleum refineries differ, given the composition of the crude oil they process and their particular products. “For these reasons,” one analysis points out, “no two refineries are alike.” Operations at a given refinery may also differ over time as crude oil of different composition is used.

Basic steps in the refining process begin with desalting, to remove from the crude oil corrosive salts along with some of the metals and suspended solids. Distillation, which follows, involves heating, vaporization, fractionation, condensation, and cooling. Distillation at atmospheric pressure separates lighter fractions; distillation at very low pressure (vacuum distillation) separates heavier fractions. Both are complex processes with



numerous output streams, and these may feed back into the process, into previous processes, into other processes, or into finished products. Downstream processes further refine fractions by cracking—that is, breaking large hydrocarbon molecules into smaller, lighter molecules. Catalytic cracking (using heat, pressure, and a catalyst) has become more common than thermal cracking. Other downstream methods include catalytic reforming, isomerization, polymerization, solvent extractions, dewaxing, and others.

SIC code 29 facilities use and manage large quantities of chemicals, and their complex operations give rise to many potential sources of environmental release. The major sources of chemical releases are air emissions (fugitive emissions from leaking equipment, emissions from process heaters used to heat process streams or generate steam, emissions from refining processes themselves) and wastewater (cooling water, process water, sanitary sewage water, and storm water).

A number of environmental concerns in the manufacture of petroleum and its products are not presently covered by TRI. These range from oil tanker spills (monitored in U.S. waters by the U.S. Coast Guard), to gasoline storage in underground tanks at service stations, to tailpipe emissions from cars and trucks.

## 1996 TRI Data for Petroleum Refining

Table 7-1 summarizes TRI reporting for the petroleum refining sector (SIC code 29). More than 3,200 TRI reporting forms were submitted for 1996. Of these, 241 (or 7.5% of all forms submitted in this sector) were Form A certification statements, certifying that a facility's total annual reportable amount of a TRI chemical was less than 500 pounds for the year and that the facility did not manufacture, process, or otherwise use more than 1 million pounds. (The Form A certification statement is explained in Chapter 1.)

Almost 80% of the forms in SIC code 29 were submitted by refineries (SIC code 2911), by far the largest segment of the sector in nearly all TRI reporting areas. Refineries reported 91.6% of total on- and off-site releases, 99.2% of other on-site waste management, 40.5% of transfers off-site for further waste management, 98.2% of total production-related waste, and close to 100% of non-production-related waste. For only one category were refineries ranked second. Lubricating oils and greases (SIC code 2992) reported 58.4% of transfers off-site for further waste management.

Some facilities in the petroleum sector engage in more than one manufacturing activity, as designated in the Standard Industrial Classification (SIC) system. Such facilities will then report more than one SIC code on their TRI forms. (Box 4-2 in Chapter 4 further explains reporting of multiple SIC codes and its affect on the analyses presented in the TRI data release.) This multiple-codes reporting in TRI is much smaller in the petroleum refining sector (SIC code 29) than in many other manufacturing sectors. Table 7-2 examines multiple-code reporting within SIC code 29. Ninety-three TRI forms reported more than one SIC code in SIC code 29 in 1996, 2.9% of all forms in the sector, a smaller percentage than in many sectors. Of these, 72 reported both petroleum refining (SIC code 2911) and miscellaneous products of petroleum and coal (SIC code 2999).

## On- and Off-site Releases

Air emissions represented 75.6% of all on- and off-site releases reported in the petroleum refining sector, as shown in Table 7-3 and Figure 7-1. The petroleum refining segment (SIC code 2911) accounted for 90.3% (47.0 million pounds) of these releases to air. Miscellaneous petroleum and coal products (SIC code 2999) was second with 5.5% (2.9 million pounds). Figure 7-2 illustrates the distribution of on-and off-site releases for the industries (four-digit SIC code) in this sector.



Table 7-1. Summary of TRI Information by 4-digit SIC Code, 1996: Petroleum Refining, SIC Code 29

Total On- and Off-site Releases Rank	Total Production-related Waste Rank	SIC Code	Industry	Total Facilities Number	Total Forms Number	Form As Number	Total On-site Releases Pounds	Total Off-site Releases Pounds	Total On- and Off-site Releases Pounds
1	1	2911	Petroleum Refining	165	2,582	93	60,851,253	2,234,680	63,085,933
7	7	2951	Asphalt Paving Mixtures & Blocks	10	16	6	4,816	0	4,816
6	5	2952	Asphalt Felts & Coatings	45	94	15	52,524	10,751	63,275
4	2	2992	Lubricating Oils & Greases	147	362	109	495,989	242,177	738,166
2	4	2999	Petroleum & Coal Products, nec*	21	80	13	2,868,906	2,500	2,871,406
3	3		Multiple within SIC 29	10	93	4	1,949,289	91,323	2,040,612
5	6		Invalid SIC Code within SIC 29	3	4	1	7,050	76,000	83,050
			Total for SIC Code 29	401	3,231	241	66,229,827	2,657,431	68,887,258

Note: On-site Releases from Section 5 of Form R. On-site Waste Management from Section 8 of Form R. Off-site Releases from Section 6 (transfers off-site to disposal) of Form R. Total Transfers Off-site for Further Waste Management from Section 6 (excluding transfers off-site to disposal) of Form R. Total Production-related Waste sums Section 8 (Current Year, Column B) of Form R, except: Non-production-related Waste (remedial/catastrophic incidents). Forms with more than one 4-digit SIC code within SIC code 20 are assigned to the "multiple" category.

\*nec: not elsewhere classified.

Table 7-2. Multiple SIC Codes, 1996: Petroleum Refining, SIC Code 29

SIC Codes	Total Forms Number	Form As Number	Total On-site Releases Pounds	Total Off-site Releases Pounds	Total On- and Off-site Releases Pounds	Total Other On-site Waste Management Pounds	Total Transfers Off-site for Further Waste Management Pounds	Total Production-related Waste Number	Non-Production-related Waste Number
2911 2951	4	0	2,036	248	2,284	9,130	5,972	17,353	0
2911 2951 2992	8	0	489,695	9,480	499,175	464,922	250	956,422	0
2911 2999	72	0	1,447,992	70,935	1,518,927	8,681,868	156,731	10,291,783	0
2952 2992	9	4	9,566	10,660	20,226	1,205	4,112	22,560	0
Total for SIC Code 29	93	4	1,949,289	91,323	2,040,612	9,157,125	167,065	11,288,118	0

Note: On-site Releases from Section 5 of Form R. On-site Waste Management from Section 8 of Form R. Off-site Releases are transfers off-site to disposal from Section 6 of Form R. Total Transfers Off-site for Further Waste Management from Section 6 of Form R. Total Production-related Waste sums Section 8 of Form R, except: Non-production-related Waste (remedial/catastrophic incidents).

Table 7-3. TRI On-site and Off-site Releases, 1996: Petroleum Refining, SIC Code 29 (in Rank Order)

SIC Code	Industry	Total Air Emissions Pounds	Surface Water Discharges Pounds	Underground Injection		On-site Land Releases		Total On-site Releases Pounds	Off-site Releases Transfers Off-site to Disposal Pounds	Total On- & Off-site Releases Pounds
				Class I Wells Pounds	Class II-V Wells Pounds	RCRA Subtitle C Landfills Pounds	Other On-site Land Releases Pounds			
2911	Petroleum Refining	47,029,821	10,295,051	2,310,233	8,664	5,685	1,201,799	60,851,253	2,234,680	63,085,933
2999	Petroleum & Coal Products, nec*	2,851,452	17,454	0	0	0	0	2,868,906	2,500	2,871,406
	Multiple within SIC 29	1,693,194	253,726	0	0	0	2,369	1,949,289	91,323	2,040,612
2992	Lubricating Oils & Greases	487,536	680	0	0	0	7,773	495,989	242,177	738,166
	Invalid SIC Code within SIC 29	7,050	0	0	0	0	0	7,050	76,000	83,050
2952	Asphalt Felts & Coatings	27,210	314	0	0	0	25,000	52,524	10,751	63,275
2951	Asphalt Paving Mixtures & Blocks	4,816	0	0	0	0	0	4,816	0	4,816
	Total for SIC Code 29	52,101,079	10,567,225	2,310,233	8,664	5,685	1,236,941	66,229,827	2,657,431	68,887,258

Note: On-site Releases from Section 5 of Form R. Off-site Releases from Section 6 (off-site transfers to disposal) of Form R. Forms with more than one 4-digit SIC code within SIC code 29 are assigned to the multiple category.

\*nec: not elsewhere classified.



Table 7-1. Summary of TRI Information by 4-digit SIC Code, 1996: Petroleum Refining, SIC Code 29, Continued

SIC Code	Industry	Total Other On-site Waste Management Pounds	Total Transfers Off-site for Further Waste Management Pounds	Total Production-related Waste Pounds	Total Non-Production-related Waste Pounds
2911	Petroleum Refining	2,045,870,460	10,587,404	2,117,356,607	1,786,042
2951	Asphalt Paving Mixtures & Blocks	1,874	0	6,708	0
2952	Asphalt Felts & Coatings	151,088	16,150	240,075	0
2992	Lubricating Oils & Greases	4,914,579	15,260,110	20,904,718	256
2999	Petroleum & Coal Products, nec*	2,384,328	109,745	5,357,523	159
	Multiple within SIC 29	9,157,125	167,065	11,288,118	0
	Invalid SIC Code within SIC 29	56,000	8,310	147,610	0
	Total for SIC Code 29	2,062,535,454	26,148,784	2,155,301,359	1,786,457

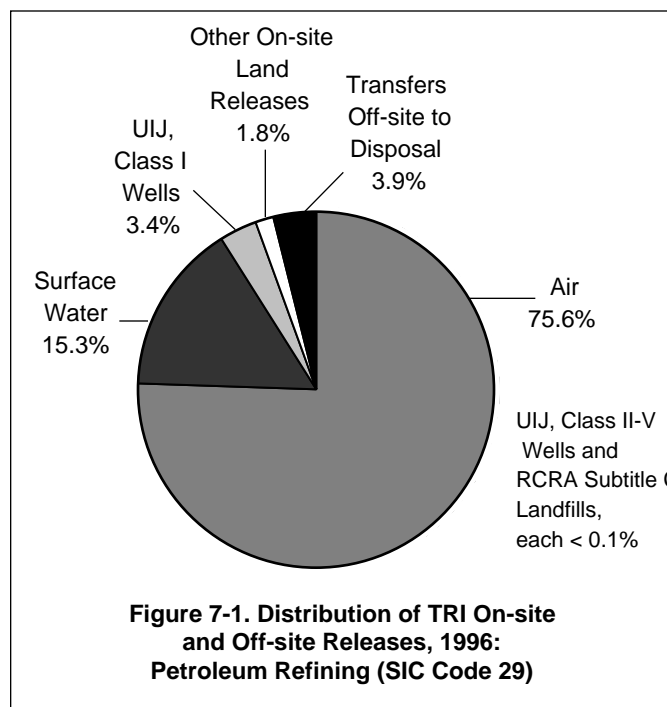
Note: **On-site Releases** from Section 5 of Form R. **On-site Waste Management** from Section 8 of Form R. **Off-site Releases** from Section 6 (transfers off-site to disposal) of Form R. **Total Transfers Off-site for Further Waste Management** from Section 6 (excluding transfers off-site to disposal) of Form R. **Total Production-related Waste** sums Section 8 (Current Year, Column B) of Form R, except: **Non-production-related Waste** (remedial/catastrophic incidents). Facilities/forms with more than one 4-digit SIC code within SIC code 20 are assigned to the “multiple” category.

\*nec: not elsewhere classified.

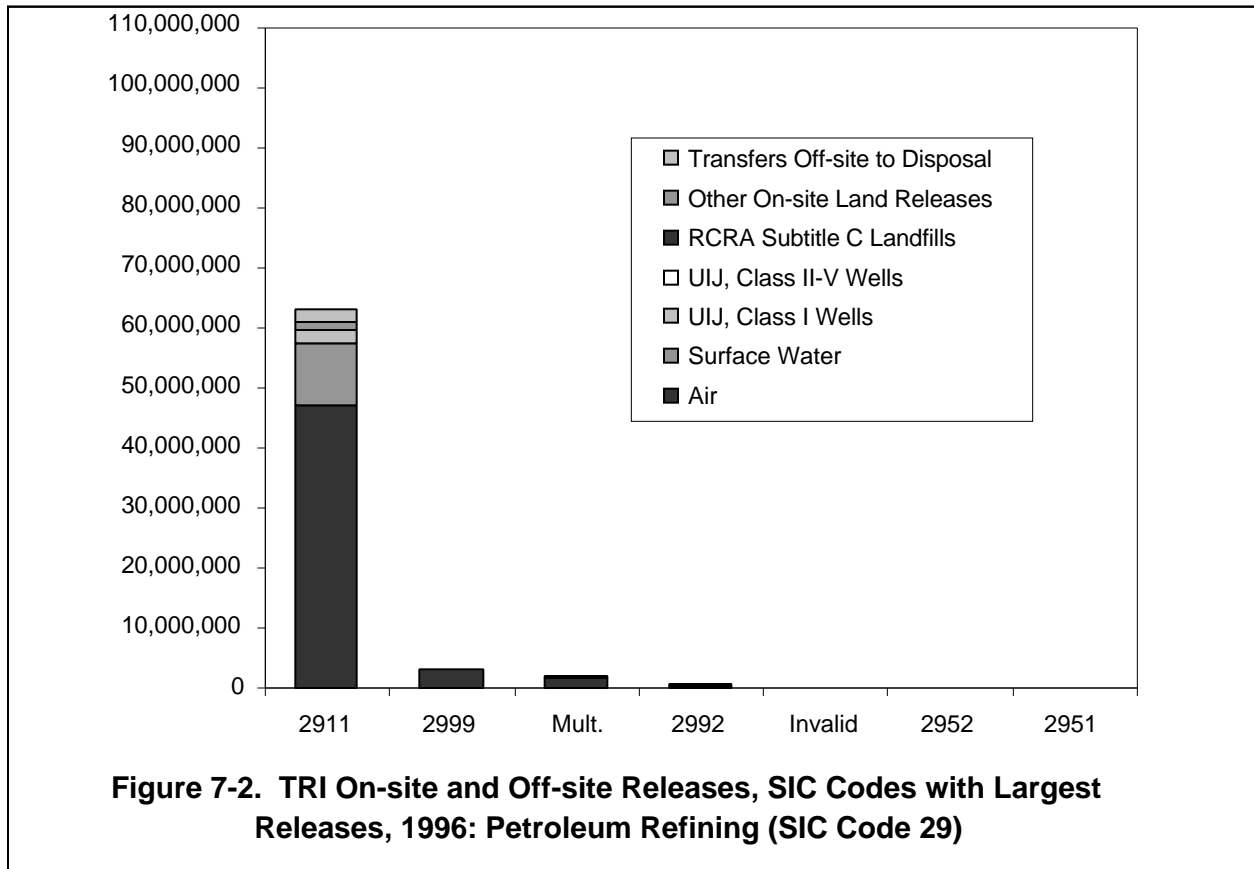
### Other On-site Waste Management

Table 7-4 and Figure 7-3 summarize other on-site waste management. Treatment was the largest category, with 1.31 billion pounds, 63.3% of the total. Refineries (SIC code 2911) reported 99.2% of total on-site waste management (2.05 billion pounds). On-site waste management has by far the largest role in this sector’s handling of TRI chemicals.

