
Summary and Analysis of the 2009 Gasoline Benzene Pre-Compliance Reports

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Compliance and Innovative Strategies Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

NOTICE

This technical report does not necessarily represent final EPA decisions or positions. It is intended to present technical analysis of issues using data that are currently available. The purpose in the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments.



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I. Executive Summary

Most refiners planning to produce gasoline after January 1, 2011 are required to submit to the U.S. Environmental Protection Agency (EPA) annual pre-compliance reports indicating their progress toward complying with EPA's gasoline benzene standards. Reports are due annually by June 1 from 2008 through 2011 under the gasoline benzene regulations finalized in February, 2007, in order to provide updates on refiners' compliance plans. This report summarizes information received from refiners in their June 2009 pre-compliance reports.

Refiners' benzene pre-compliance reports must contain estimates of average daily gasoline production and annual average benzene concentration from June 1, 2007 through December 31, 2015. For those refiners planning on participating in the credit program, the reports must contain a projection of how many credits will be generated or used by each refinery. The pre-compliance reports must also contain information outlining each refinery's timeline for complying with the gasoline benzene standards and provide information regarding engineering plans (e.g., design and construction), and capital commitments for making the necessary modifications to produce gasoline which meets the new benzene standards.

EPA received benzene pre-compliance reports for 110 refineries in 2009. The 2009 benzene pre-compliance reports showed that:

- refiners are planning to comply with the benzene standards on time by installing new benzene removal equipment at many of their refineries and using the averaging, banking and trading provisions in the regulations to comply at the rest
- 63 refineries are planning to install equipment to reduce gasoline benzene
- 47 refineries are not planning to install equipment to reduce gasoline benzene because they already comply with the gasoline benzene standards, or are planning to use credits for compliance
- 25 refineries are planning to generate early credits from 2007 through 2010, and 41 refineries are planning to generate standard credits beginning in 2011
- overall average reported benzene levels are expected to decrease from 1.05 volume percent (vol%) in 2007 to 0.60 vol% in 2015

This data represents estimates made by refiners whose final actual compliance plans may change prior to January 1, 2011. While the reported information is preliminary, the results provide the clearest snapshot of refiners' aggregate benzene compliance plans available as of June, 2009. They represent the assessment of those who have first-hand knowledge of the unique situation faced by each refinery. EPA expects that next year's benzene pre-compliance reports will contain more definite information on refiners' plans to produce gasoline which meets the benzene standards beginning January 1, 2011.

II. Gasoline Benzene Program Overview

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The Mobile Source Air Toxics (MSAT2) final rule (72 FR 8428, February 26, 2007) contains a two-step approach to reducing the benzene content of gasoline. Beginning January 1, 2011, importers and most refineries are required to import or produce gasoline containing no more than 0.62 vol% benzene on an annual average basis. This 0.62 vol% benzene standard can be met by using credits. In addition, beginning July 1, 2012, importers and most refineries are required to import or produce gasoline with a maximum annual average gasoline benzene content of 1.3 vol%. A refinery's or importer's actual annual average gasoline benzene level may not exceed this maximum average standard. Credits may not be used to meet the 1.3 vol% standard.

The MSAT2 rule includes provisions for refiners and importers to generate gasoline benzene credits. Refiners may generate early benzene credits from June 1, 2007 through December 31, 2010 if a refinery's annual average gasoline benzene is at least 10% less than its average benzene from January 1, 2004 through December 31, 2005, and the refinery reduces their benzene by implementing certain technological improvements specified in the regulations. Refiners and importers may generate standard benzene credits beginning in 2011 if a refinery's or importer's annual average gasoline benzene is less than 0.62 vol%. Early benzene credits may be used to comply with the 0.62 vol% standard during the 2011, 2012 and 2013 averaging periods, while standard benzene credits may be used to comply with the 0.62 vol% standard within five years from the year they were generated. For both early credits and standard credits, one credit is equivalent to one gallon of benzene removed from gasoline. Gasoline benzene credits may be transferred nationwide.

Small Refiner Flexibilities

Additional compliance flexibilities are provided for small refiners in the gasoline benzene regulations. The criteria for qualification as a gasoline benzene small refiner are similar to those under the Gasoline Sulfur and Diesel Sulfur rules. To qualify as "small", a refiner must: 1) have produced gasoline by processing crude oil through refinery processing units from January 1, 2005 through December 31, 2005; 2) have employed no more than 1,500 people company-wide, based on the average number of employees for all pay periods from January 1, 2005 through December 31, 2005; and, 3) have a corporate crude oil capacity less than or equal to 155,000 bpcd for 2005.

