

# In-Use Off-road Diesel Vehicle Regulation Legislatively Directed Changes: Fleet Examples

## Overview

The California legislature recently directed the Air Resources Board (ARB) to make a number of changes to the in-use off-road diesel vehicle regulation (the regulation), as part of Assembly Bill 8 2X (AB 8 2X). The regulation requires, among other things, that fleets control the emissions from their vehicles, specifically oxides of nitrogen (NOx) and particulate matter (PM). Fleets can comply by meeting fleet average emissions standards, or using the Best Available Control Technology (BACT), which requires a percent of the fleet's total horsepower to be turned over to newer and cleaner engines or vehicles, retrofit with devices that capture pollutants from the exhaust, or retired.

The legislatively directed changes focus on awarding more credit for fleets that have reduced size and/or activity, and would lower the requirements of the regulation for these fleets in the first few years that the fleets must meet the regulation requirements. These fleet examples are provided to demonstrate how a fleet may maximize their credit towards the regulation's BACT requirements, using both existing provisions in the regulations and the new provisions directed by the legislature in AB 8 2X.

## Provisions for Credit and BACT requirements

The examples demonstrate how a fleet would receive credit or meet the requirements of the following five provisions. Throughout this document, the colors shown for the different credits above will be used to help clarify which credit provisions the example is calculating or discussing.

Provisions below are already included in the regulation <sup>1</sup> . (Regulation available online at <a href="http://www.arb.ca.gov/regact/2007/ordiesl07/frooal.pdf">http://www.arb.ca.gov/regact/2007/ordiesl07/frooal.pdf</a> )	
<i>2449.1(a)(2)(A)(2) on pg. 36 of regulation</i>	Credit towards the NOx BACT requirements for replacing Tier 0s during a compliance year, from March 1, 2009, to March 1, 2010.
<i>2449.1(a)(2)(A)(2)(a)(ii) on pg. 37 of regulation</i>	Early credit for replacing Tier 0s above 8 percent of total horsepower on average annually from March 1, 2006, to March 1, 2009, towards NOx BACT.
<i>2449.2(a)(2)(A)(1)(b) on pg. 43 of regulation</i>	Credit towards PM BACT for retiring Tier 0s in a fleet reducing total horsepower during a compliance year, from March 1, 2009, to March 1, 2010.

<sup>1</sup> Previously Tier 0 retirements generated credit only if they exceeded 8 percent of total horsepower on average annually from March 1, 2006, to March 1, 2009 and only towards NOx BACT. The new AB 8 2X provisions allow credit for such retirements toward both PM and NOx BACT, but only for retirements that reduce total horsepower. To prevent unnecessary complexity and to prevent fleets from losing credit by having to choose one type of credit or another, retirements that reduce total horsepower will be included in the new provision for retirement, and retirements that do not (i.e. the vehicle was replaced) will be included in the previous credit for early turnover.

Provisions included as part of the legislatively direct changes.	
AB 8 2X 43018.2(a)(2)(B)	Credit towards PM and NOx BACT for retirement of off-road diesel vehicles which reduce total horsepower, between March 1, 2006 and March 1, 2010.
AB 8 2X 43018.2(a)(2)(B)	Credit towards PM and NOx BACT for reduced activity in the off-road diesel fleet, defined as average annual hours of use between July 1, 2007, and March 1, 2010.

ARB's proposed implementation focuses on awarding credit for each action that reduced emissions, but at the same time not double or triple counting each retirement.

### **Examples**

Each of the following examples demonstrate how the fleet would receive credits, and how the fleet could choose the optimal credit option. The examples calculate credit awarded for actions from March 1, 2006, through March 1, 2010. In some cases the fleets will have credits that roll over to 2011 or beyond. For the sake of simplicity and to focus on the early credit, the examples do not show the requirements for multiple years; however all roll over credits may be kept until they are used in future years, unless it is specifically noted that they expire in a certain year.