Figure 7-4 illustrates on-site waste management reporting for petroleum industries.



Note: **On-site Releases** from Section 5 of Form R. **Off-site Releases** from Section 6 (off-site transfers to disposal) of Form R. **UIJ** = underground injection.



**Figure 7-2. TRI On-site and Off-site Releases, SIC Codes with Largest Releases, 1996: Petroleum Refining (SIC Code 29)**

**Note:** On-site Releases from Section 5 of Form R. Off-site Releases from Section 6 (off-site transfersto disposal) of Form R. Forms with more than one 4-digit SIC code within SIC code 29 are assigned to the “multiple” category. UIJ = underground injection. Invalid SIC codes are codes beginning “29” that do not exist in the current Standard Industrial Classification code system.

**Table 7- 4. TRI Other On-site Waste Management, 1996: Petroleum Refining, SIC Code 29 (in Rank Order)**

SIC Code	Industry	Recycled On-site Pounds	Energy Recovery On-site Pounds	Treated On-site Pounds	Total Other On-site Waste Management Pounds
2911	Petroleum Refining	148,364,971	603,132,858	1,294,372,631	2,045,870,460
	Multiple within SIC 29	645,727	0	8,511,398	9,157,125
2992	Lubricating Oils & Greases	4,178,041	103,934	632,604	4,914,579
2999	Petroleum & Coal Products, nec*	4,600	364,600	2,015,128	2,384,328
2952	Asphalt Felts & Coatings	151,088	0	0	151,088
	Invalid SIC Code within SIC 29	56,000	0	0	56,000
2951	Asphalt Paving Mixtures & Blocks	109	0	1,765	1,874
	Total for SIC Code 29	153,400,536	603,601,392	1,305,533,526	2,062,535,454

**Note:** Other On-site Waste Management from Section 8 of Form R. Forms with more than one 4-digit SIC code within SIC code 29 are assigned to the “multiple” category. Invalid SIC codes are codes beginning “29” that do not exist in the current Standard Industrial Classification code system.  
\*nec: not elsewhere classified.

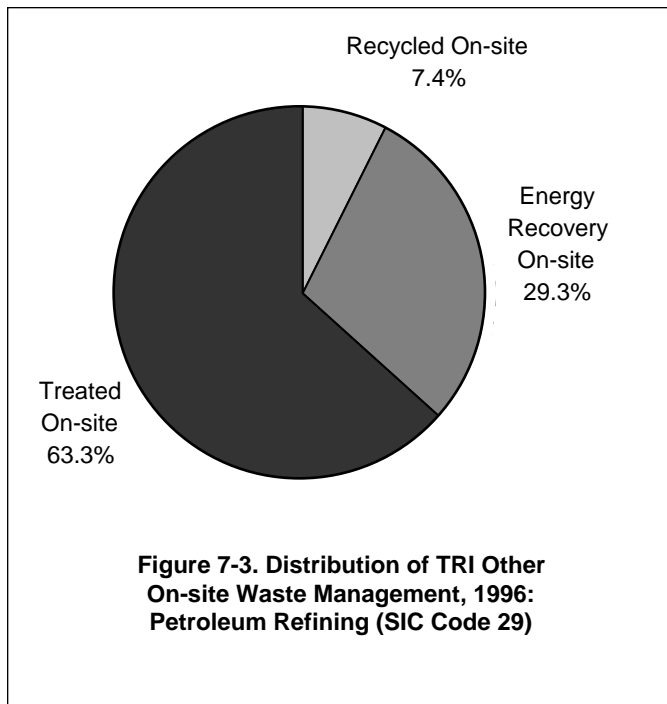


## Transfers Off-site for Further Waste Management

Lubricating oils and greases (SIC code 2992) reported the largest transfers off-site for further waste management, 15.3 million pounds, as shown in Table 7-5. Refineries (SIC code 2911) were second with 10.6 million. The two industries together accounted for 98.8% of the total.

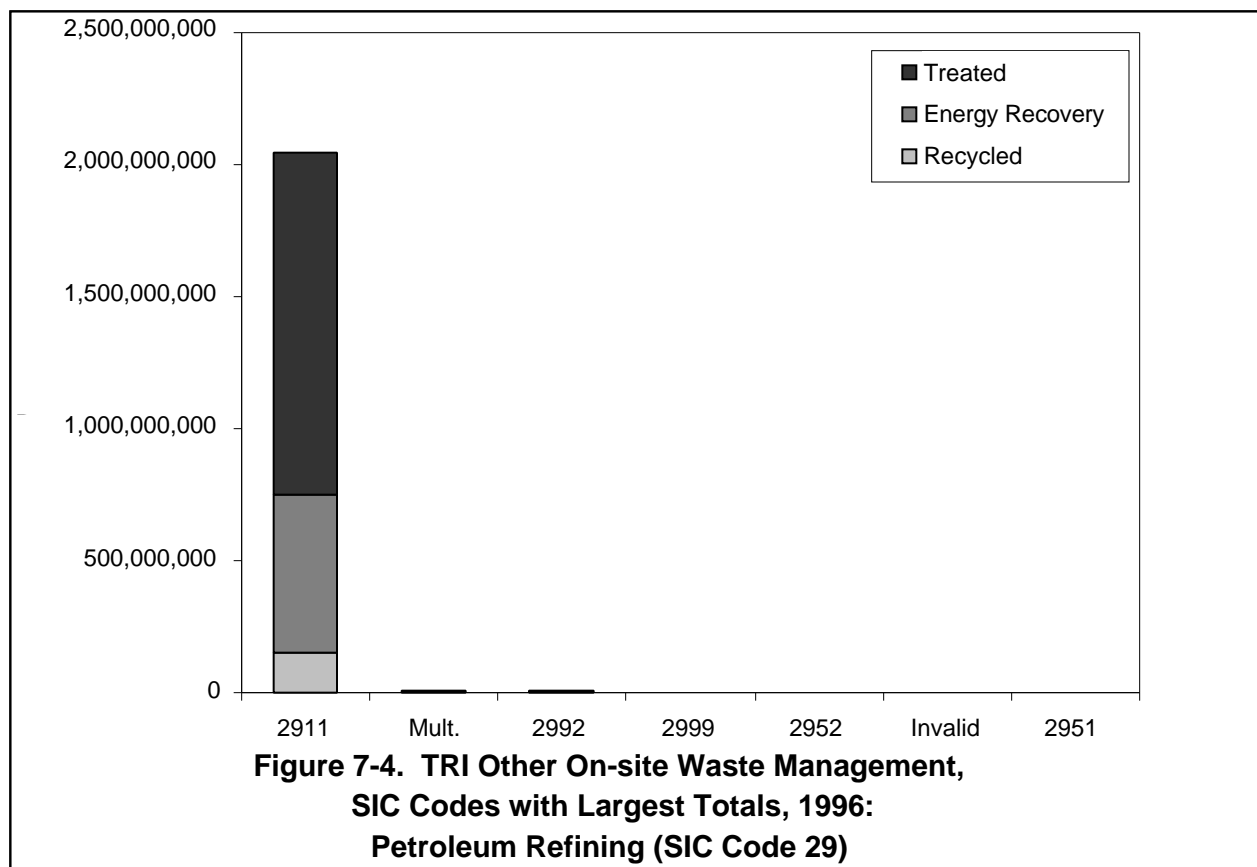
Figure 7-5 shows transfers off-site for further waste management by category of waste-management method. Recycling was the largest category with 18.6 million pounds reported, 71.0% of the total.

Figure 7-6 shows the off-site transfer data by four-digit SIC code.



**Figure 7-3. Distribution of TRI Other On-site Waste Management, 1996: Petroleum Refining (SIC Code 29)**

Note: Data from Section 8 of Form R.



**Figure 7-4. TRI Other On-site Waste Management, SIC Codes with Largest Totals, 1996: Petroleum Refining (SIC Code 29)**

Note: Other On-site Waste Management from Section 8 of Form R. Forms with more than one 4-digit SIC code within SIC Code 29 are assigned to the "multiple" category. Invalid SIC codes are codes beginning "29" that do not exist in the current Standard Industrial Classification code system.



Table 7-5. TRI Transfers Off-site for Further Waste Management, 1996: Petroleum Refining, SIC Code 29 (in Rank Order)

SIC Code	Industry	Transfers to Recycling Pounds	Transfers to Energy Recovery Pounds	Transfers to Treatment Pounds	Transfers to POTWs Pounds	Other Off-site Transfers Pounds	Total Off-site Transfers for Further Waste Management Pounds
2992	Lubricating Oils & Greases	14,184,602	415,767	57,587	602,154	0	15,260,110
2911	Petroleum Refining	4,212,448	239,672	1,958,367	4,176,916	1	10,587,404
	Multiple within SIC 29	112,180	39	53,737	1,109	0	167,065
2999	Petroleum & Coal Products, nec*	35,902	1,593	72,250	0	0	109,745
2952	Asphalt Felts & Coatings	8,195	0	0	7,955	0	16,150
	Invalid SIC Code within SIC 29	0	0	8,310	0	0	8,310
2951	Asphalt Paving Mixtures & Blocks	0	0	0	0	0	0
	Total for SIC Code 29	18,553,327	657,071	2,150,251	4,788,134	1	26,148,784

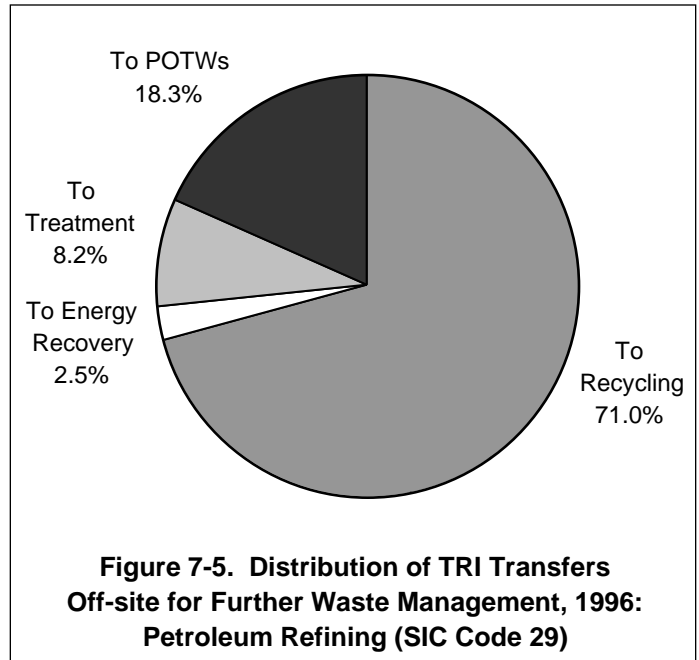
Note: Off-site Transfers for Further Waste Management from Section 6 (excluding off-site transfers to disposal) of Form R. Other Off-site Transfers reported without valid waste management code. Forms with more than one 4-digit SIC code within SIC code 29 are assigned to the “multiple” category.

\*nec: not elsewhere classified.

## 1996 TRI Data by State for Petroleum Refining

Petroleum refining industries are primarily located near sources of crude oil (either oil and gas fields or onshore petroleum terminals) or near consumers of petroleum products (heavily industrialized areas). Three states, Texas, Louisiana, and California, were home to 42% of U.S. refineries and were also responsible for 53% of the crude distillation capacity in 1994. These three states accounted for 28.9% of the facilities reporting to TRI and 40.9% of the TRI forms submitted in SIC code 29 in 1996.

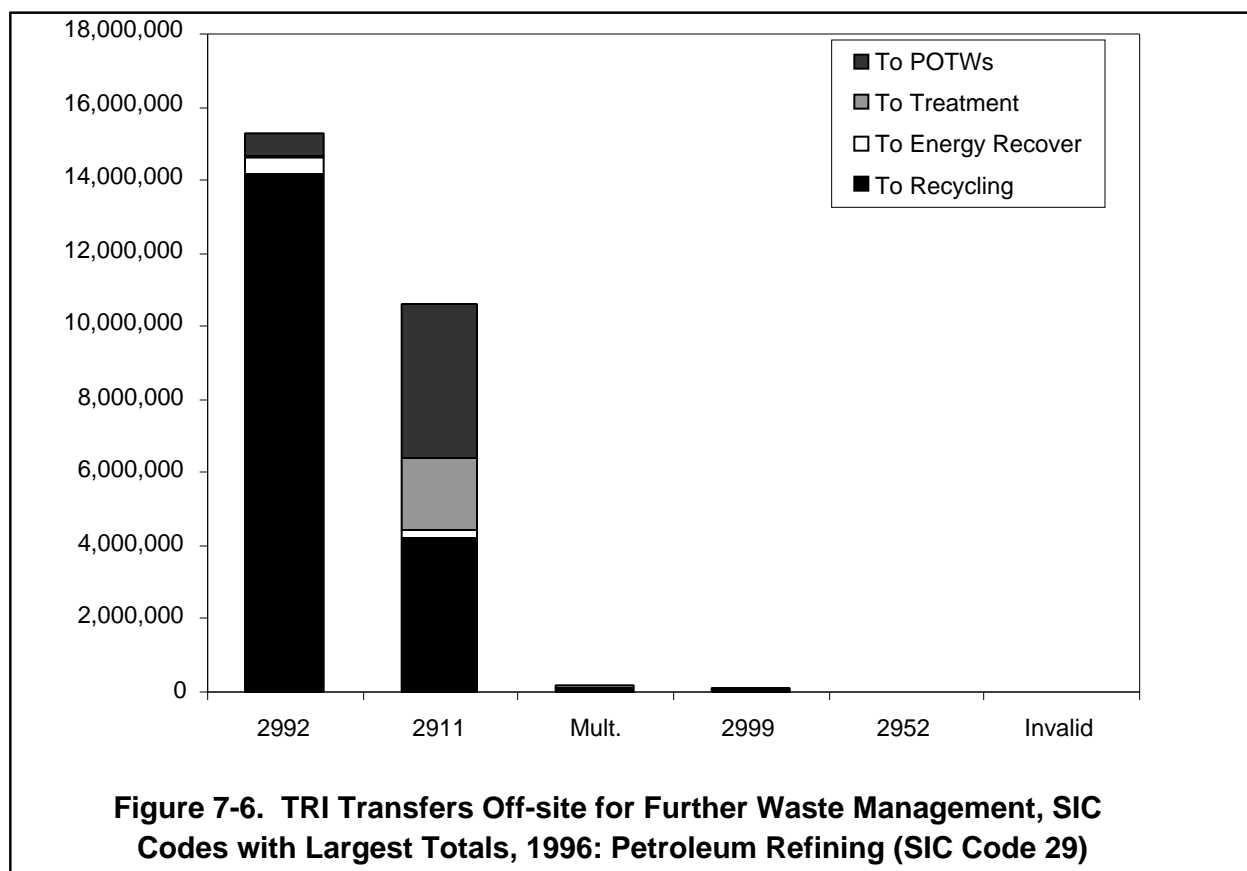
Texas reported the largest total on- and off-site releases (21.4 million pounds) and California had the second largest total (11.8 million pounds). These states also ranked first and second for both on-site releases and off-site releases (transfers to disposal). California reported the largest quantities



Note: Transfers Off-site for Further Waste Management from Section 6 (excluding transfers off-site to disposal) of Form R.

of other on-site waste management, with 1.03 billion pounds, and total production-related waste,





**Note: Off-site Transfers for Further Waste Management** from Section 6 (excluding off-site transfers to disposal) of Form R. Forms with more than one 4-digit SIC code within SIC code 20 are assigned to the “multiple” category. Invalid SIC codes are codes beginning “29” that do not exist in the current Standard Industrial Classification code system.

with 1.04 billion pounds. New Jersey was second in both categories, with 331.9 million pounds in other on-site waste management and 333.8 million pounds in total production-related waste. Indiana reported the largest transfers off-site for further waste management with 12.7 million pounds, followed by California with 4.7 million pounds.