Small refiners are allowed an additional four years to comply with each benzene standard. They must begin complying with the 0.62 vol% standard no later than January 1, 2015, and begin complying with the 1.3 vol% standard no later than July 1, 2016.

Other Flexibilities

In addition to allowing refiners and importers to use credits to meet the 0.62 vol% annual average standard, the gasoline benzene regulations also allow refiners and

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importers to carry forward a benzene deficit from one year to the next year. If a refinery or importer exceeds the 0.62 vol% annual average standard, and does not procure sufficient credits to meet the standard, they may offset the deficit during the following year by reducing their benzene concentration below 0.62 vol%, and/or procuring credits. Benzene deficits for one year must be offset during the following year, and may not be carried over for a second consecutive year.

III. Benzene Pre-Compliance Reporting Requirements

The gasoline benzene regulations require refiners to submit annual pre-compliance reports for each of their refineries to EPA. The first pre-compliance report was due by June 1, 2008 and subsequent reports are due annually through 2011.

The pre-compliance reports must contain the following information:

1. Any changes in the refiner's basic company or facility information since registration.
2. Estimates of the average daily volume of gasoline produced at each refinery. The volume estimates must include gasoline produced during the periods of June 1, 2007 through December 31, 2007, and calendar years 2008 through 2015.
3. An estimate of the average gasoline benzene concentration for the periods listed above in 2.
4. For refineries expecting to participate in the benzene credit program, estimates of the number of credits generated and/or used during the periods listed above in 2.
5. Information on project schedule by known or projected completion date (by quarter) for each stage of the project (strategic planning, front-end engineering, detailed engineering and permitting, procurement and construction, and commissioning and startup).
6. Basic information regarding the selected technology pathway for compliance (e.g. re-routing of benzene precursors or other technologies, revamp versus grassroots, etc.).
7. Whether capital investments have been made or are projected to be made.
8. An update of the progress in each of these areas.

The pre-compliance reporting requirements do not apply to certain types of gasoline, including imported gasoline, gasoline produced for and used in California, gasoline produced by small refiners, gasoline exported for use outside the United States, and gasoline produced through distillation of transmix. These products are not included in this summary and analysis.

We recognize that the pre-compliance reports contain preliminary information and that final decisions on benzene removal plans may not have been made in all cases as

III. Benzene Pre-Compliance Reporting Requirements

of the reporting deadline. Accordingly, the information in this summary and analysis is based on the best available refinery information as of June 1, 2009. The information presented here will be updated with more current analyses from subsequent annual pre-compliance reports in 2010 and 2011.

IV. Gasoline Benzene Summary Data

A. Nationwide Analysis

1. Refinery Numbers and Production

We received benzene pre-compliance reports in 2009 for 110 refineries. Refiners indicated that, for most of their refineries, they have made decisions on producing gasoline which meets the benzene standards beginning January 1, 2011. Table 1 shows the aggregated results for all reporting refineries for the four years leading up to the beginning of the gasoline benzene standards, and Table 2 shows the aggregated results for the first five years when the standards are in effect.

Table 1 Reported Data for Total U.S., 2007-2010				
Year	2007	2008	2009	2010
# reporting refineries	110	110	110	110
Reported gasoline production, bbls/day	7,032,887	6,788,798	7,094,997	7,460,758
Average benzene concentration, vol%	1.05	1.08	1.02	0.99
# refineries with benzene < or = 0.62 vol%	21	23	24	27
# refineries with benzene > 0.62 vol% and < or = 1.3 vol%	43	36	39	40
# refineries with benzene > 1.3 vol%	46	51	47	43

Table 2 Reported Data for Total U.S., 2011-2015					
Year	2011	2012	2013	2014	2015
# reporting refineries	110	110	110	110	110
Reported gasoline production, bbls/day	7,687,068	7,715,576	7,747,637	7,742,999	7,751,801
Average benzene concentration, vol%	0.70	0.63	0.60	0.60	0.60
# refineries with benzene < or = 0.62 vol%	56	64	68	68	69
# refineries with benzene > 0.62 vol%	54	46	42	42	41

Table 1 shows that in 2007, only 21 refineries produced gasoline averaging 0.62 vol% benzene or less. Also in 2007, 89 refineries produced gasoline averaging greater than 0.62 vol% benzene, including 46 refineries that produced gasoline averaging greater than 1.3 vol% benzene. Table 2 shows that 35 of these 89 refineries plan to begin