The examples summarize the calculations for credits in the following four categories, and then apply the credits to the fleet's March 1, 2010, requirements. Fleets will receive credit for both of:

1. Tier 0 replacements from March 1, 2009, to March 1, 2010 (for NOx)
2. Tier 0 replacements from March 1, 2006 to March 1, 2009, that exceed 8 percent of their horsepower per year, on average over the three years (for NOx)

And the greater of the following:

3. <b>New:</b> Credit for retirements of Tier 0 (and possibly Tier 1) which reduced total horsepower from March 1, 2006 to March 1, 2010* (covers both provisions for Tier 0 retirements, NOx and PM)
4. <b>New:</b> Credit for reduced activity from July 1, 2007, to March 1, 2010 (NOx and PM) (expires in 2011)

\*If the fleet did not reduce horsepower over the entire period, but only from March 1, 2009, to March 1, 2010, they can claim that reduced horsepower instead.

**NOTE:** Fleets keep all repower and retrofit credit they previously had. Also, fleet average credit for electric or alternative fuel vehicles, and specialty credits such as vehicle replacement with a non-vehicle system, remain in place.

These are left out of the examples for simplicity, and because all of the credits mentioned above don't interact with the new credits. They are given in addition to, or on top of, the previously mentioned credits.

Replacements: Note that where the credits say "Tier 0 Replacements" it refers to a replacement of the horsepower, not the specific vehicle. That is, if the fleet's only actions are retiring a 500 horsepower (HP) scraper, and purchasing a 350 HP off-road crane for an entirely different purpose, the regulation will count this as 350 HP replaced, and 150 HP retired. The calculations consider only how much horsepower has been retired, and how much has been added.

**Example layout:** Each fleet example begins with:

- A description of the fleet by total horsepower,
- An overview of the actions the fleet took from March 1, 2006, to March 1, 2010, and
- A summary of which credits provisions would apply, and how much credit they would provide.

For those interested in the background and the numbers, the full calculations for early credit, new credits, and the BACT requirements, as well as what credit the fleet would have received under the credit provisions in place prior to the legislatively-directed changes, are also provided.

**Example fleets:** The following examples of the credits and interaction are presented below:

1. A fleet that reduced activity only.
2. A fleet that retired Tier 0s.
3. A fleet that both reduced activity, and retired Tier 0s.

## 1: Fleet with Reduced Activity Only

### Fleet on March 1, 2006:

100,000 Horsepower

#### 1. Retirement / Turnover

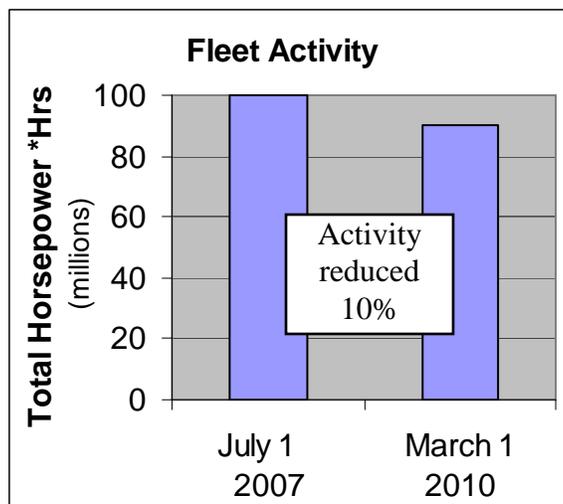
The fleet does not retire or replace any vehicles.

#### 2. Activity

The fleet has reduced activity by 10 percent from July 1, 2007 to March 1, 2010.

This fleet had 400 vehicles working an average of 1000 hours per year on July 1, 2007.

The fleet has the same 400 vehicles working an average of 900 hours per year on March 1, 2010.



This is a 10 percent reduction in total activity.

#### 3. Credit Available

	NOx Credit (HP)	PM Credit (HP)
2009-2010 Replacements	0	n/a
Early Replacements (2006-2009)	0	n/a
<i>The fleet may select the maximum of following credit options</i>		
Retirement Credit for Shrinking Fleets	0	0
New Reduced Activity Credit (expires in 2011)	10,000	10,000
<b>Total</b>	<b>10,000 HP</b> (expires in 2011) <sup>2</sup>	<b>10,000 HP</b> (expires in 2011)

<sup>2</sup> Unless noted, the credits in these examples do not expire until they are used to meet the BACT requirements for the fleet.