Table 7-6 presents 1996 TRI data for the petroleum sector in all states and territories. Map 7-1 illustrates the geographic distribution of on- and off-site releases reported in this sector.

## 1996 TRI Data by Chemical for Petroleum Refining

Nitrate compounds (9.3 million pounds) and ammonia (9.0 million pounds) were the two chemicals with the largest on- and off-site releases for petroleum refining. These were followed by toluene, methanol, and n-hexane with 7.7 million, 5.4 million, and 5.1 million pounds, respectively (see Table 7-7).



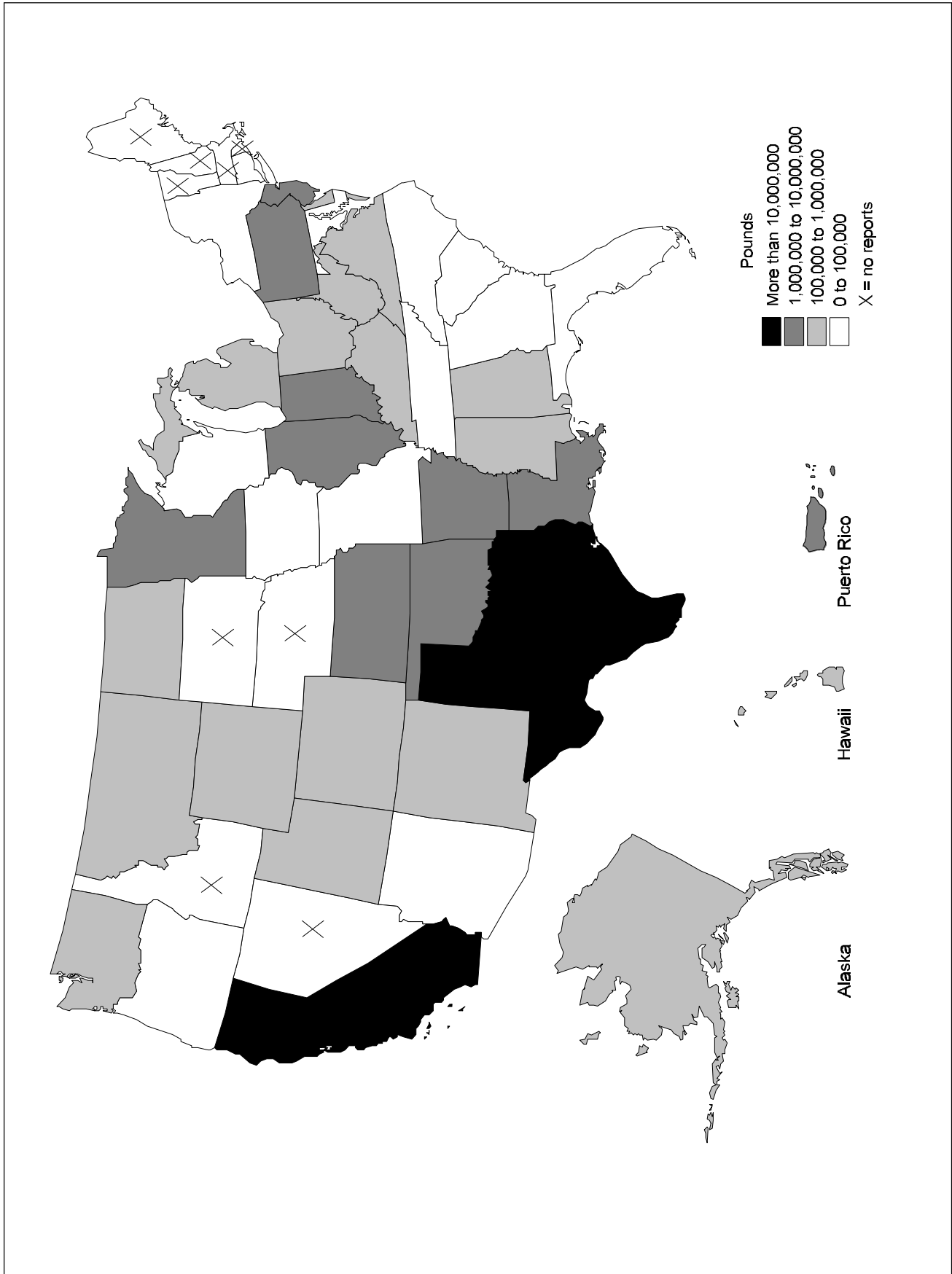
Table 7-6. Summary of TRI Information by State, 1996: Petroleum Refining, SIC Code 29

State	Total Facilities Number	Total Forms Number	Form As Number	Total On-site Releases Pounds	Total Off-site Releases Pounds	Total On- and Off-site Releases Pounds	Total Other On-site Waste Management Pounds	Total Transfers Off-site for Further Waste Management Pounds	Total Production-related Waste Pounds	Non-Production-related Waste Pounds
Alabama	10	41	2	461,060	45	461,105	33,621	508,463	1,008,212	0
Alaska	4	22	3	313,501	0	313,501	147,120	22,240	475,429	6,257
Arizona	5	15	1	10,340	206	10,546	2,933	0	13,480	0
Arkansas	5	31	1	1,328,776	190	1,328,966	1,025,540	92,965	2,448,730	0
California	48	459	38	11,402,869	441,261	11,844,130	1,028,481,664	4,745,047	1,044,581,141	222,820
Colorado	5	39	1	216,155	211,832	427,987	10,383,840	3,792	10,853,473	0
Connecticut	1	1	0	250	0	250	0	1,295	1,794	0
Delaware	2	21	5	162,642	0	162,642	279,600	12,134	428,375	26,000
Florida	10	20	4	4,119	285	4,404	60,252	55,800	64,671	0
Georgia	9	27	7	29,507	1,094	30,601	101,127	8,000	140,195	0
Hawaii	2	30	3	312,207	1,774	313,981	3,527,837	4,554	3,837,689	20
Illinois	29	184	16	2,867,425	125,326	2,992,751	46,227,495	456,035	49,669,653	2,162
Indiana	13	81	11	1,017,661	255,251	1,272,912	8,943,010	12,651,801	22,840,039	10,069
Iowa	4	10	2	1,255	0	1,255	0	0	706	0
Kansas	11	81	9	3,386,540	584	3,387,124	35,710,390	167,722	39,216,245	352
Kentucky	2	44	5	533,772	126,408	660,180	13,672,504	17,066	14,346,645	28,806
Louisiana	24	249	7	6,435,946	286,833	6,722,779	73,801,504	669,201	81,059,845	45,089
Maryland	4	6	2	100	750	850	5,600	250	6,040	0
Massachusetts	2	3	2	0	0	0	0	0	0	0
Michigan	12	62	18	225,621	1,437	227,058	51,150,941	315,487	51,709,072	0
Minnesota	5	57	1	1,118,882	54,220	1,173,102	2,414,518	301,838	3,882,433	0
Mississippi	5	10	4	433,250	0	433,250	33,300	0	421,810	300
Missouri	7	25	4	31,825	4,191	36,016	1,465	11,597	46,171	3
Montana	4	69	1	549,506	15,068	564,574	4,649,688	25,708	5,226,784	10,438
New Jersey	16	126	6	2,751,607	57,469	2,809,076	331,915,837	238,431	333,819,747	90,516
New Mexico	4	51	0	925,060	9,500	934,560	35,993,442	8,374	36,932,410	0
New York	5	14	1	416	175	591	2,498	500,300	502,893	0
North Carolina	6	8	4	1,000	4,501	5,501	106	14,197	15,234	0
North Dakota	1	19	0	345,861	408	346,269	1,275,107	925	1,628,787	0
Ohio	21	111	14	653,842	142,741	796,583	28,082,916	279,947	29,156,543	90
Oklahoma	8	101	8	1,335,910	29,692	1,365,602	56,875,229	193,760	58,413,984	0
Oregon	4	14	1	66,184	1	66,185	2,452	1,621	70,026	0
Pennsylvania	24	155	18	3,298,360	148,555	3,446,915	8,522,028	647,299	12,600,769	10,877
Puerto Rico	8	47	0	1,122,606	14,629	1,137,235	700,211	11,021	1,617,169	3,250
South Carolina	5	13	4	808	226	1,034	3,202	719	4,949	0
Tennessee	2	23	2	49,585	1,555	51,140	28,292,915	166,693	28,508,998	0
Texas	44	614	20	20,751,077	672,007	21,423,084	154,090,426	3,133,283	178,610,982	1,323,213
Utah	5	74	3	289,269	20,980	310,249	100,974,221	151,247	101,445,137	306
Virgin Islands	1	24	0	1,506,131	8	1,506,139	10,959,652	479,203	12,944,993	0
Virginia	2	26	2	330,713	47	330,760	3,007,030	1,680	3,339,189	30
Washington	8	104	5	930,421	0	930,421	15,895,630	246,843	17,067,241	2,875
West Virginia	2	12	3	181,785	0	181,785	619,930	500	803,244	0
Wisconsin	5	23	3	82,676	0	82,676	0	1,531	84,225	0
Wyoming	7	85	0	763,307	28,182	791,489	4,668,673	215	5,456,207	2,984
Total for SIC Code 29	401	3,231	241	66,229,827	2,657,431	68,887,258	2,062,535,454	26,148,784	2,155,301,359	1,786,457

**Note:** On-site Releases from Section 5 of Form R. On-site Waste Management from Section 8 of Form R. Off-site Releases from Section 6 (transfers off-site to disposal) of Form R. Total Transfers Off-site for Further Waste Management from Section 6 (excluding transfers off-site to disposal) of Form R. Total Production-related Waste sums Section 8 (Current Year, Column B) of Form R, except: Non-production-related Waste (remedial/catastrophic incidents).



Map 7-1. Total On- and Off-site Releases, 1996: Petroleum Refining, SIC Code 29



Note: On-site Releases from Section 5 of Form R and Off-site Releases from Section 6 (transfers off-site to disposal) of Form R.



**Table 7-7. The 15 Chemicals with the Largest Total On-site and Off-site Releases, 1996: Petroleum Refining, SIC Code 29 (in Rank Order)**

CAS Number	Industry	Total Air Emissions Pounds	Surface Water Discharges Pounds	Underground Injection		On-site Land Releases		Total On-site Releases Pounds	Off-site Releases Transfers to Disposal Pounds	Total On- & Off-site Releases Pounds
				Class I Wells Pounds	Class II-V Wells Pounds	RCRA Subtitle C Landfills Pounds	Other On-site Land Releases Pounds			
	Nitrate compounds	0	9,257,747	0	0	0	22,298	9,280,045	0	9,280,045
7664-41-7	Ammonia	6,775,446	697,412	1,323,520	4,154	0	7,953	8,808,485	203,062	9,011,547
108-88-3	Toluene	7,092,393	37,706	171,612	500	250	351,233	7,653,694	86,341	7,740,035
67-56-1	Methanol	5,205,244	42,317	144,430	0	0	150	5,392,141	81	5,392,222
110-54-3	n-Hexane	4,885,511	153,256	7,208	0	250	9,444	5,055,669	16,831	5,072,500
115-07-1	Propylene	4,302,329	7,050	0	0	0	1,338	4,310,717	387	4,311,104
78-93-3	Methyl ethyl ketone	4,270,000	6,192	19,000	0	0	5	4,295,197	1,145	4,296,342
1330-20-7	Xylene (mixed isomers)	3,864,532	18,700	32,551	500	0	23,300	3,939,583	127,345	4,066,928
71-43-2	Benzene	2,730,100	21,155	179,403	500	5	42,452	2,973,615	43,769	3,017,384
1634-04-4	Methyl tert-butyl ether	2,323,386	101,444	161,550	750	0	26,566	2,613,696	63	2,613,759
74-85-1	Ethylene	1,944,681	2,927	0	0	0	280	1,947,888	92	1,947,980
7647-01-0	Hydrochloric acid	1,433,392	0	0	0	0	0	1,433,392	0	1,433,392
110-82-7	Cyclohexane	1,241,794	7,961	4,862	0	5	5,423	1,260,045	5,796	1,265,841
100-41-4	Ethylbenzene	932,247	3,797	4,299	250	5	56,505	997,103	27,665	1,024,768
95-63-6	1,2,4-Trimethylbenzene	659,083	2,966	1,270	0	5	9,261	672,585	47,663	720,248
	Subtotal	47,660,138	10,360,630	2,049,705	6,654	520	556,208	60,633,855	560,240	61,194,095
	Total for SIC Code 29	52,101,079	10,567,225	2,310,233	8,664	5,685	1,236,941	66,229,827	2,657,431	68,887,258

**Note:** On-site Releases from Section 5 of Form R. Off-site Releases from Section 6 (off-site transfers to disposal) of Form R.

Reporting of discharges to surface water was dominated by nitrate compounds (87.6% of the sector's total in this category). Ammonia, toluene, and methanol totaled over 5 million pounds each in emissions to air, the medium with the largest releases, and they accounted for 36.6% of total air emissions in this sector. Underground injection was 1.3 million pounds for ammonia, nearly all of it in Class I wells.