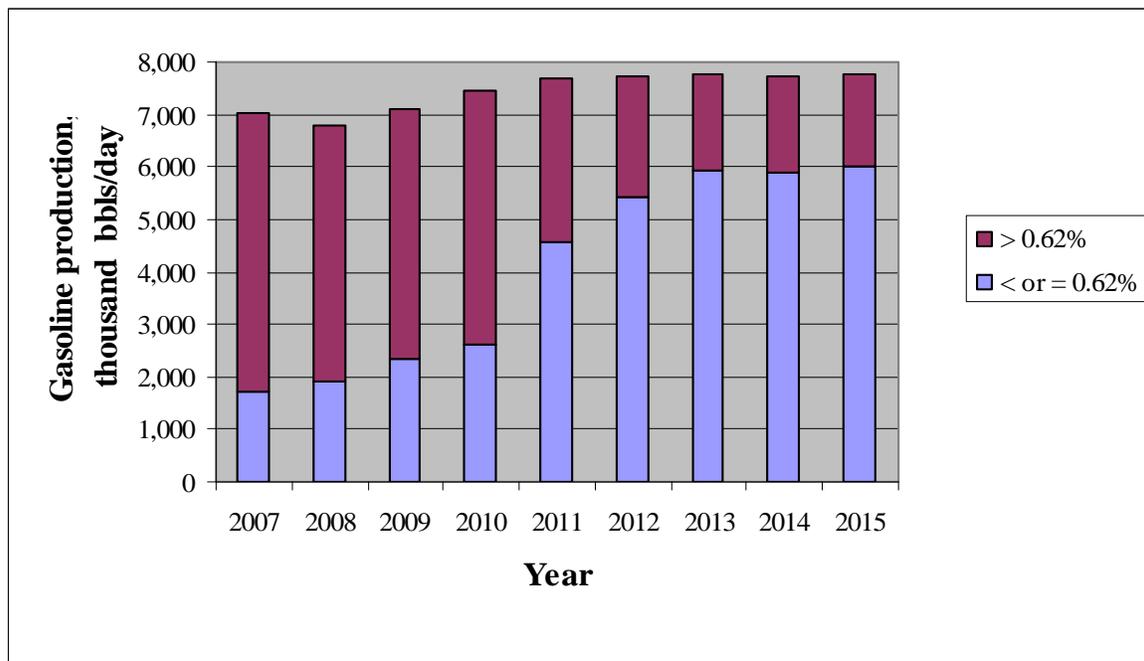
IV. Gasoline Benzene Summary Data

producing gasoline averaging 0.62 vol% benzene or less by 2011, as the number of refineries producing gasoline averaging 0.62 vol% benzene or less increases from 21 in 2007 to 56 in 2011. The number of refineries producing gasoline averaging 0.62 vol% benzene or less further increases to 68 by 2013, after the 1.3 vol% benzene maximum annual average standard takes effect in mid-2012, and increases to 69 by 2015.

Table 2 shows that the average benzene concentration for all reporting refineries is slightly greater than 0.62 vol% in 2011 and 2012, as some refineries plan to use early credits to meet the 0.62 vol% standard in 2011 and 2012. Refiners begin producing gasoline averaging 0.62 vol% benzene or less in 2013, when average benzene concentration decreases to 0.60 vol%. Table 2 also shows that refiners plan to significantly increase production of gasoline from 2007 to 2011, by approximately 654,000 bbls/day.

Figure 1 illustrates reported gasoline production, by benzene concentration, for each reported year. By 2013, approximately 76 percent of all gasoline will contain 0.62 vol% benzene or less.

Figure 1. Reported U.S. Gasoline Production and Benzene Content, 2007-2015



2. Projected Credit Generation and Use

Table 3 shows total reported gasoline benzene credits generated and used for each reported year. Twenty five refineries indicated they plan to generate a total of 158.9 million benzene credits (1 credit = 1 gallon benzene) during the early credit generation period from June 1, 2007 through December 31, 2010. Twenty three of these refineries are owned by refiners who own multiple refineries. To spread out the transition to the