### Applied to the Regulation Requirements

	NOx (HP)	PM (HP)
<b>2010 BACT Requirements</b>	8,000	20,000
<b>Credit Applied</b>	-10,000	-10,000
<b>Requirements After Credit</b>	0	10,000
<b>Credit Rollover</b>	-2,000 (expires in 2011)	0

- 4. Result:** The fleet receives enough credit so that it does not have to turn over any vehicles or engine in 2010 for NOx BACT requirements, and receives 2,000 HP credit towards their 2011 compliance requirements for NOx BACT.

The fleet's retrofit requirements for 2010 are cut from 20,000 HP to 10,000 HP by the reduced activity credit.

### 5. Comparison of credit under current vs. proposed provisions

To receive credit under the previous credit provisions, the retirement of Tier 0s would have had to exceed: **24,000HP**

Actual Fleet Tier 0 retirement from March 1, 2006 to March 1, 2009: **15,000 HP**

	NOx (HP)	PM (HP)
<b>Total Credit Available Before Changes</b>	0	0
<b>Total Credit Available After Legislatively Directed Changes</b>	10,000	10,000

## 2: Fleet that has retired Tier 0s and shrunk

### Fleet on March 1, 2006:

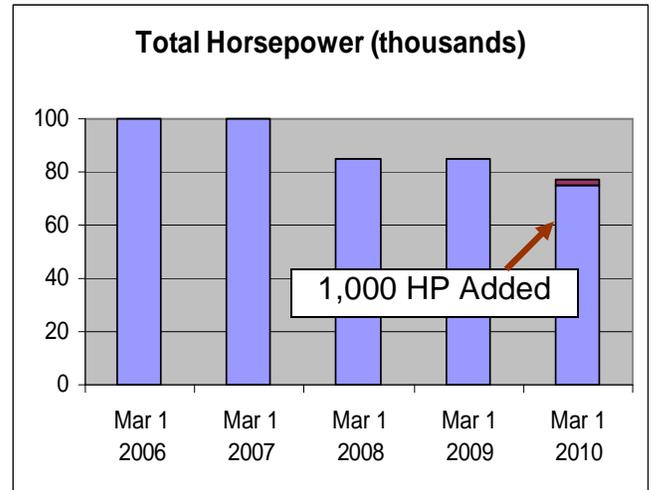
100,000 Horsepower

#### 1. Retirement / Turnover

The fleet retires 15,000 horsepower of Tier 0 vehicles in 2007. In July, 2009, the fleet retires another 10,000 horsepower, and adds 1,000 horsepower back in the form of Tier 2 vehicles.

#### 2. Activity

The fleet does not reduce activity overall, i.e. the fleet increases activity in their remaining vehicles so that total overall activity remains constant.



#### 3. Credit Available

	NOx Credit (HP)	PM Credit (HP)
2009-2010 Replacements	1,000	n/a
Early Replacements (2006-2009)	0	n/a
<i>The fleet may select the maximum of following credit options</i>		
Retirement Credit for Shrinking Fleets	24,000	24,000
New Reduced Activity Credit (expires in 2011)	0	0
<b>Total</b>	<b>25,000 HP</b>	<b>24,000 HP</b>

#### Applied to the Regulation Requirements

	NOx (HP)	PM (HP)
2010 BACT Requirements	6,800	17,000
Credit Applied	-25,000	-24,000
Requirements After Credit	0	0
Credit Rollover	-18,200	-7,000

4. **Result:** The fleet has no turnover requirements in 2010 for NOx or PM.

The fleet receives 18,200 HP in NOx rollover credit, and 7,000 HP in PM rollover credit that can be applied to the BACT requirements in future years.