## OSHA Carcinogens

Petroleum refining releases of chemicals designated as OSHA carcinogens totaled 4.2 million pounds in 1996, as shown in Table 7-8. (OSHA Carcinogens and the bases for their designation appear in Box 2-4 in Chapter 2). The large majority (3.2 million pounds) was released to air.

One of the top 15 chemicals for total on- and off-site releases, benzene, is an OSHA carcinogen. It accounted for 3.0 million pounds of on- and off-site releases, including 2.7 million pounds of air emissions. No other OSHA carcinogen was reported in such a large amount in this sector. The next largest total release of an OSHA carcinogen in the petroleum refining sector was nickel compounds with 327,000 pounds, followed by asbestos with 291,000 pounds.

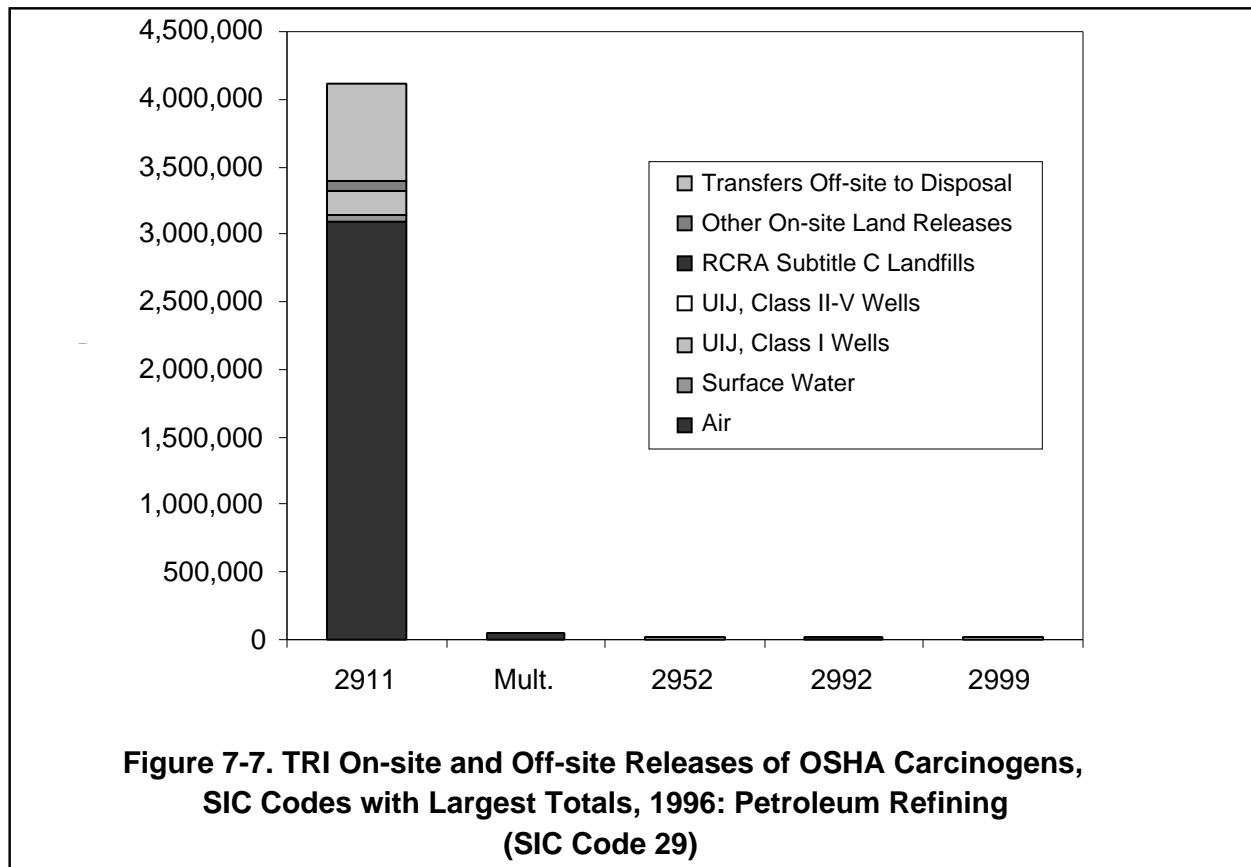
Refineries (SIC code 2911) reported 97.9% of the air emissions of OSHA carcinogens reported in this sector. Figure 7-7 shows the on- and off-site releases of OSHA carcinogens for the four-digit SIC codes in the petroleum sector.



**Table 7-8. TRI On-site and Off-site Releases of OSHA Carcinogens by 4-digit SIC Code, 1996: Petroleum Refining, SIC Code 29 (in Rank Order)**

SIC Code	Industry	Total Air Emissions Pounds	Surface Water Discharges Pounds	Underground Injection		On-site Land Releases		Total On-site Releases Pounds	Off-site Releases Transfers Off-site to Disposal Pounds	Total On- & Off-site Releases Pounds
				Class I Wells Pounds	Class II-V Wells Pounds	RCRA Subtitle C Landfills Pounds	Other On-site Land Releases Pounds			
2911	Petroleum Refining	3,100,498	30,811	179,403	750	3,605	70,966	3,386,033	729,822	4,115,855
	Multiple within SIC 29	40,034	654	0	0	0	167	40,855	732	41,587
2952	Asphalt Felts & Coatings	5,424	0	0	0	0	0	5,424	4,156	9,580
2992	Lubricating Oils & Greases	8,427	0	0	0	0	0	8,427	245	8,672
2999	Petroleum & Coal Products, nec*	5,504	0	0	0	0	0	5,504	2,500	8,004
	Invalid SIC Code within SIC 29	6,300	0	0	0	0	0	6,300	0	6,300
	Subtotal	3,166,187	31,465	179,403	750	3,605	71,133	3,452,543	737,455	4,189,998
	Total for SIC Code 29	52,101,079	10,567,225	2,310,233	8,664	5,685	1,236,941	66,229,827	2,657,431	68,887,258

**Note:** On-site Releases from Section 5 of Form R. Off-site Releases from Section 6 (off-site transfers to disposal) of Form R. Forms with more than one 4-digit SIC code within SIC code 29 are assigned to the “multiple” category.  
 \*nec: not elsewhere classified.



**Figure 7-7. TRI On-site and Off-site Releases of OSHA Carcinogens, SIC Codes with Largest Totals, 1996: Petroleum Refining (SIC Code 29)**

**Note:** On-site Releases from Section 5 of Form R. Off-site Releases from Section 6 (off-site transfers to disposal) of Form R. Forms with more than one 4-digit SIC code within SIC code 29 are assigned to the “multiple” category. UIJ = underground injection.



**Table 7-9. Quantities of TRI Chemicals in Waste by 4-digit SIC Code, 1996: Petroleum Refining, SIC Code 29 (in Rank Order)**

SIC Code	Industry	Recycled On-site Pounds	Energy Recovery On-site Pounds	Treated On-site Pounds	Recycled Off-site Pounds	Energy Recovery Off-site Pounds	Treated Off-site Pounds	Quantity Released On- and Off-site Pounds	Total Production-related Waste Pounds	Non-Production-related Waste Pounds
2911	Petroleum Refining	148,364,971	603,132,858	1,294,372,631	4,179,325	245,436	5,982,505	61,078,881	2,117,356,607	1,786,042
2992	Lubricating Oils & Greases	4,178,041	103,934	632,604	14,167,093	412,381	688,754	721,911	20,904,718	256
	Multiple within SIC 29	645,727	0	8,511,398	112,208	39	55,311	1,963,435	11,288,118	0
2999	Petroleum & Coal Products, nec*	4,600	364,600	2,015,128	35,900	2,393	72,245	2,862,657	5,357,523	159
2952	Asphalt Felts & Coatings	151,088	0	0	8,441	0	7,306	73,240	240,075	0
	Invalid SIC Code within SIC 29	56,000	0	0	0	0	8,310	83,300	147,610	0
2951	Asphalt Paving Mixtures & Blocks	109	0	1,765	0	0	19	4,815	6,708	0
	Total for SIC Code 29	153,400,536	603,601,392	1,305,533,526	18,502,967	660,249	6,814,450	66,788,239	2,155,301,359	1,786,457

**Note:** Data from Section 8 of Form R. Forms with more than one 4-digit SIC code within SIC code 29 are assigned to the “multiple” category.

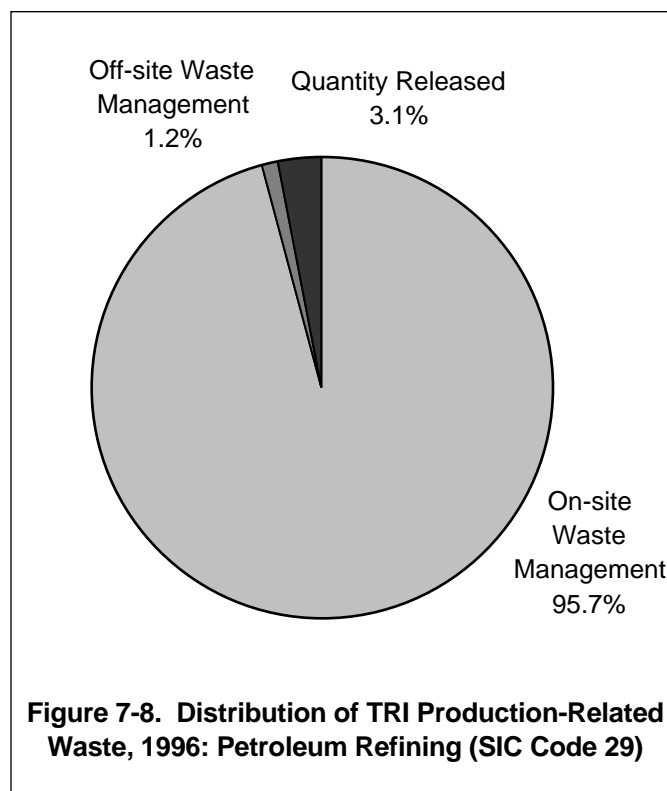
\*nec: not elsewhere classified.

## 1996 TRI Chemicals in Waste for Petroleum Refining

The petroleum refining sector reported a total of 2.16 billion pounds of TRI chemicals in production-related waste for 1996, as shown in Table 7-9 and Figure 7-8. On-site treatment amounted to 1.31 billion pounds, or 60.6% of total production-related waste. On-site energy recovery was next with 603.6 million pounds, or 28.0%.

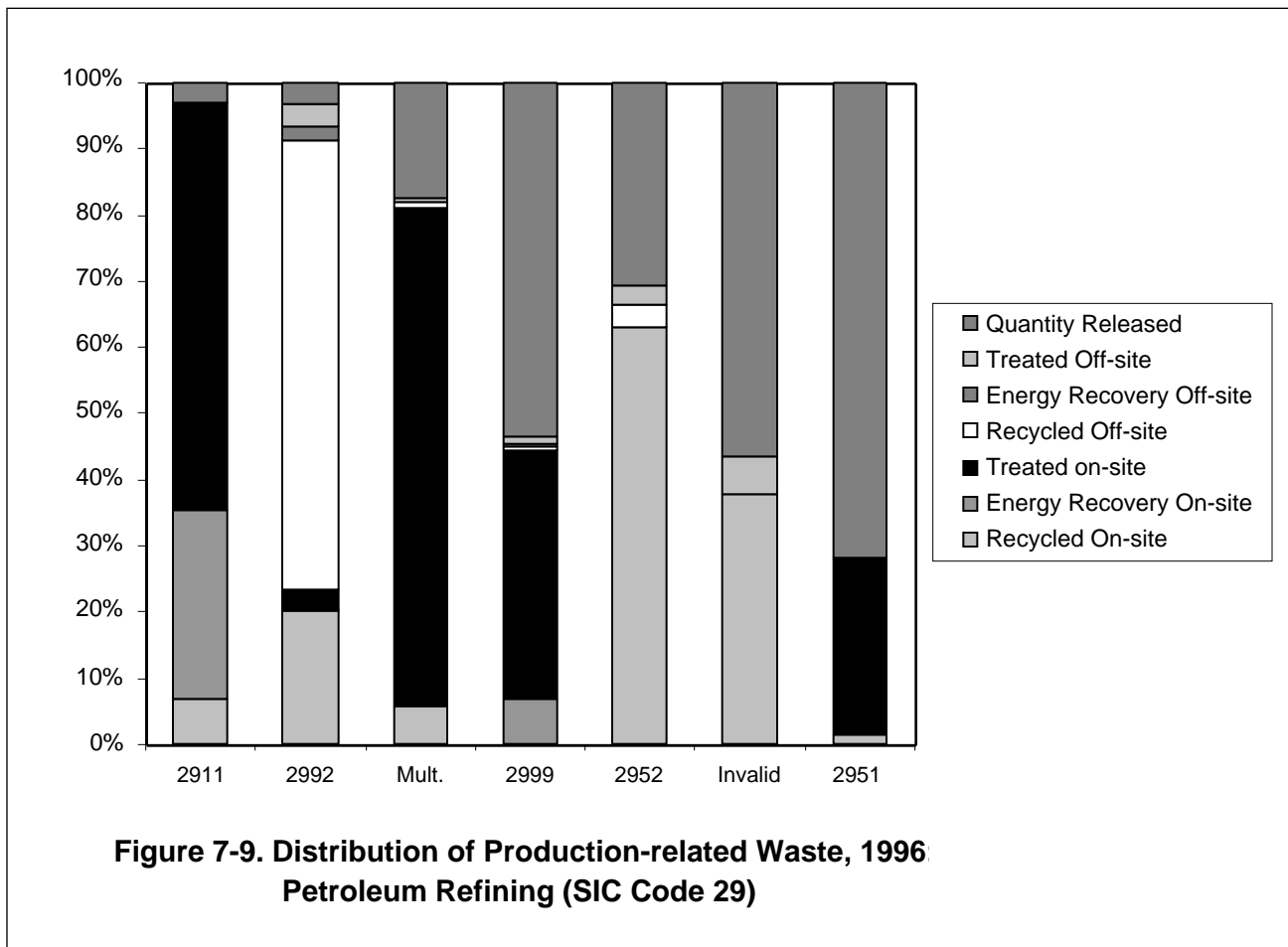
Refineries (SIC code 2911) topped the list in all production-related waste categories except one, off-site recycling. In that category, lubricating oils and greases (SIC code 2992) reported the largest quantity, 14.2 million pounds. Refineries (SIC code 2911) reported 148.4 million pounds in on-site recycling, 603.1 million pounds in on-site energy recovery, 1.29 billion pounds in on-site treatment, 4.2 million pounds in off-site recycling, 245,000 pounds in off-site energy recovery, 6.0 million pounds in off-site treatment, and 61.1 million pounds in quantities released on- and off-site.