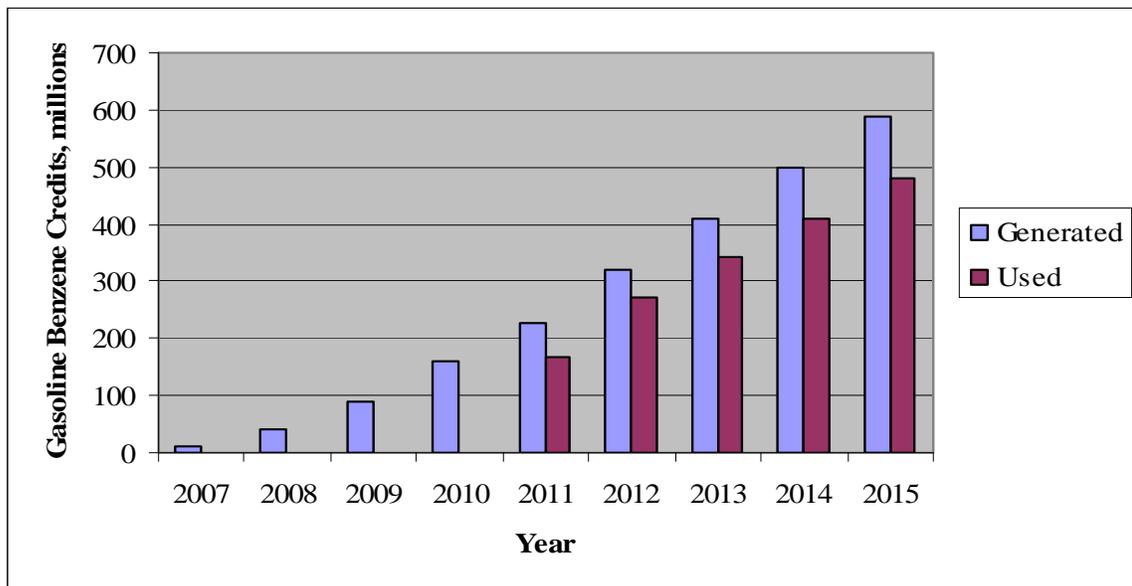
IV. Gasoline Benzene Summary Data

0.62 vol% benzene standard, refiners plan to use some of these early credits during the 2011 and 2012 compliance periods. In 2011, 41 refineries are projected to generate a total of 69.1 million credits, and 54 refineries are projected to use a total of 167.3 million credits. In 2012, 47 refineries are projected to generate a total of 91.6 million credits and 46 refineries are projected to use a total of 103.5 million credits. Annual generation of standard credits begins to exceed annual usage of standard credits in 2013, when 48 refineries are projected to generate 90.1 million credits and 42 refineries are projected to use only 70.7 million credits. By 2015, annual credit generation exceeds annual credit usage by 32.2 million credits, as 48 refineries plan to generate 90.1 million credits and 41 refineries plan to use only 67.9 million credits.

Table 3					
Reported Gasoline Benzene Credits for Total U.S., 2007-2015					
Year	2007	2008	2009	2010	total
# refineries generating benzene credits	5	12	16	20	25
Benzene credits generated, millions	10.8	30.7	48.2	69.2	158.9
Year	2011	2012	2013	2014	2015
# refineries generating benzene credits	41	47	48	48	48
# refineries using benzene credits	54	46	42	42	41
Benzene credits generated, millions	69.1	91.6	90.1	89.4	90.1
Benzene credits used, millions	167.3	103.5	70.7	69.4	67.9

Figure 2 shows cumulative projected generation and usage of gasoline benzene credits for each reported year. Refiners are planning to generate sufficient credits for overall compliance during each annual compliance period from 2011 onward.

Figure 2. Cumulative U.S. Gasoline Benzene Credits



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3. Project Scope and Timing

In addition to providing projections of gasoline production, benzene concentration, and credit generation/usage, refineries must also include information outlining both their timeline for compliance with the gasoline benzene standards and their engineering plans (e.g., design and construction) in their pre-compliance reports. We requested that refineries report their progress according to the following five stages: 1) strategic planning, 2) planning and front-end engineering, 3) detailed engineering and permitting, 4) procurement and construction, and 5) commissioning and start-up.

In the 2009 benzene pre-compliance reports, refiners indicated they have plans to install new benzene reduction facilities at 63 refineries. These refineries are generally in the early stages of their projects to comply with the gasoline benzene standards. Most have completed their strategic planning phase, and have started front-end engineering design work.

Most of the 63 refineries indicated that they plan to use one or more of the gasoline benzene reduction strategies identified by EPA in the gasoline benzene rulemaking. Reported scopes for benzene compliance projects are summarized in the following list:

- 19 refineries plan to install additional naphtha pre-fractionation capacity to reduce the amount of benzene precursors in their naphtha reformer feed
- 15 refineries plan to install a new reformat splitter tower
- 17 refineries plan to install a new benzene saturation unit
- 2 refineries plan to install new benzene extraction facilities
- 7 refineries plan to revamp existing benzene extraction facilities.
- 2 refineries plan to install new isomerization units
- 3 refineries plan to revamp existing isomerization units
- 11 refineries plan to outhaul benzene-rich light reformat to other refineries for processing

In addition, 5 refineries indicated they planned to make operational changes to reduce gasoline benzene.