5. **Comparison of credit under current vs. proposed provisions**

To receive credit, the retirement of Tier 0s must exceed: **21,800HP**

Actual Fleet Tier 0 retirements from March 1, 2006 to March 1, 2009: **15,000 HP**

**0 HP early credit Available prior to legislatively directed changes**

Total Tier 0 Retirements from March 1, 2009 to March 1, 2010: **10,000 HP**

Total Reduction in Fleet size from March 1, 2009, to March 1, 2010: **9,000 HP**

	NOx (HP)	PM (HP)
<b>Total Credit Available Before Changes</b>	10,000	9,000
<b>Total Credit Available After Legislatively Directed Changes</b>	25,000	24,000

### 3: Fleet that has retired Tier 0s and reduced activity

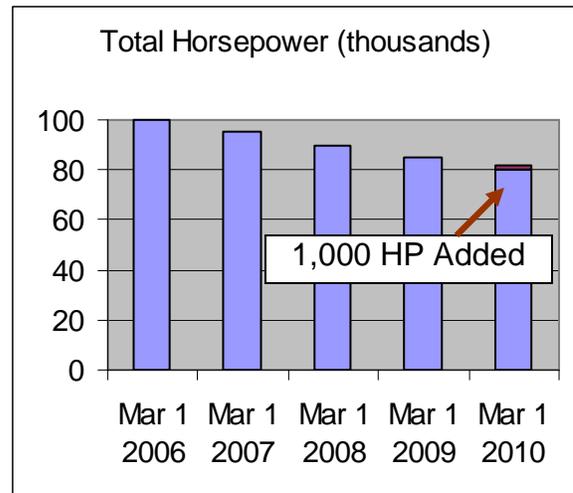
#### Fleet on March 1, 2006:

100,000 Horsepower

#### 1. Retirement /Turnover

The fleet retires 5,000 horsepower per year from 2006 to 2010.

The fleet also adds another 1,000 horsepower of Tier 1s in August, 2009.



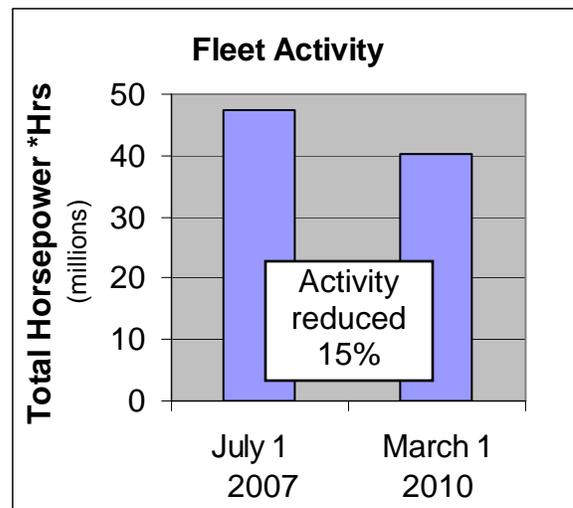
#### 2. Activity

The fleet has reduced activity by 15 percent from July 1, 2007 to March 1, 2010.

This fleet had 380 vehicles working 500 hours a year on average in July 2007.

They have 320 vehicles working 505 hours a year on average in March 2010.

This is a 15 percent reduction in total activity for this fleet based on HP\*hours.



#### 3. Credit Available

	NOx Credit (HP)	PM Credit (HP)
2009-2010 Replacements	1,000	n/a
Early Replacements (2006-2009)	0	n/a
<i>The fleet may select the maximum of following credit options</i>		
Retirement Credit for Shrinking Fleets	19,000	19,000
New Reduced Activity Credit (expires in 2011)	14,250	14,250
<b>Total</b>	<b>20,000 HP</b>	<b>19,000 HP</b>

## Applied to the Regulation Requirements

	NOx (HP)	PM (HP)
<b>2010 BACT Requirements</b>	6,800	17,000
<b>Credit Applied</b>	-20,000	-19,000
<b>Requirements After Credit</b>	0	0
<b>Credit Rollover</b>	-13,200	-2,000

4. **Result:** The fleet could meet both the turnover or retrofits requirements in 2010 for NOx or PM by applying their credits.