Refineries accounted for 98.2% of all SIC code 29 chemicals reported in waste. Distribution of production-related waste for SIC code 29 industries appear in Figure 7-9.



**Figure 7-8. Distribution of TRI Production-Related Waste, 1996: Petroleum Refining (SIC Code 29)**

**Note:** Data from Section 8 of Form R.



**Note:** Data from Section 8 of Form R. Forms with more than one 4-digit SIC code within SIC code 29 are assigned to the “multiple” category. Invalid SIC codes are codes beginning “29” that do not exist in the current Standard Industrial Classification code system.

## Projected Quantities of TRI Chemicals in Waste

Table 7-10 and Figure 7-10 summarize the petroleum refining sector’s projections for on- and off-site waste management through 1998. (As explained in Chapter 2, facilities not only report current data but project waste management quantities for the next two years in their TRI submissions.) Total production-related waste is not projected to change by much—a small decrease for 1996 to 1997 and a small increase for 1997 to 1998—because its largest component (on-site treatment) is projected to decrease by just 1.3% and

its second largest component (on-site energy recovery) is projected to increase by 3.5%.

Two categories of off-site waste management are projected to decrease significantly: energy recovery by 15.5% and treatment by 32.2%. In both cases, the greatest change is projected for the first year, 1996-1997. The quantity released on- and off-site is expected to decrease by 4.9% between 1996 and 1998.

Overall, between 1996 and 1998, the projected change in production-related waste is quite small, less than 0.01%. On-site treatment is expected to remain the prevalent waste management method in this sector, representing 60.6% of total production-

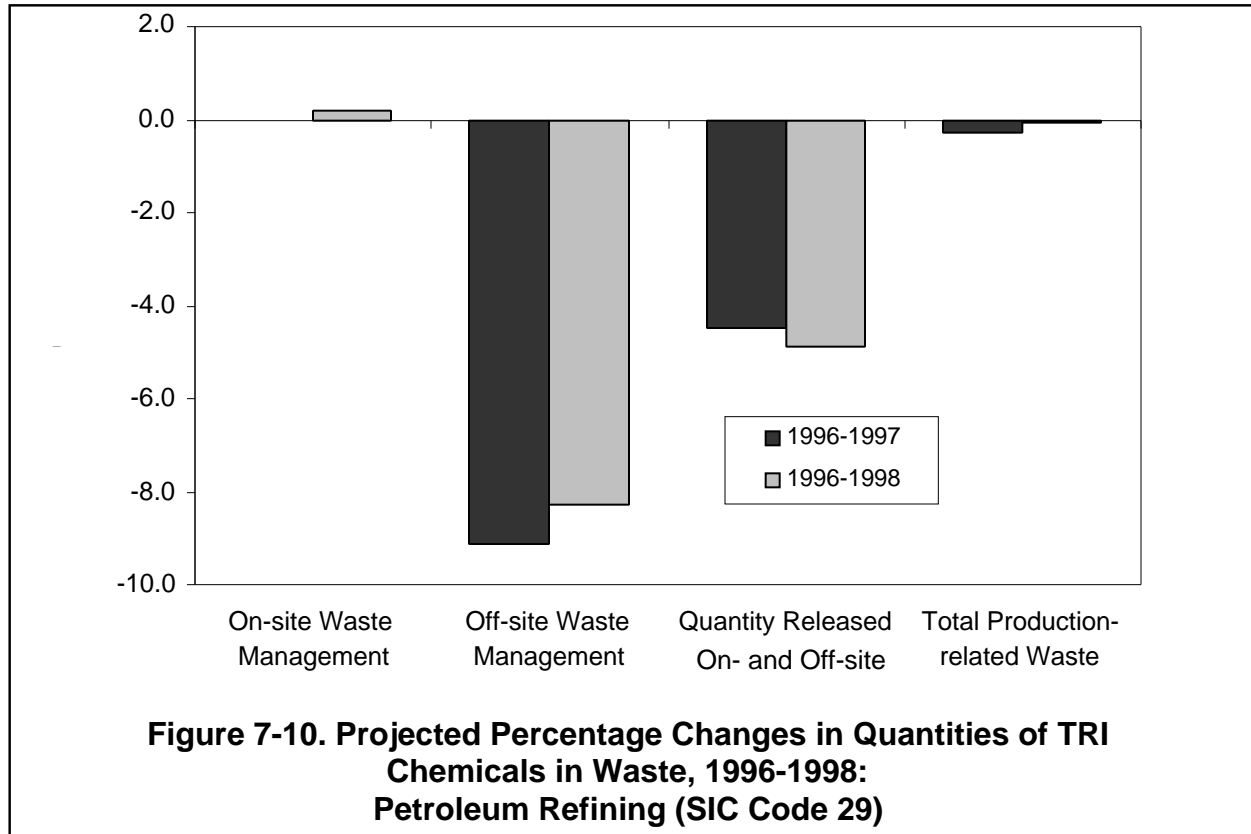


**Table 7-10. Current Year and Projected Quantities of TRI Chemicals in Waste, 1996-1998: Petroleum Refining, SIC Code 29**

Waste Management Activity	<u>Current Year 1996</u>		<u>Projected 1997</u>		<u>Projected 1998</u>	
	Total Pounds	Percent of Total	Total Pounds	Percent of Total	Total Pounds	Percent of Total
<u>On-site Waste Management</u>						
Recycled On-site	153,400,536	7.1	152,902,846	7.1	153,044,029	7.1
Energy Recovery On-site	603,601,392	28.0	619,232,516	28.8	624,678,006	29.0
Treated On-site	1,305,533,526	60.6	1,289,721,204	60.0	1,289,190,556	59.8
<u>Off-site Waste Management</u>						
Recycled Off-site	18,502,967	0.9	18,371,699	0.9	18,647,223	0.9
Energy Recovery Off-site	660,249	0.0	543,337	0.0	557,708	0.0
Treated Off-site	6,814,450	0.3	4,684,602	0.2	4,622,140	0.2
Quantity Released On- and Off-site	66,788,239	3.1	63,800,506	3.0	63,516,964	2.9
Total Production-related Waste for SIC Code 29	2,155,301,359	100.0	2,149,256,710	100.0	2,154,256,626	100.0
Waste Management Activity	<u>Projected Change 1996 - 1997</u>		<u>Projected Change 1997 - 1998</u>		<u>Projected Change 1996 - 1998</u>	
	Percent		Percent		Percent	
<u>On-site Waste Management</u>						
Recycled On-site	-0.3		0.1		-0.2	
Energy Recovery On-site	2.6		0.9		3.5	
Treated On-site	-1.2		-0.0		-1.3	
<u>Off-site Waste Management</u>						
Recycled Off-site	-0.7		1.5		0.8	
Energy Recovery Off-site	-17.7		2.6		-15.5	
Treated Off-site	-31.3		-1.3		-32.2	
Quantity Released On- and Off-site	-4.5		-0.4		-4.9	
Total Production-related Waste for SIC Code 29	-0.3		0.2		-0.0	

**Note:** Current year and projected year amounts are all taken from Section 8 of Form R for 1996.





Note: Current year and projected year amounts are all taken from Section 8 of Form R for 1996.

Table 7-11. Number of Forms Reporting Source Reduction Activity, 1996: Petroleum Refining, SIC Code 29

SIC Code	Industry	Forms Reporting Source Reduction Activities			Category of Source Reduction Activity							
		Total Forms Number	Form As Number	Percent of All Forms Percent	Good Operating Practices Number	Inventory Control Number	Spill and Leak Prevention Number	Raw Material Modifications Number	Process Modifications Number	Cleaning and Degreasing Number	Surface Preparation and Finishing Number	Product Modifications Number
2911	Petroleum Refining	2,582	530	20.5	150	10	339	4	170	4	-	1
2951	Asphalt Paving Mixtures & Blocks	16	1	6.3	1	-	1	-	-	-	-	-
2952	Asphalt Felts & Coatings	94	54	57.4	12	1	-	27	3	1	-	12
2992	Lubricating Oils & Greases	362	58	16.0	23	12	21	7	15	3	-	2
2999	Petroleum & Coal Products, nec*	80	5	6.3	2	-	2	1	2	1	-	-
	Multiple within SIC 29	93	18	19.4	2	-	17	1	-	-	-	-
	Invalid SIC Code within SIC 29	4	-	0.0	-	-	-	-	-	-	-	-
	Total for SIC Code 29	3,231	666	20.6	190	23	380	40	190	9	-	15

Note: Forms with more than one 4-digit SIC code within SIC code 20 are assigned to the "multiple" category.

\*nec: not elsewhere classified.



related waste in 1996 and a projected 59.8% in 1998.

## Source Reduction Activity

One-fifth (20.6%) of the TRI reporting forms submitted in this sector indicated at least one source reduction activity during 1996. Table 7-11 shows that refineries (SIC code 2911) submitted 530 of these (also one-fifth, 20.5%, of the forms in that four-digit SIC code). In the asphalt felts and coatings industry (SIC code 2952), 57.4% of the forms submitted reported source reduction activities in 1996.

Spill and leak prevention was the most commonly reported source reduction activity for the petroleum refining sector overall (SIC code 29) and for refineries (SIC code 2911). Few if any other sectors show this emphasis, which reflects the petroleum sector's dependence on moving and storing enormous quantities of crude oil and other petroleum products. Improvements in operating practices (the most common source reduction activity in most other sectors) was the next highest reported activity in this sector.

# Year-to-Year Comparisons for Petroleum Refining

## 1995-1996 TRI Data for Petroleum Refining

### On- and Off-site Releases

From 1995 to 1996, the number of TRI forms submitted with petroleum refining codes decreased by 1.0%, as shown in Table 7-12. The number of Form A certification statements, certifying that a chemical's annual reportable amount was less than

500 pounds for the year and that the facility did not manufacture, process, or otherwise use more than 1 million pounds, rose 11.1%. (The Form A certification statement is explained in Chapter 1.) This may reflect growing awareness of the Form A certification statement, which was introduced in reporting year 1995.

On- and off-site releases reported in the petroleum refining sector totaled 7.4% more (a 4.7-million-pound increase) in 1996 than in 1995. Several areas of on-site releases showed significant increases including a 242.5% increase in on-site land releases (from 363,000 pounds to 1.2 million pounds) and an 86.1% increase in surface water discharges (from 5.7 million pounds to 10.6 million pounds). Transfers off-site to disposal decreased by 484,000 pounds (15.4%). Figure 7-11 displays these changes.

### Other On-site Waste Management

Reporting by petroleum refining facilities of other on-site waste management, which also appears in Table 7-12, rose 97.3%, from 1.05 billion pounds in 1995 to 2.06 billion pounds in 1996. Every area of other on-site waste management increased with on-site treatment topping the list with a 268.4% rise (a 1.00-billion-pound increase). Almost all of the increase in on-site treatment is accounted for by a single facility, Chevron Products in Richmond, California, which reported 2.4 million pounds in 1995 and 942.6 million pounds in 1996, a 940.3-million-pound increase. This facility attributes much of its increase to improved estimation techniques, as described in the section on **Facilities with Large Increases and Decreases in Waste Management, 1991-1996**, later in this chapter.

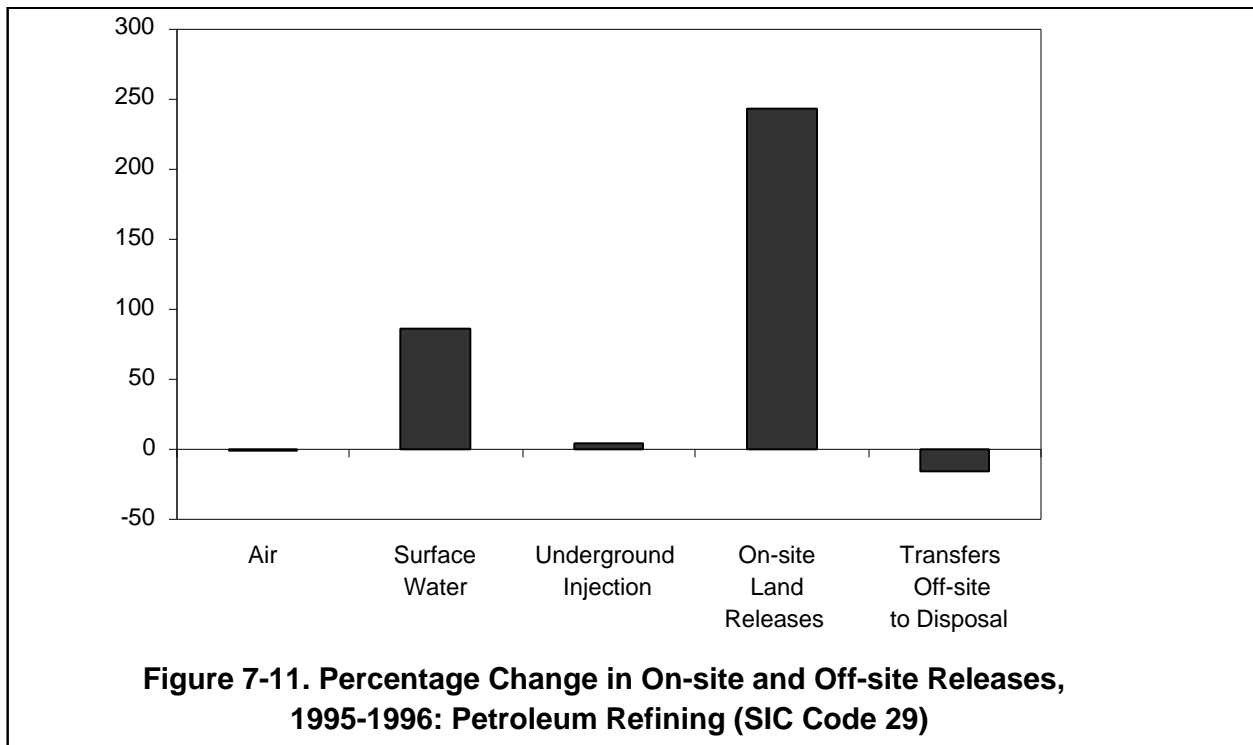
On-site recycling increased 24.1%, from 123.6 million pounds to 153.4 million pounds, and on-site energy recovery rose 6.4%, from 567.3 million pounds to 603.6 million pounds.