Refiners indicated they were not planning to install benzene reduction facilities at 47 refineries, either because these refineries already comply with the gasoline benzene standards, or because they are planning to use credits for compliance.

B. PADD Analysis

This section presents information specific to each Petroleum Administration for Defense District (PADD). Tables 4, 5 and 6 show aggregated reported data for 2007, 2011 and 2015, by PADD¹. From 2007 to 2011, reported national average benzene

¹ These tables do not include imported gasoline, gasoline used in California, gasoline produced by small refiners, gasoline exported outside the U.S., and gasoline produced by transmix processors.

IV. Gasoline Benzene Summary Data

concentration decreased by 33 percent, with the largest decrease occurring in PADD 5 (39 percent), followed by PADD 2 (36 percent), PADD 3 (35 percent), PADD 4 (21 percent), and PADD 1 (18 percent). Also from 2007 to 2011, the number of refineries producing gasoline containing 0.62 vol% benzene or less increases from 21 to 56, with the largest increase occurring in PADD 3 (18 refineries), followed by PADD 2 (8 refineries), PADD 1 (4 refineries), and PADD 5 (3 refineries), and PADD 4 (2 refineries). From 2011 to 2015, reported average benzene concentration decreases further in each PADD, with the largest decreases occurring in PADDs 2, 4 and 5, while projected gasoline production changes little in each PADD. From 2011 to 2015, 13 additional refineries begin producing gasoline containing 0.62 vol% benzene or less, including 3 refineries in PADD 1, 4 in PADD 2, 3 in PADD 3, 2 in PADD 4, and 1 in PADD 5.

Table 4						
Reported Data by PADD for 2007						
	PADD 1	PADD 2	PADD 3	PADD 4	PADD 5	total U.S.
# reporting refineries	14	21	45	11	19	110
Reported gasoline production, bbls/day	1,164,395	1,697,399	3,540,971	231,461	398,661	7,032,887
Average benzene concentration, vol%	0.81	1.28	0.95	1.55	1.42	1.05
# refineries with benzene < or = 0.62 vol%	4	1	10	0	6	21
# refineries with benzene > 0.62 vol%	10	20	35	11	13	89

Table 5						
Reported Data by PADD for 2011						
	PADD 1	PADD 2	PADD 3	PADD 4	PADD 5	total U.S.
# reporting refineries	14	21	45	11	19	110
Reported gasoline production, bbls/day	1,224,824	1,792,531	4,026,379	244,396	398,938	7,687,068
Average benzene concentration, vol%	0.66	0.82	0.62	1.22	0.87	0.70
# refineries with benzene < or = 0.62 vol%	8	9	28	2	9	56
# refineries with benzene > 0.62 vol%	6	12	17	9	10	54

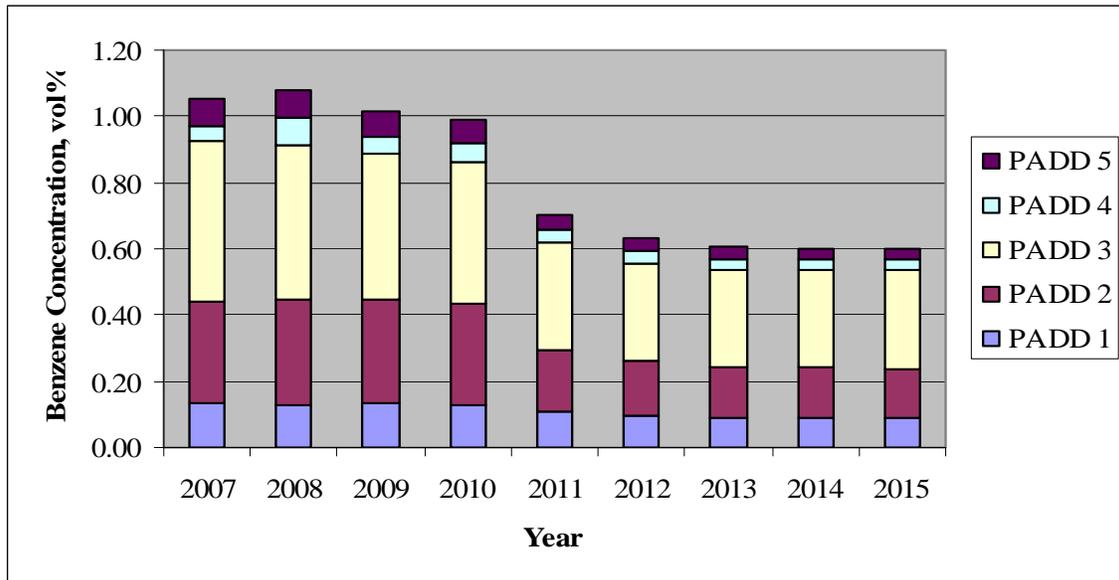
Table 6						
Reported Data by PADD for 2015						
	PADD 1	PADD 2	PADD 3	PADD 4	PADD 5	total U.S.
# reporting refineries	14	21	45	11	19	110
Reported gasoline production, bbls/day	1,205,775	1,853,102	4,042,351	246,445	404,129	7,751,801
Average benzene concentration, vol%	0.57	0.63	0.57	0.94	0.69	0.60
# refineries with benzene < or = 0.62 vol%	11	13	31	4	10	69
# refineries with benzene > 0.62 vol%	3	8	14	7	9	41