The fleet receives 18,200 HP in NOx rollover credit, and 7,000 HP in PM rollover credit that can be applied to the BACT requirements in future years.

5. **Comparison of credit under current vs. proposed provisions**

To receive credit, the retirement of Tier 0s must exceed: **21,600HP**

Actual Fleet Tier 0 retirement from March 1, 2006 to March 1, 2009: **15,000 HP**

**0 HP early credit available prior to legislatively directed changes**

Total Tier 0 Retirements from March 1, 2009 to March 1, 2010: **5,000 HP**

Total Reduction in Fleet size from March 1, 2009, to March 1, 2010: **4,000 HP**

	NOx (HP)	PM (HP)
<b>Total Credit Available Before Changes</b>	5,000	4,000
<b>Total Credit Available After Legislatively Directed Changes</b>	20,000	19,000

# Calculations

## Example 1: Fleet with Reduced Activity Only

### Calculating the Credits and Requirements

#### Credit for 2009 to 2010 replacements

The fleet did not replace any Tier 0s from March 1, 2009, to March 1, 2010, and would not receive any credit.

#### Credit for early replacement of Tier 0s

The fleet did not replace any Tier 0s from March 1, 2006, to March 1, 2009, and would not receive any credit.

#### Credit under new provision for the retirement of Tier 0s

The fleet did not retire any Tier 0s, and would not receive any credit.

#### Credit from Reduced Activity

To determine reduced activity credit, the activity of the fleet in 2007 is compared to the 12 month period ending March 1, 2010. The activity is weighted by horsepower.

### Determining July 1, 2007 Fleet Activity

Dates	Vehicle HP	Hours Used	Activity (HP*Hrs)
Jan 1, 2007	250	900	225,000
To	291	1100	320,100
Dec 31, 2007	173	725	125,425
<i>Activity calculated and summed for all vehicles.</i>			
<b>Sum of Activity</b>			100,000,000

### Determining March 1, 2010 Fleet Activity

Dates	Vehicle HP	Hours Used	Activity (HP*Hrs)
March 1, 2009	250	810	202,500
To	291	750	218,250
Feb 28, 2010	173	810	140,130
<i>Activity calculated and summed for all vehicles.</i>			
<b>Sum of Activity</b>			90,000,000

$$(100,000,000 - 90,000,000) / 100,000,000 = 10\%$$

The fleet would receive credit for 10% of their July 1, 2007 Horsepower, or

$$10\% \times 100,000 \text{ HP} =$$

**10,000 Horsepower credit to PM and NOx.**

### Calculating the BACT Requirements

The BACT requirements for 2011, 2012, and 2013 were also modified by AB 8 2X, however the 2010 BACT requirements are unchanged. Fleets that do not meet the fleet average targets are required to meet NOx BACT requirements for 8 percent of their horsepower and meet PM BACT for 20 percent.

	<b>NOx</b>	<b>PM</b>
<b>March 1, 2009 Fleet Size</b>	100,000 HP	100,000 HP
<b>2010 BACT Requirement</b>	8 %	20 %
<b>BACT HP Requirements</b>	<b>8,000 HP</b>	<b>20,000 HP</b>

**Comparison with credit available prior to any legislatively directed changes.**

Prior to the legislatively-directed changes, for a fleet to get credit for Tier 0 retirements prior to March 1, 2009, whether replacements or otherwise, the retirements had to exceed 8 percent of the fleet’s horsepower each year on average, from 2006 to 2009 (i.e., greater than 24 percent total in that three-year period).

To determine how much horsepower the fleet would have to retire prior to receiving credit, fleets can perform the following calculation.