**Table 7-12. Comparison of TRI On-site and Off-site Releases, Other On-site Waste Management, and Transfers Off-site for Further Waste Management, 1995-1996: Petroleum Refining, SIC Code 29**

	1995 Number	1996 Number	Change 1995 to 1996 Percent
Total Facilities	401	401	0.0
Total Forms	3,262	3,231	-1.0
Form Rs	3,045	2,990	-1.8
Form As	217	241	11.1
	Pounds	Pounds	Percent
<u>On-site Releases</u>			
Total Air Emissions	52,742,051	52,101,079	-1.2
Fugitive Air	30,378,054	27,968,469	-7.9
Point Source Air	22,363,997	24,132,610	7.9
Surface Water Discharges	5,677,398	10,567,225	86.1
Underground Injection	2,217,653	2,318,897	4.6
On-site Land Releases	362,828	1,242,626	242.5
Total On-site Releases	60,999,930	66,229,827	8.6
<u>Off-site Releases</u>			
Transfers Off-site to Disposal	3,140,985	2,657,431	-15.4
Total On- and Off-site Releases	64,140,915	68,887,258	7.4
<u>Other On-site Waste Management</u>			
Recycled On-site	123,620,333	153,400,536	24.1
Energy Recovery On-site	567,256,295	603,601,392	6.4
Treated On-site	354,362,794	1,305,533,526	268.4
Total Other On-site Waste Management	1,045,239,422	2,062,535,454	97.3
<u>Transfers Off-site for Further Waste Management</u>			
Transfers to Recycling	22,993,456	18,553,327	-19.3
Transfers to Energy Recovery	552,946	657,071	18.8
Transfers to Treatment	1,067,905	2,150,251	101.4
Transfers to POTWs	4,926,872	4,788,134	-2.8
Other Off-site Transfers	0	1	—
Total Transfers Off-site for Further Waste Management	29,541,179	26,148,784	-11.5

**Note:** On-site Releases from Section 5 of Form R and Off-site Releases from Section 6 (transfers off-site to disposal) of Form R. Other On-site Waste Management from Section 8 of Form R. Transfers Off-site for Further Waste Management from Section 6 (excluding transfers off-site to disposal) of Form R. Breakdown of Underground Injection and On-site Land Releases not required in 1995. Other Off-site Transfers are transfers reported without a valid waste management code.



**Figure 7-11. Percentage Change in On-site and Off-site Releases, 1995-1996: Petroleum Refining (SIC Code 29)**

**Note:** On-site Releases from Section 5 of Form R and Off-site Releases from Section 6 (transfers off-site to disposal) of Form R. Breakdown of On-site Land Releases and Underground Injection not required in 1995.

### Transfers Off-site for Further Waste Management

Transfers to treatment doubled in the petroleum refining sector from 1995 to 1996 (a 101.4% increase, or 1.1 million pounds). Transfers to energy recovery increased 18.8% (104,000 pounds). Transfers to recycling and transfers to POTWs both decreased, 19.3% (4.4 million pounds) and 2.8% (139,000 pounds), respectively. Overall, transfers off-site for further waste management decreased 11.5%, due to the large decreases in recycling. These data are also shown in Table 7-12.

### **1988-1996 TRI Data for Petroleum Refining**

As explained in Chapter 3, comparisons from the 1988 TRI baseline year to the current year rely on the list of “core” TRI chemicals that were reportable, with the same reporting definition, in all

years. These multi-year comparisons also review only the data elements that were collected in all years, which excludes from this section any analysis that distinguishes RCRA subtitle C landfills from other land releases as well as analysis based on the types of underground injection wells. On-site waste management data and transfers off-site to recycling and to energy recovery have been collected only since 1991; these data are included, but cannot be compared across the full 1988-1996 period.

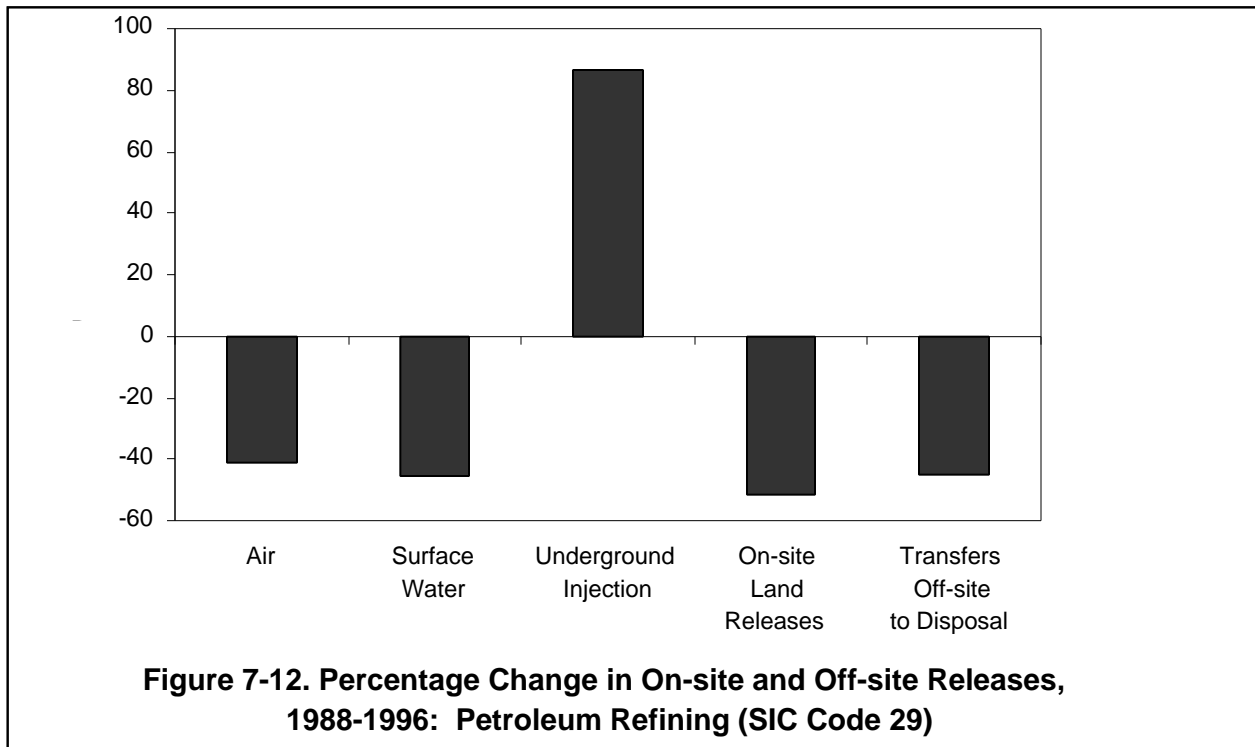
The number of forms reporting petroleum refining SIC codes dropped 2.3% from 1988 to 1996, as presented in Table 7-13. On- and off-site releases decreased by 40.8%, or 29.7 million pounds, and decreases occurred in all release media except underground injection, as shown in Figure 7-12. Underground injection increased 86.1%, from 528,000 pounds in 1988 to 982,000 pounds in 1996.



**Table 7-13. Comparison of TRI On-site and Off-site Releases, Other On-site Waste Management, and Transfers Off-site for Further Waste Management, 1988 and 1994-1996: Petroleum Refining, SIC Code 29**

	1988 Number	1994 Number	1995 Number	1996 Number	Change 1988 to 1996 Percent
Total Facilities	376	392	378	373	-0.8
Total Forms	2,814	2,853	2,790	2,748	-2.3
Form Rs	2,814	2,853	2,600	2,550	-9.4
Form As	NA	NA	190	198	NA
	Pounds	Pounds	Pounds	Pounds	Percent
<u>On-site Releases</u>					
Total Air Emissions	64,717,279	41,582,376	37,966,347	38,116,344	-41.1
Fugitive Air	47,881,163	29,028,190	25,525,376	23,418,914	-51.1
Point Source Air	16,836,116	12,554,186	12,440,971	14,697,430	-12.7
Surface Water Discharges	753,428	468,608	514,411	410,016	-45.6
Underground Injection	527,819	704,981	856,378	982,255	86.1
On-site Land Releases	2,455,013	648,650	189,625	1,181,829	-51.9
Total On-site Land Releases	68,453,539	43,404,615	39,526,761	40,690,444	-40.6
<u>Off-site Releases</u>					
Transfers Off-site to Disposal	4,327,282	3,472,485	3,066,557	2,386,208	-44.9
Total On- and Off-site Releases	72,780,821	46,877,100	42,593,318	43,076,652	-40.8
<u>Other On-site Waste Management</u>					
Recycled On-site	NA	112,965,582	115,528,019	84,154,943	NA
Energy Recovery On-site	NA	918,442,566	562,955,277	596,112,342	NA
Treated On-site	NA	167,926,607	257,045,269	1,064,485,499	NA
Other On-site Waste Management	NA	1,199,334,755	935,528,565	1,744,752,784	NA
<u>Transfers Off-site for Further Waste Management</u>					
Transfers to Recycling	NA	20,293,057	22,844,000	18,466,459	NA
Transfers to Energy Recovery	NA	1,392,657	542,664	633,417	NA
Transfers to Treatment	2,538,235	1,253,753	945,589	1,986,839	-21.7
Transfers to POTWs	6,087,311	3,356,885	3,976,605	4,312,823	-29.2
Other Off-site Transfers	906,249	0	0	1	-100.0
Total Transfers Off-site for Further Waste Management	NA	26,296,352	28,308,858	25,399,539	NA

**Note:** Does not include delisted chemicals, chemicals added in 1990, 1991, 1994, and 1995, and aluminum oxide, ammonia, hydrochloric acid, and sulfuric acid. **On-site Releases** from Section 5 of Form R and **Off-site Releases** from Section 6 (transfers off-site to disposal) of Form R. **Other On-site Waste Management** from Section 8 of Form R. **Transfers Off-site for Further Waste Management** from Section 6 (excluding transfers off-site to disposal) of Form R. Breakdown of Underground Injection and On-site Land Releases not required before 1996. For 1994-1996, Other Off-site Transfers are transfers reported without a valid waste management code. For 1988, Other Off-site Transfers are transfers reported without a valid waste management code or codes not required to be reported in 1988. **NA:** not required to be reported in that year.



**Figure 7-12. Percentage Change in On-site and Off-site Releases, 1988-1996: Petroleum Refining (SIC Code 29)**

**Note:** Does not include delisted chemicals, chemicals added in 1990, 1991, 1994, and 1995, and aluminum oxide, ammonia, hydrochloric acid, and sulfuric acid. **On-site Releases** from Section 5 of Form R and **Off-site Releases** from Section 6 (transfers off-site to disposal) of Form R. Breakdown of On-site Land Releases and Underground Injection not required before 1996.

Fugitive air emissions made up the majority of the decreases, dropping from 47.9 million pounds to 23.4 million pounds, a 51.1% reduction. Point source air emissions decreased 2.1 million pounds between 1988 and 1996, a 12.7% reduction, and surface water discharges decreased by 343,000 pounds, a 45.6% decrease. On-site land releases in 1996 were half that of 1988, decreasing from 2.5 million pounds in 1988 to 1.2 million pounds in 1996 (a 51.9% reduction).

Transfers off-site to disposal decreased 44.9%, a reduction of 1.9 million pounds.

Other on-site waste management and off-site transfers to recycling and energy recovery generally showed decreases from 1994, except for on-site treatment. On-site treatment increased from 167.9 million pounds in 1994 to 1.06 billion pounds in

1996, a 533.9% increase. (These data were not collected in 1988.)

For the 1988-1996 period, transfers to treatment decreased 21.7%, or 551,000 pounds, and transfers to POTWs decreased 29.2%, or 1.8 million pounds.

Production in the petroleum refining sector increased throughout this period, although employment declined. TRI facilities report absolute amounts of waste managed and environmental releases, not amounts adjusted for changes in production levels. As production in the petroleum refining sector has increased, however, the sector's releases have decreased, led by decreases in fugitive air emissions. Several facilities that have accomplished large decreases in air emissions have done so by implementing process changes, as well as improving their operating practices, as described below.



Table 7-14. TRI On-site and Off-site Releases by 4-digit SIC Code, 1988 and 1994-1996: Petroleum Refining, SIC Code 29

SIC Code	Industry	Year	On-site Releases				Releases to Land Pounds	Off-site Releases		Total On- and Off-site Releases Pounds
			Total Air Emissions Pounds	Surface Water Discharges Pounds	Underground Injection Pounds	Total On-site Releases Pounds		Transfers Off-site to Disposal Pounds		
2911	Petroleum Refining	96	34,837,049	379,487	982,255	1,147,695	37,346,486	2,157,061	39,503,547	
		95	33,681,768	489,453	854,178	149,756	35,175,155	2,796,594	37,971,749	
		94	37,250,761	449,194	702,581	556,682	38,959,218	3,208,739	42,167,957	
		88	56,407,891	692,938	503,202	2,251,419	59,855,450	3,799,001	63,654,451	
2951	Asphalt Paving Mixtures & Blocks	96	4,816	0	0	0	4,816	0	4,816	
		95	1,515	0	0	0	1,515	500	2,015	
		94	1,667	0	0	146	1,813	1,146	2,959	
		88	25,503	2,000	0	250	27,753	2,440	30,193	
2952	Asphalt Felts & Coatings	96	27,210	314	0	25,000	52,524	10,751	63,275	
		95	23,022	32	0	9,205	32,259	32,124	64,383	
		94	28,389	28	0	0	28,417	69,806	98,223	
		88	40,206	280	0	0	40,486	187,722	228,208	
2992	Lubricating Oils & Greases	96	449,787	680	0	7,773	458,240	52,096	510,336	
		95	274,537	705	0	15,109	290,351	15,773	306,124	
		94	269,528	915	0	55,324	325,767	87,321	413,088	
		88	827,756	3,918	0	5,219	836,893	67,814	904,707	
2999	Petroleum & Coal Products, nec*	96	1,566,370	13,449	0	0	1,579,819	0	1,579,819	
		95	2,171,009	12,563	2,200	78	2,185,850	0	2,185,850	
		94	2,279,509	13,110	2,400	0	2,295,019	0	2,295,019	
		88	2,960,467	12,250	23,000	97,000	3,092,717	250	3,092,967	
Multiple within SIC Code 29		96	1,224,062	16,086	0	1,361	1,241,509	90,300	1,331,809	
		95	1,727,469	11,658	0	15,477	1,754,604	136,566	1,891,170	
		94	1,727,722	5,111	0	36,498	1,769,331	28,073	1,797,404	
		88	4,137,449	42,042	0	79,335	4,258,826	209,542	4,468,368	
Invalid SIC Code within SIC 29		96	7,050	0	0	0	7,050	76,000	83,050	
		95	87,027	0	0	0	87,027	85,000	172,027	
		94	24,800	250	0	0	25,050	77,400	102,450	
		88	318,007	0	1,617	21,790	341,414	60,513	401,927	
Total for SIC Code 29		96	38,116,344	410,016	982,255	1,181,829	40,690,444	2,386,208	43,076,652	
		95	37,966,347	514,411	856,378	189,625	39,526,761	3,066,557	42,593,318	
		94	41,582,376	468,608	704,981	648,650	43,404,615	3,472,485	46,877,100	
		88	64,717,279	753,428	527,819	2,455,013	68,453,539	4,327,282	72,780,821	

**Note:** On-site Releases from Section 5 of Form R and Off-site Releases from Section 6 (transfers off-site to disposal) of Form R. Forms with more than one-4-digit SIC code within SIC code 29 are assigned to the "multiple" category.