Figure 3 illustrates the effect of the benzene standards on national average benzene levels from 2007 through 2015. Figure 3 also shows the volume-weighted

IV. Gasoline Benzene Summary Data

contribution of each PADD to national average benzene concentration for each reported year. PADD 3 consistently has the greatest volume-weighted contribution because PADD 3 consistently produces the most gasoline of any PADD (even though PADD 3 has the lowest gasoline benzene concentrations among all PADDs from 2011 through 2015). Conversely, PADD 4 consistently has the smallest volume-weighted contribution because PADD 4 consistently produces the least gasoline of any PADD (even though PADD 4 has the highest gasoline benzene concentrations among all PADDs in every reported year).

Figure 3. PADD Contributions to National Average Benzene, 2007-2015



More detailed information for each PADD is shown below in Tables 7 through 16.

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1. PADD 1²

Reported data for 14 PADD 1 refineries is summarized below in Tables 7 and 8. PADD 1 average gasoline benzene concentration decreases from 0.81 vol% in 2007 to 0.66 vol% in 2011, as the number of refineries producing gasoline containing 0.62 vol% benzene or less increases from 4 to 8. PADD 1 average gasoline benzene concentration decreases further to 0.57 vol% by 2015, as 3 more refineries reduce their gasoline benzene concentration to 0.62 vol% or less. Projected gasoline production also increases slightly from 2007 to 2015, by approximately 42,000 bbls/day.

Table 7				
Reported Data for PADD 1, 2007-2010				
Year	2007	2008	2009	2010
# reporting refineries	14	14	14	14
Reported gasoline production, bbls/day	1,164,395	1,169,596	1,175,302	1,199,158
Average benzene concentration, vol%	0.81	0.75	0.80	0.80
# refineries with benzene < or = 0.62 vol%	4	6	5	5
# refineries with benzene > 0.62 vol%	10	8	9	9

Table 8					
Reported Data for PADD 1, 2011-2015					
Year	2011	2012	2013	2014	2015
# reporting refineries	14	14	14	14	14
Reported gasoline production, bbls/day	1,224,824	1,210,352	1,205,775	1,205,775	1,205,775
Average benzene concentration, vol%	0.66	0.60	0.58	0.57	0.57
# refineries with benzene < or = 0.62 vol%	8	9	10	10	11
# refineries with benzene > 0.62 vol%	6	5	4	4	3

² These tables do not include imported gasoline, gasoline produced by small refiners, gasoline exported outside the U.S., and gasoline produced by transmix processors.

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2. PADD 2³

Reported data for 21 reporting PADD 2 refineries is summarized below in Tables 9 and 10. PADD 2 average gasoline benzene concentration decreases from 1.28 vol% in 2007 to 0.82 vol% in 2011, as the number of refineries producing gasoline containing 0.62 vol% benzene or less increases from 1 to 9. PADD 2 average gasoline benzene concentration decreases further to 0.63 vol% by 2015, as 4 more refineries reduce their gasoline benzene concentration to 0.62 vol% or less. Projected gasoline production also increases moderately from 2007 to 2015, by approximately 156,000 bbls/day.

**Table 9
Reported Data for PADD 2, 2007-2010**

Year	2007	2008	2009	2010
# reporting refineries	21	21	21	21
Reported gasoline production, bbls/day	1,697,399	1,649,094	1,711,287	1,760,535
Average benzene concentration, vol%	1.28	1.30	1.31	1.30
# refineries with benzene < or = 0.62 vol%	1	1	1	1
# refineries with benzene > 0.62 vol%	20	20	20	20

**Table 10
Reported Data for PADD 2, 2011-2015**

Year	2011	2012	2013	2014	2015
# reporting refineries	21	21	21	21	21
Reported gasoline production, bbls/day	1,792,531	1,821,081	1,853,102	1,843,337	1,853,102
Average benzene concentration, vol%	0.82	0.71	0.63	0.64	0.63
# refineries with benzene < or = 0.62 vol%	9	10	13	13	13
# refineries with benzene > 0.62 vol%	12	11	8	8	8

³ These tables do not include imported gasoline, gasoline produced by small refiners, gasoline exported outside the U.S., and gasoline produced by transmix processors.