<b>Year</b>	<b>Total HP</b>	<b>8% of HP</b>
<b>March 1, 2007</b>	100,000	8,000
<b>March 1, 2008</b>	100,000	8,000
<b>March 1, 2009</b>	100,000	8,000
		<b>24,000</b>

To receive credit under the previous credit provisions, the retirement of Tier 0s would have had to exceed: **24,000HP**

Actual Fleet Tier 0 retirement from March 1, 2006 to March 1, 2009: **15,000 HP**

	<b>NOx (HP)</b>	<b>PM (HP)</b>
<b>Total Credit Available Before Changes</b>	0	0
<b>Total Credit Available After Legislatively Directed Changes</b>	10,000	10,000

## Example 2: Fleet that has retired Tier 0s and shrunk

### Calculating the Credits and Requirements

#### Credit for 2009 to 2010 Replacements

The fleet retires 10,000 HP in Tier 0s and adds back 1,000 HP of Tier 2s.  
The fleet receives 1,000 HP credit to NOx only for Tier 0 replacements.

#### Credit for early replacement of Tier 0s

From March 1, 2006, to March 1, 2009, the fleet does not replace any vehicles.

#### Credit under new provision for the retirement of Tier 0s

From March 1, 2006, to March 1, 2010, the fleet

- Retired 25,000 HP Tier 0s
- Shrunk by 24,000 HP
  - The fleet receives the lesser of these, 24,000 HP, to NOx and PM

#### Credit from Reduced Activity

The fleet's total overall activity (in horsepower-hours) remains constant.

### Calculating the BACT Requirements

The BACT requirements for 2011, 2012, and 2013 were also modified by AB 8 2X, however the 2010 BACT requirements are unchanged. Fleets that do not meet the fleet average targets are required to meet NOx BACT requirements for 8 percent of their horsepower and meet PM BACT for 20 percent by March 1, 2010.

	<b>NOx</b>	<b>PM</b>
<b>March 1, 2009 Fleet Size</b>	85,000 HP	85,000 HP
<b>2010 BACT Requirement</b>	8 %	20 %
<b>BACT HP Requirements</b>	<b>6,800 HP</b>	<b>17,000 HP</b>

### Comparison with credit available prior to any legislatively directed changes.

Prior to the legislatively-directed changes, for a fleet to get credit for Tier 0 retirements prior to March 1, 2009, whether replacements or otherwise, the retirements had to exceed 8 percent of the fleet's horsepower each year on average, from 2006 to 2009 (i.e., greater than 24 percent total in that three-year period).

To determine how much horsepower the fleet would have to retire prior to receiving credit, fleets can perform the following calculation.

<b>Year</b>	<b>Total HP</b>	<b>8% of HP</b>
<b>March 1, 2007</b>	100,000	8,000
<b>March 1, 2008</b>	85,000	6,800
<b>March 1, 2009</b>	85,000	6,800

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<b>21,800</b>
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Therefore, to receive credit, the retirement of Tier 0s must exceed: **21,800HP**  
Actual Fleet Tier 0 retirements from March 1, 2006 to March 1, 2009: **15,000 HP**

**0 HP early credit available prior to legislatively directed changes**

However, the fleet would receive credit for vehicle retirements that reduced total horsepower to PM BACT, and would receive credit for all retirements to NOx BACT requirements, if the retirements occurred between March 1, 2009, and March 1, 2010.

Total Tier 0 Retirements from March 1, 2009 to March 1, 2010: **10,000 HP**  
Total Reduction in Fleet size from March 1, 2009, to March 1, 2010: **9,000 HP**

	NOx (HP)	PM (HP)
<b>Total Credit Available Before Changes</b>	10,000	9,000
<b>Total Credit Available After Legislatively Directed Changes</b>	25,000	24,000

### Example 3: Fleet that has retired Tier 0s and reduced activity

#### Calculating the Credits and Requirements

##### Credit for 2009 to 2010 Replacements

The fleet retires 5,000 HP in Tier 0s and adds back 1,000 HP of Tier 2s.  
The fleet receives **1,000 HP credit to NOx only for Tier 0 replacements.**

##### Credit for early replacement of Tier 0s

To get credit for early replacement of Tier 0s, the fleet would have had to replace Tier 0s at a rate exceeding 8% of their horsepower on average from March 1, 2006, to March 1, 2009