\*nec: not elsewhere classified.

### 1988-1996 Data for Four-Digit Industries in Petroleum Refining

Tables 7-14 through 7-16 summarize, respectively, on- and off-site releases, other on-site waste management, and transfers off-site for further waste management. They present data for 1988 and 1994-1996 for industries at the four-digit SIC code level within SIC code 29.

As made evident in the preceding sections of this chapter, refineries (SIC code 2911) represent the vast majority of facilities and forms for the petroleum refining sector. Only two categories of reporting, for all reporting years presented in the tables, are led by an industry other than SIC code 2911. Lubricating oils and greases (SIC code 2992) reported more transfers to recycling and energy



Table 7-15. TRI Other On-site Waste Management by 4-digit SIC Code, 1988 and 1994-1996: Petroleum Refining, SIC Code 29

SIC Code	Industry	Year	Recycled On-site Pounds	Energy Recovery On-site Pounds	Treated On-site Pounds	Total Other On-site Waste Management Pounds
2911	Petroleum Refining	96	79,132,470	595,705,592	1,057,877,820	1,732,715,882
		95	78,987,422	561,020,619	248,808,273	888,816,314
		94	67,287,193	915,552,746	162,212,091	1,145,052,030
		88	NA	NA	NA	NA
2951	Asphalt Paving Mixtures & Blocks	96	109	0	1,765	1,874
		95	0	0	950	950
		94	0	0	885	885
		88	NA	NA	NA	NA
2952	Asphalt Felts & Coatings	96	151,088	0	0	151,088
		95	52,545	0	0	52,545
		94	72,940	0	0	72,940
		88	NA	NA	NA	NA
2992	Lubricating Oils & Greases	96	4,178,041	55,250	590,903	4,824,194
		95	5,369,064	0	634,009	6,003,073
		94	12,894,749	0	352,813	13,247,562
		88	NA	NA	NA	NA
2999	Petroleum & Coal Products, nec*	96	0	351,500	983,243	1,334,743
		95	30,336,000	1,934,658	2,586,503	34,857,161
		94	32,640,000	2,889,820	1,358,598	36,888,418
		88	NA	NA	NA	NA
Multiple within SIC Code 29		96	637,235	0	5,031,768	5,669,003
		95	726,988	0	5,015,534	5,742,522
		94	14,700	0	3,997,550	4,012,250
		88	NA	NA	NA	NA
Invalid SIC Code within SIC 29		96	56,000	0	0	56,000
		95	56,000	0	0	56,000
		94	56,000	0	4,670	60,670
		88	NA	NA	NA	NA
Total for SIC Code 29		96	84,154,943	596,112,342	1,064,485,499	1,744,752,784
		95	115,528,019	562,955,277	257,045,269	935,528,565
		94	112,965,582	918,442,566	167,926,607	1,199,334,755
		88	NA	NA	NA	NA

Note: Data from Section 8 of Form R. Forms with more than one 4-digit SIC code within SIC code 29 are assigned to the "multiple" category.

\*nec: not elsewhere classified.

recovery in each year covered here (1994-1996), except for transfers to energy recovery in 1995.

### On- and Off-site Releases

As shown in Table 7-14, refineries (SIC code 2911) saw the biggest reported reductions (in total air emissions) (21.6-million-pound reduction) from 1988 to 1996. This contributed to an overall 24.2-million-pound decrease for all release media, a 37.9% reduction.

Multiple-code reporting decreased from 4.5 million pounds to 1.3 million pounds (a 3.1-million-pound decrease, or 70.2%). Reporting in the miscellaneous petroleum and coal product industry (SIC code 2999) decreased from 3.1 million pounds in 1988 to 1.6 million pounds in 1996 (1.5 million pounds, or a 48.9% decrease). These data are also presented in Table 7-14.





**Table 7-16. TRI Transfers Off-site for Further Waste Management by 4-digit SIC Code, 1988 and 1994-1996: Petroleum Refining, SIC Code 29**

SIC Code	Industry	Year	Transfers to Recycling Pounds	Transfers to Energy Recovery Pounds	Transfers to Treatment Pounds	Transfers to POTWs Pounds	Other Off-site Transfers Pounds	Total Transfers Off-site for Further Waste Management Pounds
2911	Petroleum Refining	96	4,161,812	216,181	1,818,554	3,709,662	1	9,906,210
		95	4,822,314	304,161	708,706	3,465,291	0	9,300,472
		94	4,746,251	260,453	992,820	2,817,042	0	8,816,566
		88	NA	NA	2,321,128	5,462,836	903,672	NA
2951	Asphalt Paving Mixtures & Blocks	96	0	0	0	0	0	0
		95	0	0	0	0	0	0
		94	0	0	0	0	0	0
		88	NA	NA	0	1,250	0	NA
2952	Asphalt Felts & Coatings	96	8,195	0	0	7,955	0	16,150
		95	1,016	3,750	175	7,551	0	12,492
		94	4	3,285	334	8,450	0	12,073
		88	NA	NA	0	266	0	NA
2992	Lubricating Oils & Greases	96	14,184,342	415,604	40,637	594,575	0	15,235,158
		95	17,910,494	231,493	140,309	503,273	0	18,785,569
		94	15,497,147	1,127,019	149,333	530,157	0	17,303,656
		88	NA	NA	100,837	458,318	2,077	NA
2999	Petroleum & Coal Products, nec*	96	2	1,593	72,250	0	0	73,845
		95	0	3,260	70,250	0	0	73,510
		94	0	1,900	70,250	0	0	72,150
		88	NA	NA	9,750	0	0	NA
Multiple within SIC Code 29		96	112,108	39	47,088	631	0	159,866
		95	110,176	0	18,929	490	0	129,595
		94	49,655	0	35,466	1,236	0	86,357
		88	NA	NA	1,350	52,550	500	NA
Invalid SIC Code within SIC 29		96	0	0	8,310	0	0	8,310
		95	0	0	7,220	0	0	7,220
		94	0	0	5,550	0	0	5,550
		88	NA	NA	105,170	112,091	0	NA
Total for SIC Code 29		96	18,466,459	633,417	1,986,839	4,312,823	1	25,399,539
		95	22,844,000	542,664	945,589	3,976,605	0	28,308,858
		94	20,293,057	1,392,657	1,253,753	3,356,885	0	26,296,352
		88	NA	NA	2,538,235	6,087,311	906,249	NA

**Note:** Transfers Off-site for Further Waste Management from Section 6 (excluding transfers off-site to disposal) of Form R. Forms with more than one 4-digit SIC code within SIC code 29 are assigned to the "multiple" category.

\*nec: not elsewhere classified

Figure 7-12 shows percentage changes by media for 1988 to 1996.

### Other On-site Waste Management

Table 7-15 presents on-site waste management data for the sector. (These data have been collected since 1991.)

Refineries reported a large increase in the amount of TRI chemicals treated on-site between 1994 and 1996 (from 162.2 million pounds to 1.06 billion pounds). The amount reported as energy recovery dropped from 915.6 million pounds to 595.7 million pounds over the three-year period, while on-site recycling increased from 67.3 million pounds to 79.1 million pounds. Although the net change for on-site waste management in SIC code



2911 reporting was an increase of almost 600 million pounds over the three years, the total dropped substantially in 1995.

Reported amounts by all other SIC code 29 industries do not approach those of SIC code 2911 for on-site waste management, except for the amount recycled on-site by miscellaneous petroleum and coal products (SIC code 2999). This industry reported 32.6 million pounds in 1994 and zero in 1996 for on-site recycling (see Table 7-15).

### **Transfers Off-site for Further Waste Management**

From 1994 to 1996, refineries had an increase in reporting of transfers off-site for further waste management of 1.1 million pounds, a 12.4% increase. (Data for some types of off-site transfers were not collected in 1988.) This increase was primarily due to an 826,000-pound increase, since 1994, in the amount reported as transfers to treatment. The largest amounts reported in transfers off-site for further waste management were in transfers to recycling and to energy recovery by lubricating oils and greases (SIC code 2992). This industry reported a 1.3-million-pound decrease in transfers to recycling between 1994 and 1996, an 8.5% decrease, and a 711,000-pound reduction in transfers to energy recovery, 63.1% less than the 1994 amount (see Table 7-16).

### **Facilities with Large Increases and Decreases in Releases, 1988-1996**

All facilities discussed in this section reported in SIC code 2911, petroleum refining.

Amoco Petroleum Products, in Texas City, Texas, was the top facility for increases with an overall increase of 2.7 million pounds in on- and off-site releases from 1988 to 1996. This was largely due to reporting of methanol in point source air emissions in 1996 (zero pounds reported in 1988 and 2.2 million pounds in 1996). In 1996, several California refineries researching Maximum Available Control

Technologies (MACT) under the Clean Air Act discovered methanol to be a by-product of a hydrogen production process that employs a low-temperature Schiff-reaction catalyst. The Amoco facility attributes its ranking as the top petroleum refining facility for increases of on- and off-site releases to the fact that other facilities engaged in similar processes have not yet modified their reporting to reflect these findings. No other facility in this sector reported a comparable increase in total on- and off-site releases.

Four of the top five facilities for decreases in total on- and off-site releases reported significant decreases in fugitive air emissions of methyl ethyl ketone (MEK). The top facility for decreases, Sun Company, Inc., in Tulsa, Oklahoma, credits pollution prevention projects, including a study to better assess fugitive losses, for the decrease. The Sun Company facility also replaced open systems with closed, "hard-pipe" systems, improved the quality of gaskets in piping, and brought chillers on-line to lower the vapor pressure of some volatile chemicals. Methyl ethyl ketone reporting in fugitive air emissions decreased between 1988 and 1996 from 1.8 million to 93,000 pounds at this facility, part of its overall reduction of 2.8 million pounds in releases.

BP Oil Company in Belle Chasse, Louisiana, reported large reductions in fugitive air emissions for four chemicals: xylene (mixed isomers), benzene, toluene, and hydrogen fluoride between 1988 and 1996. The BP facility, ranked second in decreases with a reduction of 2.3 million pounds, treated wastewater containing aromatic compounds (xylene, benzene, and toluene) in open ponds prior to 1989. Evaporation of the volatile aromatic compounds from the open ponds resulted in significant fugitive air emissions. Establishment of National Emission Standards for Hazardous Air Pollutants (NESHAPs) for petroleum refineries in August 1995, under the Clean Air Act, is one regulatory development cited as influencing decisions by many refineries, including the BP Oil



facility, to switch from open pond/open ditch wastewater treatment to closed systems. Another regulation cited by BP Oil as encouraging this change is the primary sludge rule (under the Resource Conservation and Recovery Act), which classifies sludge contaminated by petroleum wastewater as hazardous waste.

The Belle Chasse BP facility also reduced hydrogen fluoride point source air emissions by 550,000 pounds between 1988 and 1996. Acid-soluble oil containing free hydrogen fluoride had been used as a fuel in process heaters before passage of RCRA's Boilers or Industrial Furnaces (BIF) rule (February 1991). Burning the acid-soluble oil in heaters contributed to point source air emissions of hydrogen fluoride. BP decided not to apply for a BIF permit and instead employed a new system for treating hydrogen fluoride that neutralizes hydrofluoric acid.

Two of the top five facilities for decreases in fugitive air emissions of both MEK and toluene attributed their reductions to changes in their solvent dewaxing systems. The MEK dewaxing process involves use of a solvent mixture of MEK and toluene to remove wax from lube oil feedstock. The Mobil Oil Beaumont Refinery in Beaumont, Texas, ranked third for decreases in total on- and off-site releases, with an overall reduction of 2.0 million pounds. The facility's 1.4-million-pound decrease in fugitive air emissions of MEK from 1988 to 1996 was largely the result of upgrades made to the solvent dewaxing system. Farmland Industries, Inc., in Coffeyville, Kansas, was fourth for decreases (1.8 million pounds overall). The facility reduced MEK and toluene fugitive air emissions by 828,000 pounds, combined, by eliminating the solvent dewaxing process altogether. Farmland also replaced fixed-roof toluene storage tanks with floating-roof tanks, which contain vapors more efficiently. Ethylene and propylene emissions from point air sources were also significantly reduced at the Farmland facility. Ethylene and propylene are produced as by-

products of catalytic cracking in crude oil refining. The refinery stream containing these chemicals is often used as a fuel gas. Farmland reduced point source air emissions of these chemicals by recovering the fuel gas to sell as product and by improving its refining system so that more of the chemicals are consumed in process.

The fifth-ranked facility for decreases, Star Enterprises of Port Arthur, Texas, also reduced fugitive air emissions of toluene (by 483,000 pounds) by switching to a closed wastewater treatment system. The Star Enterprises facility had an overall decrease of 1.7 million pounds.

## 1991-1996 Waste Management Data for Petroleum Refining

Table 7-17 summarizes on-and off-site waste management data for the petroleum refining sector for 1991, when TRI began collecting this information, and the three most recent years (1994-1996). Total production-related waste increased from 1.17 billion pounds to 1.81 billion pounds, an increase of 54.7%. The largest increase was reported in on-site treatment, from 107.9 million pounds to 1.06 billion pounds. This amounted to a ten-fold increase, or 956.6 million pounds. Figure 7-13 shows these changes. As noted later, one refinery attributes its large increase in on-site treatment to improved estimating methods rather than to any change in actual quantities of TRI chemicals in waste.

The largest reduction in waste management occurred in on-site recycling, from 294.4 million pounds in 1991 to 84.2 million pounds in 1996, a 71.4% decrease.