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3. PADD 3⁴

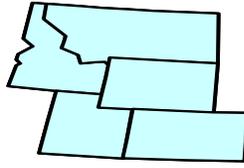
Reported data for 45 PADD 3 refineries is summarized below in Tables 11 and 12. PADD 3 average gasoline benzene concentration decreases from 0.95 vol% in 2007 to 0.62 vol% in 2011, as the number of refineries producing gasoline containing 0.62 vol% benzene or less increases from 10 to 28. PADD 3 average gasoline benzene concentration decreases further to 0.57 vol% by 2015, as 3 more refineries reduce their gasoline benzene concentration to 0.62 vol% or less. Projected gasoline production also increases significantly from 2007 to 2015, by approximately 501,000 bbls/day.

Table 11 Reported Data for PADD 3, 2007-2010				
Year	2007	2008	2009	2010
# reporting refineries	45	45	45	45
Reported gasoline production, bbls/day	3,540,971	3,258,603	3,580,916	3,854,485
Average benzene concentration, vol%	0.95	0.97	0.87	0.83
# refineries with benzene < or = 0.62 vol%	10	11	13	16
# refineries with benzene > 0.62 vol%	35	34	32	29

Table 12 Reported Data for PADD 3, 2011-2015					
Year	2011	2012	2013	2014	2015
# reporting refineries	45	45	45	45	45
Reported gasoline production, bbls/day	4,026,379	4,029,915	4,036,885	4,041,121	4,042,351
Average benzene concentration, vol%	0.62	0.57	0.57	0.57	0.57
# refineries with benzene < or = 0.62 vol%	28	31	31	31	31
# refineries with benzene > 0.62 vol%	17	14	14	14	14

⁴ These tables do not include imported gasoline, gasoline used in California, gasoline produced by small refiners, gasoline exported outside the U.S., and gasoline produced by transmix processors.

IV. Gasoline Benzene Summary Data



4. PADD 4⁵

Data for 11 reporting PADD 4 refineries is summarized below in Tables 13 and 14. PADD 4 average gasoline benzene concentration decreases from 1.55 vol% in 2007 to 1.22 vol% in 2011, as the number of refineries producing gasoline containing 0.62 vol% benzene or less increases from 0 to 2. PADD 4 average gasoline benzene concentration decreases further to 0.94 vol% by 2015, as refineries further reduce their gasoline benzene concentration. Projected gasoline production also increases slightly from 2007 to 2015, by approximately 15,000 bbls/day.

Table 13
Reported Data for PADD 4, 2007-2010

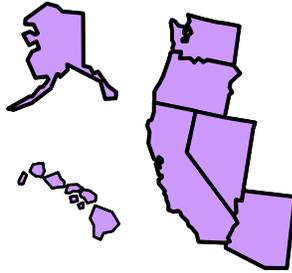
Year	2007	2008	2009	2010
# reporting refineries	11	11	11	11
Reported gasoline production, bbls/day	231,461	351,710	237,169	248,666
Average benzene concentration, vol%	1.55	1.58	1.54	1.54
# refineries with benzene < or = 0.62 vol%	0	0	0	0
# refineries with benzene > 0.62 vol%	11	11	11	11

Table 14
Reported Data for PADD 4, 2011-2015

Year	2011	2012	2013	2014	2015
# reporting refineries	11	11	11	11	11
Reported gasoline production, bbls/day	244,396	248,456	247,746	248,638	246,445
Average benzene concentration, vol%	1.22	1.01	0.94	0.94	0.94
# refineries with benzene < or = 0.62 vol%	2	4	4	4	4
# refineries with benzene > 0.62 vol%	9	7	7	7	7

⁵ These tables do not include imported gasoline, gasoline used in California, gasoline produced by small refiners, gasoline exported outside the U.S., and gasoline produced by transmix processors.

IV. Gasoline Benzene Summary Data



5. PADD 5⁶

Data for 19 reporting PADD 5 refineries is summarized below in Tables 15 and 16. PADD 5 average gasoline benzene concentration decreases from 1.42 vol% in 2007 to 0.87 vol% in 2011, as the number of refineries producing gasoline containing 0.62 vol% benzene or less increases from 6 to 9. PADD 5 average gasoline benzene concentration decreases further to 0.69 vol% by 2015, as refineries further reduce their gasoline benzene concentration. Projected gasoline production also increases slightly from 2007 to 2015, by approximately 5,000 bbls/day.