Year	Total HP	8% of HP
<b>March 1, 2007</b>	95,000	7,600
<b>March 1, 2008</b>	90,000	7,200
<b>March 1, 2009</b>	85,000	6,800
		<b>21,600</b>

Therefore, to receive credit, the replacement of Tier 0s must exceed: **21,600HP**  
Actual Fleet Replacement from March 1, 2006 to March 1, 2009: **0 HP**

**Credit: 0**

##### Credit under new provision for the retirement of Tier 0s

From March 1, 2006, to March 1, 2010, the fleet

- Retired 20,000 Tier 0s
- Shrunk by 20,000 HP
  - The fleet receives **20,000 HP, to NOx and PM**

##### Credit from Reduced Activity

#### Determining July 1, 2007 Fleet Activity

Dates	Vehicle HP	Hours Used	Activity (HP*Hrs)
Jan 1, 2007	250	500	125,000
To	291	500	145,500
Dec 31, 2007	173	500	86,500
<i>Activity calculated and summed for all vehicles.</i>			
<b>Sum of Activity</b>			<b>47,500,000</b>

#### Determining March 1, 2010 Fleet Activity

Dates	Vehicle HP	Hours Used	Activity (HP*Hrs)
March 1, 2009	461	505	232,805
To	237	505	119,685

Feb 28, 2010	245	505	123,725
<i>Activity calculated and summed for all vehicles.</i>			
<b>Sum of Activity</b>			40,375,000

$$(47,500,000 - 40,375,000) / 47,500,000 = 15\%$$

The fleet would receive credit for 15% of their July 1, 2007 Horsepower, of 95,000 HP

$$15\% * 95,000 = 14,250$$

**14,250 Horsepower credit to PM and NOx.**

**Calculating the BACT Requirements**

The BACT requirements for 2011, 2012, and 2013 were also modified by AB 8 2X, however the 2010 BACT requirements are unchanged. Fleets that do not meet the fleet average targets are required to meet NOx BACT requirements for 8 percent of their horsepower and meet PM BACT for 20 percent.

	<b>NOx</b>	<b>PM</b>
<b>March 1, 2009 Fleet Size</b>	85,000 HP	85,000 HP
<b>2010 BACT Requirement</b>	8 %	20 %
<b>BACT HP Requirements</b>	<b>6,800 HP</b>	<b>17,000 HP</b>

**Comparison with credit available prior to any legislatively directed changes.**

Prior to the legislatively-directed changes, for a fleet to get credit for Tier 0 retirements prior to March 1, 2009, whether replacements or otherwise, the retirements had to exceed 8 percent of the fleet’s horsepower each year on average, from 2006 to 2009 (i.e., greater than 24 percent total in that three-year period).

To determine how much horsepower the fleet would have to retire prior to receiving credit, fleets can perform the following calculation.

<b>Year</b>	<b>Total HP</b>	<b>8% of HP</b>
<b>March 1, 2007</b>	95,000	7,600
<b>March 1, 2008</b>	90,000	7,200
<b>March 1, 2009</b>	85,000	6,800
		<b>21,600</b>

Therefore, to receive credit, the retirement of Tier 0s must exceed: **21,600HP**  
 Actual Fleet Tier 0 retirement from March 1, 2006 to March 1, 2009: **15,000 HP**

**0 HP early credit available prior to legislatively directed changes**

However, the fleet would receive credit for vehicle retirements that reduced total horsepower to PM BACT, and would receive credit for all retirements to NOx BACT

requirements, if the retirements occurred between March 1, 2009, and March 1, 2010.

Total Tier 0 Retirements from March 1, 2009 to March 1, 2010: **5,000 HP**

Total Reduction in Fleet size from March 1, 2009, to March 1, 2010: **4,000 HP**

	NOx (HP)	PM (HP)
<b>Total Credit Available Before Changes</b>	5,000	4,000
<b>Total Credit Available After Legislatively Directed Changes</b>	20,000	19,000