### Facilities with Large Increases and Decreases in Waste Management, 1991-1996

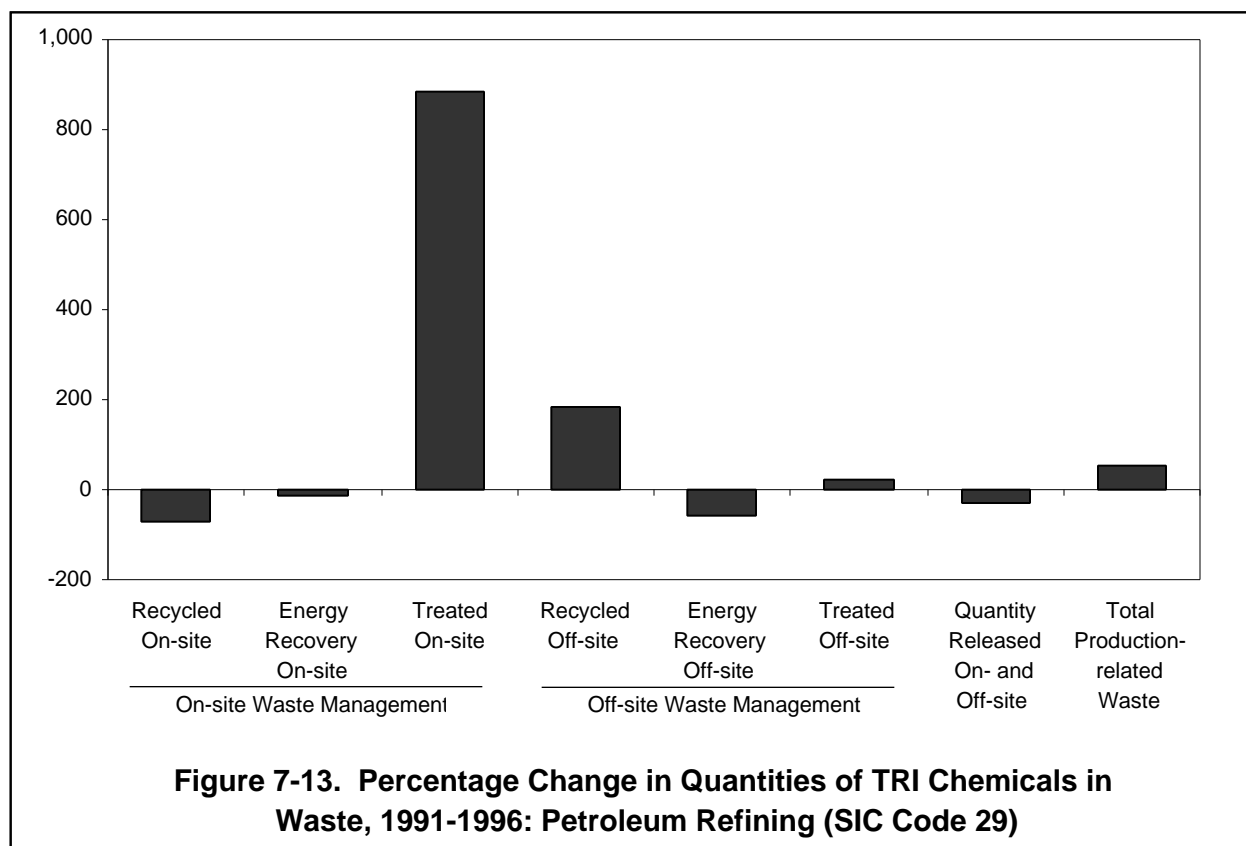
Chevron facilities ranked first and fourth for increases in production-related waste. (All facilities with large changes in production-related waste for



Table 7-17. TRI Waste Management Data, 1991, 1994-1996: Petroleum Refining, SIC Code 29

Waste Management Activity	1991 Pounds	1994 Pounds	1995 Pounds	1996 Pounds
<u>On-site Waste Management</u>				
Recycled On-site	294,400,808	112,965,582	115,528,019	84,154,943
Energy Recovery On-site	693,949,563	918,442,566	562,955,277	596,112,342
Treated On-site	107,896,271	167,933,107	257,072,989	1,064,502,499
Total On-site Waste Management	1,096,246,642	1,199,341,255	935,556,285	1,744,769,784
<u>Off-site Waste Management</u>				
Recycled Off-site	6,561,837	20,793,547	22,849,324	18,461,203
Energy Recovery Off-site	1,515,956	1,285,326	517,997	636,870
Treated Off-site	5,028,307	4,516,539	4,952,864	6,234,577
Total Off-site Waste Management	13,106,100	26,595,412	28,320,185	25,332,650
Quantity Released On- and Off-site	62,053,552	46,201,530	42,981,272	42,318,869
Total Production-related Waste	1,171,406,294	1,272,138,197	1,006,857,742	1,812,421,303
Non- Production-related Waste	157,986	400,639	346,033	1,622,512
Waste Management Activity	Change 1994-1995 Percent	Change 1995-1996 Percent	Change 1991-1996 Percent	
<u>On-site Waste Management</u>				
Recycled On-site	2.3	-27.2	-71.4	
Energy Recovery On-site	-38.7	5.9	-14.1	
Treated On-site	53.1	314.1	886.6	
Total On-site Waste Management	-22.0	86.5	59.2	
<u>Off-site Waste Management</u>				
Recycled Off-site	9.9	-19.2	181.3	
Energy Recovery Off-site	-59.7	22.9	-58.0	
Treated Off-site	9.7	25.9	24.0	
Total Off-site Waste Management	6.5	-10.5	93.3	
Quantity Released On- and Off-site	-7.0	-1.5	-31.8	
Total Production-related Waste	-20.9	80.0	54.7	
Non- Production-related Waste	-13.6	368.9	927.0	

Note: Does not include delisted chemicals, chemicals added in 1994 and 1995, ammonia, hydrochloric acid, and sulfuric acid. Data from Section 8 of Form R (Current Year, Column B) of year indicated.



**Note:** Does not include delisted chemicals, chemicals added in 1994 and 1995, ammonia, hydrochloric acid, and sulfuric acid. Data from Section 8 of Form R (Current Year, Column B) of year indicated.

1991-1996 reported in SIC code 2911, except the facility discussed at the end of this section). Both Chevron facilities reported large increases in aromatic hydrocarbons treated on-site. Chevron Products in Richmond, California, had the largest increases in on-site treatment for toluene (174.9 million pounds), m-xylene (158.4 million pounds), 1,2,4-trimethylbenzene (125.2 million pounds), and naphthalene (124.2 million pounds). These chemicals comprised 71.8% of the facility's overall 811.6-million-pound increase in total production-related waste. Chevron USA Products in Salt Lake City, Utah, reported increases in on-site treatment of mixed isomers of xylene (24.0 million pounds), toluene (20.0 million pounds), and 1,2,4-trimethylbenzene (14.0 million pounds). This represented 81.3% of the facility's overall increase of 71.4 million pounds. All of these aromatic hydrocarbons are formed in petroleum refining processes. One such process, catalytic reforming, is intended to increase the octane of automobile

gasoline. Catalytic cracking, another process where these aromatic compounds are formed, breaks down ("cracks") large organic molecules into smaller ones.

The Richmond Chevron facility noted that the reported increases of toluene, m-xylene, 1,2,4-trimethylbenzene, and naphthalene in on-site treatment did not represent actual increases in the amounts of these chemicals in the wastewater; rather, the estimation techniques for calculating chemical quantities removed in Chevron's on-site wastewater treatment unit have improved, resulting in significantly different reported amounts.

The facilities with the second, third, and fifth largest increases in total production-related waste all reported significant increases in ethylene and propylene. These two chemicals are formed in the catalytic cracking process and are later partially



consumed in process. Each of the three facilities—Coastal Eagle Point Oil Company, Westville, New Jersey (177.4-million-pound increase), Mobil Oil Paulsboro Refinery, Paulsboro, New Jersey (128.9 million pounds), and Total Petroleum, Inc., Ardmore, Oklahoma (53.9 million pounds)—attribute changes in the reported amounts of ethylene and propylene to a difficulty in applying TRI reporting guidelines to chemicals that are formed in process and partially consumed in process. The facilities also cited a lack of information on how to estimate the amount of these chemicals in refinery streams.

Propylene and ethylene were the chemicals largely responsible for facilities with rankings as the first, third, fourth, and fifth in decreases of production-related waste. The National Cooperative Refinery Association facility in McPherson, Kansas, ranked first with a 303.3-million-pound decrease in production-related waste. This facility reduced the amount of propylene and ethylene burned for energy recovery (sent as constituents of fuels to process heaters) by improving its method of “splitting” (or separating) lighter alkanes from refinery streams so they can be used in product. Energy-recovery quantities of the two chemicals were reduced by a combined 303.5 million pounds. The facility with the third largest decreases, Arco Products Company in Carson, California (124.2 million pounds), stopped reporting individual components of process fuel gases as energy recovery after 1994. The Arco facility reported 123.0 million pounds of propylene and ethylene in energy recovery, combined, in 1991. In 1996 the total for both chemicals was 1.2 million pounds. The fourth-ranked facility, Sinclair Oil Corporation in Sinclair, Wyoming, reported 54 million pounds of propylene and ethylene in energy recovery in 1991 and zero pounds for both in 1996. Its overall reduction for 1991-1996 was 55.8 million pounds.

Quaker State Corporation in Newell, West Virginia (multiple codes 2911 and 2992), reported a 99.8-million-pound decrease for methyl ethyl ketone and a 99.7-million-pound decrease for toluene from 1991 to 1996, both primarily in on-site recycling. The change in reporting was the result of a change in the facility’s interpretation of recycling. The two chemicals, solvents in the facility’s dewaxing system, were previously considered to be recycled each time they were fed back into the dewaxing process. The Quaker State facility no longer reports this “turn-over” as recycling.<sup>1</sup> This facility was second for decreases in production-related waste, with a 199.5-million-pound reduction.

### **Other Apparent Increases and Decreases in Waste Management, 1991-1996**

In the TRI database, there are other facilities with large apparent increases and decreases, which have been identified as reporting errors or plant closures. Because these are errors or plant closures and not actual changes in the data, these facilities are not discussed in detail here. There is one such facility in petroleum refining:

Sedrift Coke L.P., Sedrift, Texas, decrease of 46.8 million pounds, reporting error.

### **Facilities Contacted for Explanations (alphabetical by facility):**

Amoco Petroleum Products, Texas City, Texas: L. G. Kuchinski, March 9, 1998 (explanation provided)

Arco Products Company, Carson, California: Josh Miller, March 9, 1998 (explanation provided)

BP Oil Company, Belle Chasse, Louisiana: Randy Borne, March 11, 1998 (explanation provided)

Chevron Products, Richmond, CA: Troy M. Howell, March 9-12, 1998 (explanation provided)

Chevron USA Products, Salt Lake City (no explanation provided)

Coastal Eagle Point Oil Company, Westville, New Jersey: P. Dziubinski, March 9, 1998 (explanation provided)

<sup>1</sup> There are no TRI regulatory definitions of recycling. Facilities may use their own interpretations for purposes of reporting to TRI. Changes in these interpretations do not represent a change in guidance by EPA on how to report recycling.



Farmland Industries, Inc., Coffeyville, Kansas:  
Darrel Stonecipher, March 10, 1998 (explanation  
provided)

Mobil Oil Beaumont Refinery, Beaumont, Texas:  
S.T. Stirling, March 9, 1998 (explanation provided)

Mobil Oil Paulsboro Refinery, Paulsboro, New  
Jersey: Paul Taylor, March 10, 1998 (explanation  
provided)

National Cooperative Refinery Association,  
McPherson, Kansas: Steven Cater, March 9, 1998  
(explanation provided)

Quaker State Corporation, Newell, West Virginia:  
Ronald Ryan, March 9, 1998 (explanation  
provided)

Seadrift Coke L.P., Seadrift, Texas: Emmanuel  
Oladoyin, March 9, 1998 (explanation provided)

Star Enterprises, Port Arthur, Texas: Becky  
Demetre, March 10, 1998 (explanation provided)

Sinclair Oil Corp. Sinclair, Wyoming (could not be  
reached for comment)

Sun Company, Inc., Tulsa, Oklahoma: Sidney  
Cabiness, March 11, 1998 (explanation provided)

Total Petroleum, Inc., Ardmore, Oklahoma: Darcy  
Jordan, March 11, 1998 (explanation provided)

### Sources

Executive Office of the President, Office of Management and Budget, *Standard Industrial Classification Manual, 1987*:  
Standard Industrial Classification (SIC) codes and industry descriptions.

*U.S. Industry & Trade Outlook '98*, DRI/McGraw Hill, Standard & Poor's, and U.S. Department of Commerce,  
International Trade Administration, 1998: economic analyses, also provides some information on environment and  
industrial processes for selected industries.

U.S. Census Bureau, *1996 Annual Survey of Manufactures: Statistics for Industry Groups and Industries*, M96(AS)-1,  
February 1998 <<http://www.census.gov/prod/www/titles.html#mm>>: value of shipments and employment.  
Supplemental data from U.S. Census Bureau <<http://www.census.gov>> for some industries.

U.S. Environmental Protection Agency, Office of Enforcement and Compliance Assurance, Office of Compliance, *Profile  
of the Petroleum Refining Industry*, Sector Notebook Project, EPA/310-R-95-013, September 1995 <[http://es.epa.gov/  
oeca/sector/index.html](http://es.epa.gov/oeca/sector/index.html)>: industry processes and technologies, pollutant sources, and selected economic data.



**Chapter 7 — TRI Data for Petroleum Refining**



## 1996 Toxics Release Inventory: Public Data Release—Errata

**Table 7-2. Multiple SIC Codes, 1996: Petroleum Refining, SIC Code 29**

SIC Codes		Total Forms Number	Form As Number	Total On-site Releases Pounds	Total Off-site Releases Pounds	Total On- and Off-site Releases Pounds	Total Other On-site Waste Management Pounds	Total Transfers Off-site for Further Waste Management Pounds	Total Production-related Waste Pounds	Non-Production-related Waste Pounds
2911	2951	14	0	66,504	0	66,504	30	1,618	68,139	0
2911	2951	29	0	977,469	64,824	1,042,293	8,356,038	49,991	9,440,658	0
2911	2992	9	0	181,785	0	181,785	619,930	500	803,244	0
2911	2999	36	0	722,863	26,499	749,362	181,127	114,956	975,409	0
2951	2952	1	0	668	0	668	0	0	668	0
2952	2992	4	4	0	0	0	0	0	0	0
Total for SIC Code 29		93	4	1,949,289	91,323	2,040,612	9,157,125	167,065	11,288,118	0

**Note:** **On-site Releases** from Section 5 of Form R. **On-site Waste Management** from Section 8 of Form R. **Off-site Releases** are transfers off-site to disposal from Section 6 of Form R. **Total Transfers Off-site for Further Waste Management** from Section 6 of Form R. **Total Production-related Waste** sums Section 8 of Form R, except: **Non-production-related Waste** (remedial/catastrophic incidents).

In Chapter 7 of the first volume of the *1996 Toxics Release Inventory Public Data Release* (published May 1998), the table that presented data from TRI forms reporting more than one SIC code in SIC code 29 in 1996 (Table 7-2 on page 256) contained incorrect data. The total row in Table 7-2 was correct, but the detailed data were not. This errata sheet presents the correct data, above.

One sentence in the text reflected the incorrect data. On page 255, the right-hand column, the second paragraph, the last sentence of that paragraph, the number “72” should be “36.” The corrected text follows.

Table 7-2 examines multiple-code reporting within SIC code 29. Ninety-three TRI forms reported more than one SIC code in SIC code 29 in 1996, 2.9% of all forms in the sector, a smaller percentage than in many sectors. Of these, 36 reported both petroleum refining (SIC code 2911) and miscellaneous products of petroleum and coal (SIC code 2999).