Table 15				
Reported Data for PADD 5, 2007-2010				
Year	2007	2008	2009	2010
# reporting refineries	19	19	19	19
Reported gasoline production, bbls/day	398,661	359,795	390,323	397,914
Average benzene concentration, vol%	1.42	1.54	1.44	1.41
# refineries with benzene < or = 0.62 vol%	6	5	5	5
# refineries with benzene > 0.62 vol%	13	14	14	14

Table 16					
Reported Data for PADD 5, 2011-2015					
Year	2011	2012	2013	2014	2015
# reporting refineries	19	19	19	19	19
Reported gasoline production, bbls/day	398,938	405,771	404,129	404,129	404,129
Average benzene concentration, vol%	0.87	0.76	0.69	0.69	0.69
# refineries with benzene < or = 0.62 vol%	9	10	10	10	10
# refineries with benzene > 0.62 vol%	10	9	9	9	9

⁶ These tables do not include imported gasoline, gasoline used in California, gasoline produced by small refiners, gasoline exported outside the U.S., and gasoline produced by transmix processors.

IV. Gasoline Benzene Summary Data

C. Comparison of 2008 and 2009 Pre-compliance Reports

The 2009 pre-compliance reports show a greater overall projected reduction in benzene during the early credit generation period (June 1, 2007 through December 31, 2010), compared to the 2008 pre-compliance reports. The 2009 pre-compliance reports also show that benzene concentrations from 2011 through 2015 are projected to be slightly higher compared to the 2008 pre-compliance reports. Table 17 lists projected average national gasoline production and benzene concentration from the 2008 and 2009 pre-compliance reports.

Table 17					
Projected Gasoline Production and Benzene Concentration for Total U.S., 2007-2015					
	2007	2008	2009	2010	
2008 benzene reports					
Reported gasoline production, bbls/day	7,009,410	7,321,248	7,523,745	7,690,694	
Average benzene concentration, vol%	1.05	1.07	1.06	1.04	
2009 benzene reports					
Reported gasoline production, bbls/day	7,032,887	6,788,798	7,094,997	7,460,758	
Average benzene concentration, vol%	1.05	1.08	1.02	0.99	
	2011	2012	2013	2014	2015
2008 benzene reports					
Reported gasoline production, bbls/day	7,953,682	7,968,849	7,968,195	7,957,194	7,968,537
Average benzene concentration, vol%	0.65	0.61	0.59	0.59	0.59
2009 benzene reports					
Reported gasoline production, bbls/day	7,687,068	7,715,576	7,747,637	7,742,999	7,751,801
Average benzene concentration, vol%	0.70	0.63	0.60	0.60	0.60

The 2009 pre-compliance reports show more early credits being generated from 2007 through 2010, compared to the 2008 pre-compliance reports. However, the 2009 pre-compliance reports also show fewer standard credits being generated and more credits being used from 2011 through 2015, compared to the 2008 pre-compliance reports. Table 18 lists projected credits generated and used from the 2008 and 2009 pre-compliance reports, along with the cumulative credit surplus by the end of each year. Figure 4 illustrates that the 2009 pre-compliance reports still show a cumulative credit surplus at the end of each year from 2007 through 2015, but the cumulative credit surplus by the end of 2015 is not as great as the cumulative credit surplus from the 2008 pre-compliance reports.

IV. Gasoline Benzene Summary Data

Table 18					
Projected Gasoline Production and Benzene Concentration for Total U.S., 2007-2015					
	2007	2008	2009	2010	
2008 benzene reports					
Benzene credits generated, millions	9.4	8.7	18.5	37.5	
Cumulative credit surplus, millions	9.4	18.2	36.7	74.2	
2009 benzene reports					
Benzene credits generated, millions	10.8	30.7	48.2	69.2	
Cumulative credit surplus, millions	10.8	41.5	89.7	158.9	
	2011	2012	2013	2014	2015
2008 benzene reports					
Benzene credits generated, millions	95.8	96.3	99.6	98.7	99.4
Benzene credits used, millions	128.0	83.6	68.8	67.5	65.8
Cumulative credit surplus, millions	41.9	54.6	85.4	116.7	150.2
2009 benzene reports					
Benzene credits generated, millions	69.1	91.6	90.1	89.4	90.1
Benzene credits used, millions	167.3	103.5	70.7	69.4	67.9
Cumulative credit surplus, millions	60.8	48.9	68.3	88.4	110.5

Figure 4. Cumulative U.S. Gasoline Benzene Credit Surplus

